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The "Electrician" Index.

Copies of the Index to Vol. LXXXVI. of The "Electrician," which concluded last week, will shortly be available, on receipt of postage 1d., to those desiring it. Applications should be made to the Circulation Manager, The "Electrician," 8, Bouverie Street, London, E.C.4.

Notes.

The Coal Dispute.

AFTER thirteen weeks of conversations, conferences, speeches, ballots, wage scales, suggested panaceas from all and sundry, advice and recriminations, the dispute in the coal industry has been settled. The settlement, which is on a wage basis, cannot be claimed as a victory for either party. For the original demands of the miners have been gradually shorn away and schemes for nationalisation, for wages boards and for pools have all disappeared. On the other hand, the attempt of the employers to reduce to a pre-war standard or even lower the rates of wages paid to the various workers in the mining industry has been unsuccessful. Now a settlement has been arrived at by a temporary arrangement of wages until October 1st on the basis that with the help of the £10 000 000 re-granted by Parliament a fall will gradually take place until an economic level is reached. To earn this subsidy, between now and October 1st the mineowners and miners are to agree upon the principles upon which wages are to be calculated after that date and the agreement then come to is to be observed by both sides for twelve months, with three months' notice thereafter to terminate it. That arrangement will include a profit-sharing scheme on lines which were agreed upon before the strike took place. This gives us roughly eighteen months of peace, a peace which is most sorely needed. This is the more necessary, as in the agreement the interests of the consumer seems to have been entirely neglected. There is no hint that any attempts will be made to bring down the cost of fuel either by better business methods or by the use of more efficient equipment. In fact, the tendency is all to encourage both owners and miners in the opposite course. We sincerely hope that besides coming to a satisfactory wages agreement

both sides will, therefore, settle down to providing the industries of the country with the cheap fuel they require, so that the trade revival which is predicted may really set in. If this dispute has proved one thing more than another it is how little good can be gained by the use of the strike weapon. We hope that other trade organisations, and especially those connected with engineering, will learn this useful lesson before it is too late.

Wind Pressure and Wireless Structures.

THE article by Mr. S. P. WING, which we publish on another page of this issue, deals with a subject which, though primarily of a civil and mechanical rather than electrical character is one which is of great importance to those engaged in wireless work. He gives the results of a series of experiments carried out at the Ballybunion wireless station, with the help of Sir NAPIER SHAW and the Meteorological Office, to find out the wind loading for such structures as wireless towers. Such an investigation is not only important in itself, but is made the more laborious by the absence of accurate analogous data. Accuracy is, however, the first necessity, for, as Mr. Wing points out, the figure taken has a great influence on the cost of the tower. To be of value the result must be an educated guess rather than a wild estimate erring widely on the side of safety. By taking simultaneously the actual velocities at different points above the ground the curve connecting velocity and pressure can be obtained, whence, knowing the law of the variation of the velocity, the ground velocity and that at any desired height, say 750 ft., can be derived. A complete series of readings obtained on these lines showed that the velocity of the wind varied directly with the height, and a formula relating the velocity at a given height to the velocity on the ground was worked out.

Some Interesting Conclusions.

As a result of these experiments Mr. WING comes to the conclusion that the velocity increases considerably with increasing elevation and has not reached the limit of its increase at a height of 500 ft., though any further increase will probably not exceed 15 per cent. of the value at that height. This is

work which has long required doing and we are very glad that it has been done. For though as a whole, as Mr. WING modestly points out, the experiments were disappointing and unsatisfactory, the results obtained form a starting point from which research of a more extended and more accurate character may well proceed. We hope that it will not be long before the results obtained will be checked and amplified and the lines connecting the various values more definitely laid down.

The Fuel Problems of the Future.

SIR GEORGE BEILEY'S "James Forrest" lecture on the "Fuel Problems of the Future," which was delivered before the Institution of Civil Engineers last Thursday, is at once revolutionary and academic in its subject matter and treatment. As far as "James Forrest" lectures are concerned it is revolutionary because it recognises that behind all technical reforms in our methods of dealing with the fuel at our disposal, methods which, it is true, are capable of great improvement and development, there remains that human element about whose behaviour we can predict so little. It is, indeed, pre-eminently a case of the joint variation of two unknowns, the human and the material. Academically, Sir GEORGE enunciates once again the well-worn dictum that if we are to maintain our position in the world's markets we must either produce cheap fuel or find out how to use our fuel in such a way that the products which its employment make possible can be manufactured cheaply and in large quantities. He dismisses for the present the idea that a solution of our difficulties rests on the greater employment of alternative fuels, though he sees a future in the use of alcohol and recommends that we follow with a careful eye what is being done in the consumption of lignite and brown coal.

Selling Coal by the Therm.

As a revolutionary his suggestions are, as might be expected, more interesting. There is something in his idea of selling coal by its thermal value which is very intriguing. If, for instance, electricity supply engineers knew when placing their coal contracts that from every ton of fuel supplied they would be able to obtain a certain number of thermal units, compared with present conditions, they would feel that the millennium had arrived. We do not expect that those who supply fuel will not look upon the matter with quite the same delight, but will immediately see in the idea an excuse for erecting all sorts of obstacles to the proposed change. Some of these obstacles are obvious, but all the same they might be overcome, or rather circumvented. One way of doing this would be to prevent the direct use of coal for domestic and many industrial purposes and provide what is necessary in this direction only through electricity and gas works which can supply light, heat and power in small quantities in a smokeless, usable and efficient form. This seems to be a better way of reaching that smokeless domestic era of which Sir GEORGE BEILEY so rightly approves, than by providing the domestic hearth or stove with solid smokeless fuel.

Honours Worth Having.

ENGINEERS and scientists have long realised that, however profound the influence of their work on human progress, they can expect to receive little official recognition of what they do. It therefore happens that the awards both these classes of workers value most are those given by institutions or bodies connected with the same activities as their own. This week we are able to chronicle two examples of this recognition, one to an eminent British engineer and metallurgist and the other to an equally eminent British scientist. The presentation by a deputation representing the leading engi-

neering societies of the United States of the John Fritz medal to Sir ROBERT HADFIELD on Tuesday was a worthy tribute to his services to science and industry from a nation which is renowned for its progress. The John Fritz medal is the highest honour in the engineering profession in the United States and it is only awarded for scientific or industrial achievements of the greatest eminence. The list of previous recipients of the medal is a sufficient guarantee of the truth of this statement. Sir ROBERT HADFIELD is to be congratulated on the addition of his name to that list.

The Albert Medal.

EQUALLY appropriate is the award of the Albert medal of the Royal Society of Arts to Prof. J. A. FLEMING, F.R.S., in recognition of his valuable contributions to electrical science and especially of his original invention of the thermionic valve. This award was announced a short time ago, and the formal presentation took place on Monday last, when the medal was handed to Prof. FLEMING by H.R.H. the DUKE OF CONNAUGHT AND STRATHEARN, President of the Society. Readers of THE ELECTRICIAN will be second to none in congratulating Prof. FLEMING on this honour, the more so as they know full well not only how his invention has revolutionised wireless science, but how it may yet bring about advances of which we can only now see the beginning. In many ways it may be said to be as fundamental a discovery as that of FARADAY, so that in honouring Prof. FLEMING in this way the Royal Society of Arts have honoured a discoverer of the first eminence.

X-Ray Dangers.

THE preliminary report of the X-Ray and Radium Protection Committee which was recently appointed under the chairmanship of Sir HUMPHREY ROLLESTON, emphasises the danger of over-exposure to X-rays and radium. It points out that these dangers can best be avoided by the provision of efficient protection and suitable working conditions. The known effects which have to be guarded against are visible injuries to the operators and derangement of the internal organs. To obviate these disabilities the committee recommend a careful regulation of the working hours of those engaged in X-ray work, the complete protection of the X-ray bulb itself by adequate protective material, except for an aperture as small as possible for the work in hand. The protective measures recommended in each particular case necessarily depend on the work which is being performed, as, for instance, to use for deep therapy arrangements intended only for superficial therapy would probably subject the worker to serious injury. It is also recommended that certain electrical precautions should be taken in X-ray departments. These consist in the provision of insulating floors, the employment of stout metal tubes or rods instead of wires for conductors, the use of insulated in preference to bare wire, and the avoidance of slack wires. Earthing of all metal parts is a necessity, and it is desirable that the circuits controlled by the various switches should be indicated on the switches. Recommendations of this kind coming from such a body are worthy of the closest attention, and we hope they will be put into force without delay. A certain number of details remain to be filled in and this might well be the first duty of the X-ray Institute, whose foundation we recently suggested.

The National Physical Laboratory.

THE annual report of the Executive Committee of the National Physical Laboratory, of which we give an account on another page of this issue, shows, as might be expected, that a large amount of useful work is being done by that institution. It is work which is abundantly necessary not only on purely theoretical grounds but also for sound technical

and financial reasons. To that extent we have nothing but praise for the organisation and ability which enable it to be carried out. But in studying the details of the investigations which are being undertaken in the various departments we cannot fail to be struck by the lack of finality which is indicated in a good many cases. The war, of course, was a great obstacle to the progress of many of the investigations, but this cannot altogether explain why year after year so many of the researches are dismissed in a phrase indicating that no results have been obtained. Though we realise that work of this kind cannot be carried out to a time table and that unforeseen difficulties may arise in its progress, some of the delay which is occurring seems undoubtedly due to the organisation of the Laboratory itself. The work that is there carried on includes both mere commercial testing and research work proper. The quantity of work which is performed in both these sections is increasing. It is, therefore, a matter of consideration whether they should not be definitely separated, especially as the qualifications required from the workers in these two branches are also entirely different.

Miners' Electric Safety Lamps.

THOUGH the coal mines have been closed for many weeks, the Mines Department of the Board of Trade has not ceased work, but has taken the opportunity to issue a Safety Lamps Order giving details of five new electric safety lamps, which have been approved for general use in collieries. Apparently, the old prejudice against the use of electric lamps has disappeared, while the increasing demand for the better lighting of collieries in order to minimise, if not to get rid of, the ravages of *nystagmus* amongst the workers has induced a number of electrical manufacturers to meet the peculiar requirements of this apparatus. With the five new lamps, some particulars of which we give elsewhere, there are now thirty-two electric safety lamps on the market all of which have been officially approved for general use in colliery work, while thirteen are authorised for use by officials or for special purposes. The conditions in collieries require a relatively good and steady light for a certain time and the lamp must also be of robust construction. The official requirement is that the new lamps must be capable of maintaining a light of not less than one c.p. all round a horizontal plane for a period of not less than nine hours and also of giving a light of not less than 1.5 c.p. over an arc of 45 deg. in a horizontal plane. There are, in addition, provisions as to the weight, and regarding the lanterns and batteries, which indicate that the Mines Department is taking a paternal interest in those who are to use this apparatus.

Administrative Changes.

UNTIL recently the Home Office, which is responsible for the administration of the Factory and Workshops Acts and for the Regulations on the generation and use of electricity in factories and workshops, supervised and enforced the regulations for the use of electricity in mines. Now, with the creation of the Mines Department, the Board of Trade, which has given up its electric lighting powers to the Ministry of Transport and the Electricity Commissioners, becomes the proper authority to enforce the Mining Regulations. It is unfortunate that three different Government departments should be concerned with regulations governing the use of electricity supply. Multiplicity of departmental regulations creates confusion and checks progress. We had hoped that with the advent of the Electricity Commissioners the tendency would have been towards unity and simplicity of administration, but apparently we are to be disappointed. These frequent changes in the administrative powers of Government departments, even though there may not be any actual

alteration in the substance of the regulations, lead to that class of infringement which arises from ignorance. Our bureaucrats are fond of changes of titles, which they appear to associate with real reform. Or, perhaps, they only want to scratch out the unwary and make work for themselves.

U.S.A. Cable Company's Dispute.

THE annual report of the Western Union Telegraph Company for 1920 is a document of more than usual length and contains many interesting details of the history and development of what is probably the largest telegraph undertaking in the world. It throws light upon, though not sufficient to enable us to understand the real reason for, the dispute between the Company and the American Government over the landing of the projected Barbados-Florida submarine cable at Miami. It was generally admitted that American trade and political interests urgently required direct cable connection with Brazil and Argentina, and though the exclusive concession of the Western Telegraph Company was an obstacle, this was removed by a working arrangement between the two companies. The Western Union Company then placed an order in England for the manufacture of 1 630 miles of cable and notified its Government of what it had done. It was not, however, until the British cable-laying ship arrived off the Florida coast with the cable on board that the Washington authorities intervened and prohibited the laying of the cable on the ostensible ground that the connection would be a means of perpetuating the preferential position enjoyed by the British company in Brazil. The Western Union Company easily disposes of this argument by citing numerous instances of American companies making use of foreign submarine telegraph systems. It is also stated that "there is not a cable leaving the shores of the United States that does not connect with cable systems enjoying monopolistic and preferential arrangements overseas."

Testimonial to British Methods.

IT is not for us to deal exhaustively with the merits of the dispute or to support either of the parties to it, but viewing the matter from an impartial standpoint we cannot resist expressing an opinion that the Company has a genuine grievance against its Government, which, for once, has not acted equitably towards one of its national undertakings. Apart altogether from any questions of natural right or justice we regret to see unnecessary obstacles placed upon that expansion of the means of international communication which is so desirable for the peaceful development and progress of nations. Incidentally, we are gratified to see that British probity and commercial honesty receiving a handsome testimonial from the American Company. It will be remembered that last year, when the dispute was very acute and had become the subject of discussion in political and commercial circles, mendacious rumours were spread in the United States to the effect that American messages sent over British cables were subject to censorship and that therefore commercial secrets were liable to leak out. The directors of the Western Union Company flatly contradict this and point out that there is now no censorship. They say "no British company, and certainly not the British Government, would concern itself with deciphering and disclosing the contents of code messages for the benefit of British trade." For over 50 years 75 per cent. of the telegraph messages between the United States and Europe have passed over British lines and during the whole of that time there has never been an authenticated case of a leak in a United States message. At the time we commented upon the absurdity and viciousness of the rumour, and though we did not attach too much importance to them,

in view of the political and other interests involved, we are pleased to have such a frank and generous appreciation of British methods.

Assessment of Tramways

THE situation of tramways undertakings is at present so difficult that every means of reducing expenses should be explored. Owing to the high rates, close attention should be paid to the question of the assessment of the lines. It is a pretty safe assertion that practically all tramways are over-assessed and that the amount paid in rates is much more than it should be. Consequently, steps should be taken to obtain a modification of the assessments so as to make these a more accurate reflection of existing conditions. Notwithstanding the higher fares in force, few undertakings are being run at a profit, and several of them have had to meet deficits out of the rates. The case of the London County Council tramways is a good illustration of the present condition of things. The undertaking is not meeting all its expenses, but the total rateable value of the lines in the administrative county is £168 000. However, as a result of representations made by the Highways Committee, the majority of the Metropolitan assessment committees have agreed to reduce the assessment of the lines to one half of the pre-quinquennial figures, though the value of the buildings remains unaltered. As the average rate in the London boroughs is about 15s. in the £, the reduction in the total assessment from £168 000 to £84 000 will represent an annual saving in rates and taxes of something like £80 000 a year, which will be a very welcome relief and will assist in adjusting accounts in future. Similar action should be taken by other tramway authorities.

Tramway Finance in 1920.

DESPITE the difficulties that have had to be faced by tramway and electricity-supply companies during the past year the accounts of the British Electric Traction Company, whose revenue is mainly derived from investments in these enterprises, show an improvement upon the previous year's record. The ordinary dividend is maintained at 4 per cent. and there is an increase of £18 000 in the gross, and of nearly £9 000 in the net, profit, while, after paying the preference and ordinary dividends, a sum of £12 300 has been placed to reserve, £177 300 being carried forward, or about £27 000 more than the amount brought in. The investments of the company now stand at about £3 862 000, a decrease of £166 000, and the average yield was 5.39 per cent., compared with 5.28 per cent. for the preceding year. Though the majority of the undertakings in which the company is interested are electric tramway and power companies, there appears to be an increasing tendency on the part of the directors to widen the scope of their investments. Among the changes we notice in this direction is an increase in their holdings in the Brush Electrical Engineering Company and the Electric & General Investment Company, while shares to the value of £71 300 have been acquired in the Stoll Picture Productions, Ltd. We are not surprised at this change, for we are told in the report that while the aggregate receipts of the associated companies in 1920 showed an increase, the expenses advanced in a greater ratio, due in a large measure to the restrictions on charging higher fares until the latter part of 1920, although wages were advanced earlier in the year. A dividend of 4 per cent. is a poor return upon capital in these days, but in view of the probability of tramway wages questions being adjusted amicably, the outlook would be comparatively good were it not for the miners' strike.

Current Limiters and Load Factors.

THE apparatus which we describe on another page of this issue is an interesting attempt to solve the problem of how best the load factors of our supply systems can be improved. This current limiter, which has been devised by Messrs. J. CLEARY and G. A. PHILPOTT, of the Brighton electricity department and has been placed on the market by the Edison, Swan Electric Company, Ltd., embodies a resistance which, when the predetermined amount of energy taken by a consumer is exceeded, is placed in series with the load, so dimming all the lamps on the circuit. This avoids the many disadvantages due to the flicker, which is usually a feature of other limiters and there seems to be no reason why in practice its use should not be of great assistance in simplifying certain of the financial difficulties which at present threaten to prevent the economic supply of electricity to the small consumer.

Electricity Supply Charges at Sheffield.

WE had hoped that the recent report of the Special Committee on electricity tariffs in Sheffield would have ended the controversy in local municipal and business circles on the entertaining question of the relativity of charges for power and light. On this subject Councillor GRAVES, by advocating a uniform flat rate for both services, is as much a protagonist in his way as Prof. EINSTEIN is in his. But though he has many supporters, the Committee's report, of which we recently gave an abstract, showed it was only because of the great increase in the units sold for power that it was possible to supply electricity for lighting at the present comparatively low figure. The committee even went further in the anti-Graves direction, and recommended a reduction in the percentage increase made for energy sold at 2d. and under. This step, which is all in favour of large power users, was endorsed by the Council. Nothing daunted by his defeat, Councillor GRAVES is now pursuing his propaganda in the local press. Several columns have already been filled by his communications and the replies of chairmen and ex-chairmen of the Electricity Committee, but these simply repeat old arguments. The doughty champion of the flat rate cannot or, rather, will not, understand the necessity for having different charges for power and lighting and we suppose he will continue his campaign until the local papers find a more suitable way of filling their columns, which we hope will be pretty soon. Nevertheless, though we do not support Mr. GRAVES, he is right in supporting his arguments by calling attention to the confusion which exists by continuing war-time methods of charging. At various times during the war additions had to be made to the prices and these took the form of a percentage on the existing rates. But the time has now come when this method should be discarded for something more regular and systematic.

The Pros and Cons of Standardisation.

THE Annual Report of the Institution of Electrical Engineers, the various publications of the British Engineering Standards Association and the columns of any technical journal, connected with engineering, all indicate that a movement is taking place towards the production of equipment of a stereotyped pattern for performing the many varied functions which modern engineering makes necessary. Such a movement predicates not only that the machines and apparatus shall

comply in design, manufacture and performance with certain general and special conditions, but more particularly that they shall be made of certain parts and material which themselves comply with similar regulations. This movement towards ultimate standardisation, after a slow beginning, is now accelerating, and it may therefore be as well to examine critically the advantages and disadvantages of this tendency and the effect that it is likely to have on the progress of the electrical industry.

THE ADVANTAGES OF STANDARDISATION.

To take the advantages of standardisation first, well thought-out tests, carefully written specifications, and clear conditions of contract ensure that a certain position on the scale of quality is reached by all products manufactured in accordance with them. They also ensure interchangeability and easy repair and maintenance and further they allow all the benefits derivable from those much-abused and mis-used words "mass production" to be obtained both by the manufacturer and the consumer. Our recent Manufacturers' Issue showed how these benefits were being taken advantage of by the former class. Mass production in this sense obviously not only includes all the operations necessary to the evolving of the finished article and the various parts which make it up, but it indicates the presence of a certain type of modern works organisation whose sole duty is the control of production and production methods, with a view to guaranteeing eventually an article which, while possessing a certain standard of quality, can be sold to the consumer at the lowest possible price. If in some people's eyes this reduces the manufacture of electrical apparatus to the level of the more widely advertised patent medicines, it is a disadvantage which is more apparent than real.

THE DISADVANTAGES OF STANDARDISATION.

Even when we come to examine the supposed disadvantages of standardisation, we find that most of them lack real force. It has been said that standardisation clogs initiative and prevents development. But, with one possible exception to which we refer below, this is an over-statement of the case. It is true that standardisation neutralises the personal element in the clauses of specifications, in the details of design and in some of the methods of manufacture, but this elimination is not necessarily a bad thing. Often it is a good thing. For the personal element, while necessary and useful in the preliminary work of manufacture, is unnecessary and dangerous when it interferes with what experience has shown to be worthy to be categorised as a standard article. To impose on such an article a superstructure of personal ideas, far from giving an improved machine, in general leads to poorer performance and a waste of money and human and mechanical energy. There are duties which the human element can rightly perform, but lightly-hearted modifying standard productions is not one of them.

TOO MUCH DETAIL A DISADVANTAGE.

We may refer once again to our candid friend Dr. ROSENBERG for an illustration of this text. Needless to say, his fiery darts are directed at anyone who thinks that the manufacturers' standard product is not good enough for him. He laughs sardonically at the two-volume novel of conditions of contract and specifications which was often the consulting engineer's Bible, with the difference that each consulting engineer wrote his own Bible and made his own writings a law unto himself. The technical part of this monumental work was devoted, according to Dr. ROSENBERG, to a detailed recital of the required output, overload efficiency, and heating of each part, these data being tabulated in accordance with the consultant's own personal idea, and not to correspond with

generally accepted standards. This desire for particularity was carried to an inordinate extent, and included such details as current densities permissible in every conductor, the areas of the collecting surfaces of commutators and slip-rings, the flux densities and insulation thicknesses in each and every part. This would have been disadvantageous enough to cheap production if all these factors had been the same, but when they were all different Dr. ROSENBERG ceased to wonder that the English electrical industry was in a bad way. We agree with Dr. ROSENBERG's strictures; indeed, we go a step further than he does, and point out that the high cost which is the necessary result of all these idiosyncrasies falls ultimately, not on the manufacturer, but on the buyer, and that the buyer obtains not only no real advantage from these methods, but a freakish and inefficient machine. It is true that the conscientious manufacturer suffers when he sees his long-tried methods scouted and his machines operating inefficiently, but, as Dr. ROSENBERG hints, there are ways of salving the wounds so inflicted on him. The consumer, on the other hand, by purchasing something that is not standardised obtains a product of a quality lower than he would have done had he sunk his personality, while he increases his costs and lowers the efficiency of his productive operations.

HAVING IT BOTH WAYS.

These idiosyncrasies are, however, not confined to technical details. There was, for instance, a clause in many specifications that no contractor need tender who could not show that he had supplied a similar or larger plant than that then being ordered. Comment on such a clause is needless, except to say that in practice it can hardly be more than a sonorous form of words. There were also clauses which attempted to give their author all that was best in both worlds by specifying in detail how the machine was to be made and placing the onus for its performance on the manufacturer. This is egotism run riot. Even if the specification itself contained errors, as is not inconceivable, the manufacturer was still made responsible for such errors, sometimes with unexpected results. This can all be altered by the universal use of a standard form of contract, such as that which the B.E.A.M.A. now rightly insists upon.

STANDARDISATION NECESSARY.

It is therefore, we think, abundantly proved that a great measure of standardisation in the manufacture not only of complete electrical apparatus, but of the parts which go to make it up, is beneficial to the industry and to progress generally. The one real argument that can be advanced against it is that it prevents the easy introduction of new methods and designs. In theory this may be so, but in practice the resultant effect is likely to be much less than is supposed. Grave alterations in designs are not undertaken lightly for commercial rather than technical reasons, and while to alter standard designs may be difficult, when it is found necessary to do so it is because it is really worth while. Electrical engineers should therefore use every effort to adopt standardised methods very much more in the future than they have done in the past, and to support the excellent work which is being done by the British Engineering Standards Association towards this end. For while much has been done there is much more to do. The Association requires support not only on the technical side, but especially to ensure that the standards propounded are more generally used than is unfortunately at present the case. For standardisation, like the law, depends on the sanction of the whole body concerned and without that sanction it must fail. Rules and regulations are meant to be kept, and the tendency which has been noticed in the past to render them lip service only must be abandoned.

Wind Pressures and the Design of Radio and High Transmission Towers.

By S. P. WING, Assoc. Mem. Am. Soc. C.E.
(Civil Engineer, C. F. Elwell, Ltd.)

The author, having occasion to design a 750-ft. wireless mast, was met, at the outset, with the difficulty of finding sufficient data upon which to assume the wind loads. Literature on wind pressure is, at the best, meagre. What there is of it, is based on the classic Forth Bridge or other similar experiments and concerns itself with the wind loading of structures 200 ft. or 300 ft. in height. But if 30 lbs. per sq. ft. of area exposed to wind is a proper load to assume for a structure 100 ft. high, will this loading be suitable for one 750 ft. high? On this subject there is very little published data. The New York City Building Code calls for a wind load of 30 lbs. per sq. ft. regardless of the height. On this specification the Woolworth Building, 750 ft. high, was designed. At the Panama Pacific International Exposition specifications called for an assumed wind load of 20 lbs. per sq. ft. for all heights up to 300 ft. and for 25 lbs. per sq. ft. for all heights over this. The highest structure built under this code was a tower 450 ft. high. Designers of wireless towers in the past have usually made assumptions such as 30 lbs. per sq. ft. for the first 200 ft. of tower and then 40 lbs. per sq. ft. for the next 200 ft., &c. All the above assumptions have been little more than wild estimates with a large margin of safety. Experimentally, W. H. Dines has attempted to solve the problem by the use of balloons. Commenting on these experiments, he says, "Tentatively the velocity at 1 000 ft. may be taken as double that at the ground."*

IMPORTANCE OF DETERMINING A LAW.

In view of the fact that the cost of a high wireless tower very largely depends upon the wind loading assumed, it was deemed important that the law governing the increase of wind pressure with the height should be determined. By good fortune in 1915 the author was located at the wireless station at Ballybunion, Co. Kerry, Ireland, where he could make the experiments to determine this. Through the kindness of Sir Napier Shaw, Director of the British Meteorological Office, the necessary instruments were obtained. Sir Napier Shaw was also good enough to indicate the lines upon which the experiments should be carried out. In presenting the results of these experiments the author wishes to express his thanks to him and also to Mr. F. J. W. Whipple, also of the Meteorological Office, the latter having kindly taken the trouble to work out the gradient winds existing during the period of the observations.

Although the experiments are neither as accurate nor as full as could be desired, so that the laws deduced may not be scientifically correct, yet it is hoped that the results will be of use to those designing similar structures elsewhere and that they will form a basis for making an "educated guess" as to the actual wind pressures to be expected.

The solving of the problem requires that the simultaneous, actual velocities occurring at different points above ground should be known and from these the pressure determined by the law that $P=0.003V^2$ where

$$P = \text{pressure in pounds per square foot.}$$

$$V = \text{actual velocity in miles per hour.}$$

It was thought that three points would suffice to determine the shape of the curve showing the law by which the velocity varied, and that, having obtained this curve, even though the top point of observation was only moderately high, it could be extended to show the relative velocity at 750 ft. Then, knowing the law of the variation of the velocity, by either an assumption or by an estimate from the meteorological records, the maximum ground velocity could be obtained and

that of the maximum likely to occur at 750 ft. be derived. No special attempt was made to treat the problem from a scientific meteorological standpoint.

LOCAL CONDITIONS.

Fig. 1 shows the existing local conditions at Ballybunion, Co. Kerry, Ireland, where the experiments were carried out. The wireless station is situated at the mouth of the River Shannon. It is located about half-a-mile inland from the ocean, which lies to the west, across some low rolling sand dunes about 70 ft. high. To the north of the station lie the mouth of the Shannon with the hills of Clare in the distance.

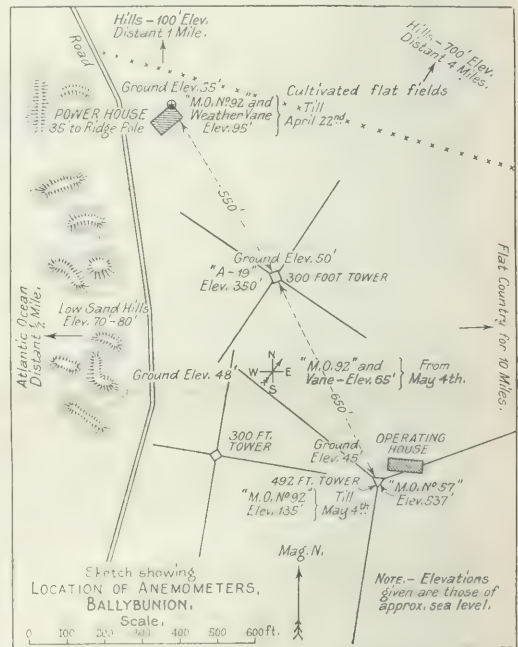


FIG. 1. GENERAL ARRANGEMENTS AT THE BALLYBUNION STATION IN 1915.

to the north east, four miles distant, a small range of hills about 1 000 ft. high, and to the south-east, a low level plain, extending back 10 or 15 miles.

Considered from the wind point of view the general position is not one at which one would expect the most violent winds, such as at an exposed cape, but it is one that is exposed to any winds to which that part of the country is liable. The strongest winds and those most free from local disturbances would normally be expected to be those from the sea to the west, although the winds from the south east have a long sweep free from obstruction down the valley.

The station itself, at the present time, consists of one central 492 ft. mast surrounded by six others 300 ft. in height and forming roughly a hexagonal figure 800 ft. on a side (see Fig. 2). The masts are of the non-self-supporting type, being stayed with wire ropes at frequent intervals and are composed of a wooden trussed framework, which is about 6 ft. on a side. The construction is of such bulky nature that it is estimated

* "Proceedings" of the Institution of Civil Engineers. Vol. CLXXI.
† For explanation of this term see later.

that it offers from 5 to 6 ft. of effective wind surface for each horizontal foot of mast.

INSTRUMENTS EMPLOYED.

For the purpose of making the experiments the British Meteorological Office lent three cup anemometers of the standard Robinson type. M.O. 92 and A. 19 were calibrated

extensively by the British Meteorological Office and the other two were calibrated by the British Meteorological Office. The anemometers were used simultaneously. It may be mentioned here that a period of two minutes proved sufficient to eliminate the effect of the gusts, the two-minute readings being either very constant or else progressively variable over a period of 10 minutes.



FIG. 2.—GENERAL VIEW OF BALLYBUNION WIRELESS STATION.

after the experiment, by the National Physical Laboratory. M.O. 57 was not calibrated, but was the sister of M.O. 56 and so could use its calibration sheet. Anemometers M.O. No. 57 and M.O. No. 92 were so designed that they gave wind velocity in miles per hour direct, but "A. 19" was of an older type and only counted revolutions and was in an inferior condition to the other two. It was decided to mount the anemometers as follows: One on top of the 492 ft. mast; one on top of the 300-ft. mast nearest the sea (i.e., the N.W. tower nearest the power-house); and the third on the roof of the power-house, at an elevation of about 40 ft. above the ground. The anemometers were mounted on the top of poles 2 ft. long and placed on the corners of the towers nearest the sea. The first readings took place on April 13th, and it soon became evident that the effect of the power-house roof was influencing the readings of that instrument. This being the case, on April 22nd the anemometer was moved to a new location on a platform about 90 ft. up the 500 ft. tower. But this position likewise proved unsatisfactory, due to the screening effect of the tower, and, on May 2nd, it was once more moved, this time to the top of a 15 ft. post in the middle of the open field between the 300 and 500 ft. masts. The weather-vane was also located here. This position gave open ground all round for some 800 ft. at least, and while it was thought that the screening effect of the low sand hills might be a factor when the winds were light, it was believed that the readings would be very fair for average breezes, and this belief was borne out by subsequent readings. At the same time that the ground anemometer was moved to its final position, the top anemometers were put on to poles extending 6 ft. above the top of the masts, so that it is after this date, May 4th, that the most reliable readings were made.

METHOD OF TAKING READINGS.

Of course, the ideal method of conducting these experiments would have been to have taken simultaneous readings of the wind velocity at three points in the same vertical plane. This being impossible, at Sir Napier Shaw's suggestion it was decided that the best chance of obtaining comparative results was to have the readings taken over a long enough period to eliminate the effects of gusts and so get true average values, and, for this reason, the readings consisted of six continuous observations taken at intervals of two minutes each and

of two minutes proved sufficient to eliminate the effect of the gusts, the two-minute readings being either very constant or else progressively variable over a period of 10 minutes.

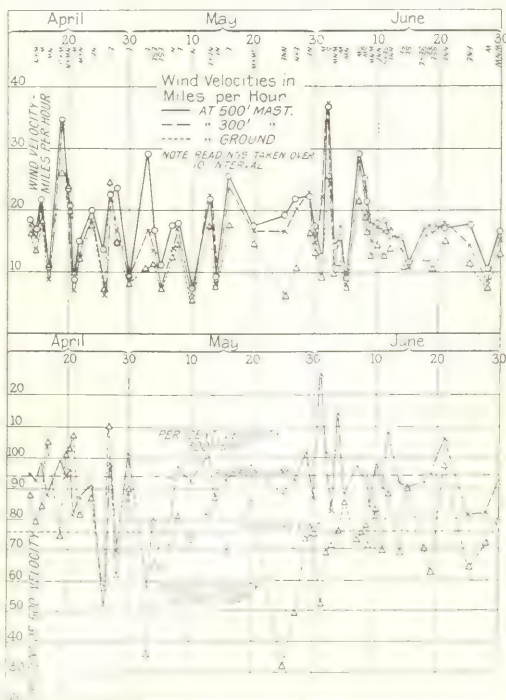


FIG. 3.

The readings were taken on Ballybunion from April 13th to June 1st, 1915, about 40 observations being taken during that time. In that period the wind velocity varied from 0

to 37 miles per hour and at different times the wind came from nearly every quarter of the compass.

RESULTS OF THE INVESTIGATION.

The results of the investigation are best shown in the form of curves. At the top of Fig 3 are shown the daily velocities in miles per hour as determined by the 10-minute intervals. The curves at the bottom show the relation which the velocity of the wind at 300 ft. and at the ground bears to the velocity of the wind at the top.

Fig. 4 shows the gradient wind as computed by Mr. Whipple (British Meteorological Office) for the days of the observations and with it, for comparison, the wind at 500 ft. The lower diagram shows the relation between the wind at 500 ft. and the gradient wind, and between the wind at the ground and the 300-ft. wind.

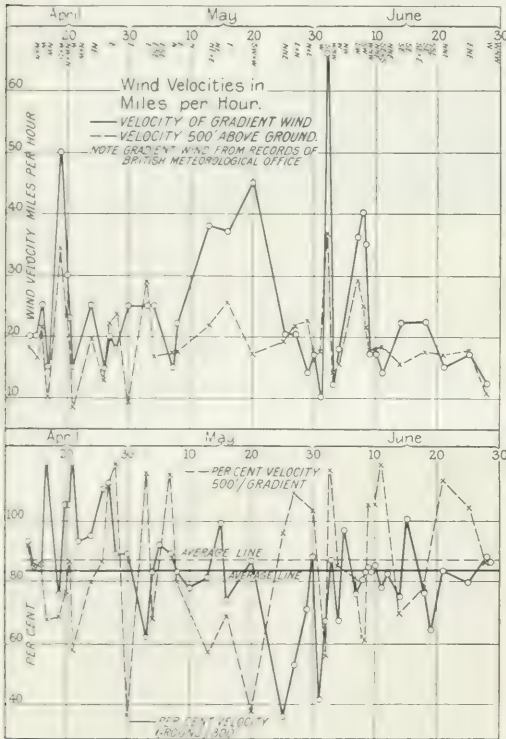


FIG. 4.

Fig. 5 shows the way in which the ratio of the observed winds to the gradient wind varies with the wind direction.

Figs. 6 and 7 delineate the variation in the ratio of the various winds with the absolute velocity.

Fig. 8 gives typical curves taken from the daily observations showing the way in which the velocity increases with the height. Curve 5 gives the average of all the readings, and Curve 2 the final approximation.

GENERAL DISCUSSION OF RESULTS.

An examination of the daily ten-minute velocities given in Fig. 3 shows very clearly that there is a decided increase of velocity with the height. Only in 10 per cent. of the readings was the wind on the ground recorded equal to that at 300 ft. and these times were all at the first of the period of experiment, when the method of mounting the anemometers was not satisfactory. Again, less than 20 per cent. of the readings at 300 ft. equalled those at 500 ft. This general increase is

best shown by the curves plotted at the bottom of Fig. 3. At first sight it would appear that little more could be said than that a general increase in velocity was apparent. However, when averaging lines were put in, examination showed

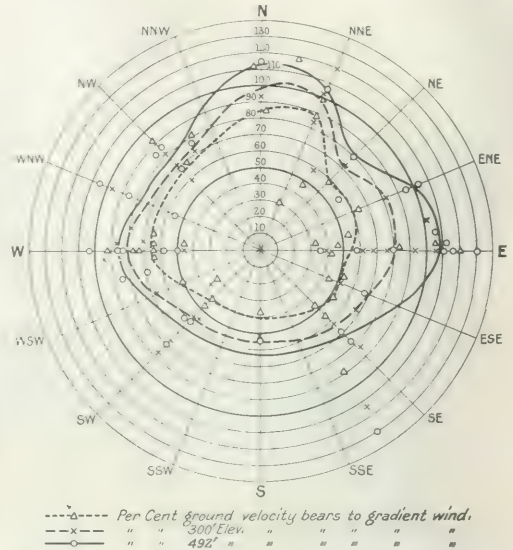


FIG. 5. -Wind Velocity Ratio Variation with Wind Direction.

that most of the points lie within 15 per cent. of either side of the lines and that the wider variations are generally at low velocities (i.e., under 15 miles per hour) and with the wind in certain directions. A fuller discussion of this variation will be given later.

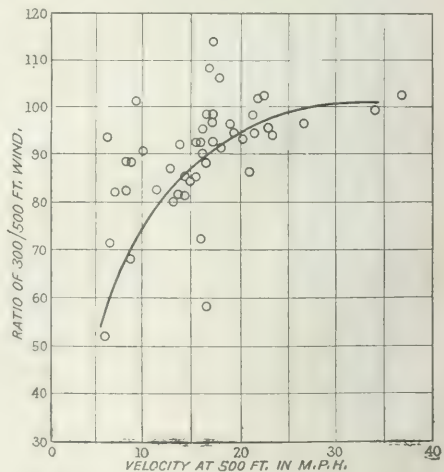


FIG. 6. -Ratio of 300 Ft. Wind Variation with Absolute Velocity M.P.H.

THE "GRADIENT" WIND.

In late years in meteorological circles, winds are compared by their relation to what is known as the "gradient wind." This is a theoretical wind based on the calculation of differences of pressure and is supposed to exist at some unknown distance

above the earth's surface where the effect of the earth's friction and local conditions are not felt. This wind is generally considered to be near the limiting velocity of all earth winds. This being the case, if, at a given place, we know the ratio which the ground winds bear to the gradient wind, then an estimate of the maximum gradient wind would give us an estimate of the maximum ground wind. Unfortunately, the gradient wind could not be very accurately determined for Ballybunion. In the first place, Ballybunion is on the edge of the meteorological net, and, in the second, it was impracticable to take the wind observations at Ballybunion at the same time that the weather bureau took their pressure

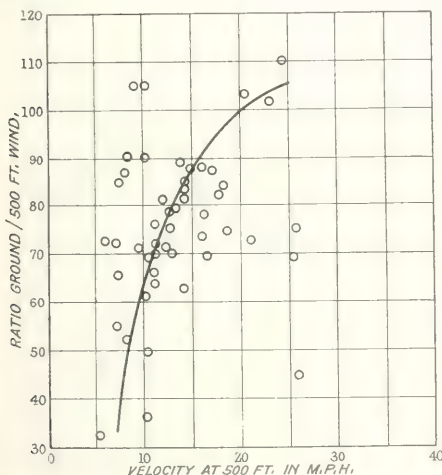


FIG. 7. GRAPH SHOWING HOW RATIOS GROUND/500 FT. WIND VARIES WITH ABSOLUTE VELOCITY, M.P.H.

observations from which the gradient wind had to be determined. In fact, the former were generally some two hours after the latter, during which time the gradient wind computed might have changed considerably.

The above facts must, then, be taken into consideration in studying Fig. 4. In the bottom diagram the dotted line shows the relation between the velocities of the gradient wind as computed and that of the wind at 500 ft. as measured. Obviously the averaging line has little meaning here, but is put in as a matter of curiosity only. At the bottom, the relation which the wind on the ground bears to that at 300 ft. was given to see if that ratio was more constant than that of the ground to 500 ft. However, there is little to choose between them; the wide variations up to May 2nd may be put down to the unsatisfactory locations of the anemometers.

Fig. 5 shows the relation which the direction of the wind plays on the percentage relationship. The gradient wind has been used as a standard of reference on this sheet, but a result giving more information would probably have been obtained if the wind at 500 ft. had been used in place of it, as the gradient wind is too uncertain. However, we do get certain useful indications, even though the points are too few and scattered to draw conclusions.

RELATION BETWEEN GRADIENT AND OBSERVED WINDS.

Mr. Fairgrieve, in his "Geophysical Memoir No. 9" "On the relation between the velocity of the Gradient Wind and that of the Observed Wind," has shown that the relation which the ground velocity bears to the gradient velocity varies with the direction of the wind. As can be seen from Fig. 5, the relations at Ballybunion also vary greatly with the direction of the wind, and even though the points are much scattered, give a certain general shape to the plot. There is a marked increase in the percentage value for all three different elevations in a northern and eastern direction. This is hardly what one would expect, as the hills lie in these directions, but

it is confirmed by Mr. Fairgrieve's results, for he says, "In the curves for Dungeness and London, and, to some extent, in the curves for Jersey, the relative strength of the north-easterly winds is noticeable. This suggests causes not entirely local; these may be meteorological."

The wide variations in the ratio of the winds from the west may, however, be due to local causes, the sand dunes, for instance. It is very noticeable, however, that rarely does the ratio of the winds from this direction reach so high a value as in the north and east, and this is more striking as it is in this direction that the ocean lies.

In considering the percentage ratio of the wind velocity at various heights to the wind velocity at the top, a query arose as to whether the wide relations in values could be due to the fact that many of the winds were of comparatively low velocity. It was thought that for low velocities the effect of the earth's friction, anemometer friction, &c., might be the cause of the variations. To determine this the percentage ratio is plotted against the velocity. The points are too widely scattered to draw any conclusions. Perhaps more detailed observations in the future might show that there was a general tendency for the ratio to increase in value until it reached its definite position due to meteorological causes. And, as in general, each direction has a different value for this ratio, that would account for the wide scattering of points.

THE ESSENTIALS OF THE INVESTIGATION.

The essentials of the whole investigation are given in Figs. 8 and 9. In Fig. 8 the inverse of the percentage values previously given are plotted so as to show the increase in the velocity of the wind (in terms of the ground velocity) with the height of the point of observation above the ground. Actual curves taken on different days are given illustrating

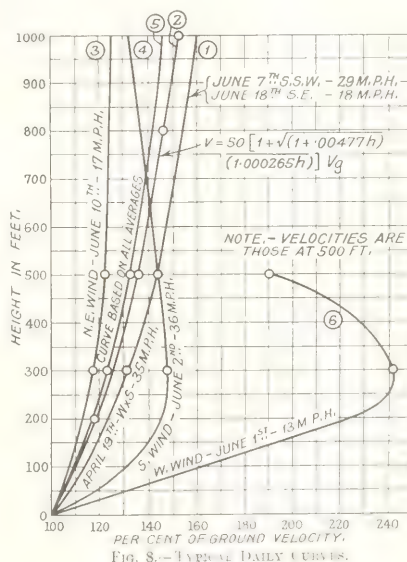


FIG. 8.—TYPICAL DAILY CURVES.

average and limiting values. A final curve based on the final averages is also given. In view of the wide variations of the observations from the lines of the averages, this curve is not the one accepted for Ballybunion, but another is chosen, Curve 1, which is a curve which most of the high winds there very nearly approach.

As a fair approximation to the final curve and one safe, the author feels, to within 15 per cent., we may take Curve 2 in Fig. 9, its equation being

$$V = 0.5 \left[1 + \sqrt{(1 - 0.00477h)(1 - 0.000265h)} \right] V_g \quad (2)$$

V = velocity in miles per hour at height "h" feet above the ground.

V_g = velocity in miles per hour at ground.

CONCLUSIONS

Figure 1 is a graph showing the relationship between Per Cent Gradient Velocity (Y-axis, 0 to 100) and Pressure (X-axis, 0 to 240). The graph contains four curves labeled 1, 2, 3, and 4. Curve 1 is a straight line from (0, 100) to (20, 0). Curve 2 is a straight line from (0, 100) to (40, 0). Curve 3 is a curve starting at (0, 100) and ending at (240, 0). Curve 4 is a curve starting at (0, 100) and ending at (240, 0). The curves are labeled with equations: 1. $(100/20) \cdot (20 - P)$, 2. $(100/40) \cdot (40 - P)$, 3. $(100/240) \cdot (240 - P)$, 4. $(100/240) \cdot (240 - P)$.

It is interesting to compare these conclusions with those of other investigators. Mr. Vines stated that the wave doubled in velocity at 1000 ft. Assuming a straight line relation this would mean the pressure doubled at about 400 ft. Our curve gives a doubling of pressure at about 670 ft. Mr.

From a civil engineering standpoint, the results though not satisfactory, are useful in showing the limits of the increase in pressure with height and the need for allowing positively for this increase in the design of tall structures. If the curves given are used perhaps the errors in wind assumption will not be out of proportion to other assumptions involved in the design of high aerial supports.

BY A. PRESS.

* Abstract of a Paper read before the Institute of Radio Engineers.

A Survey of Heat Transmission Problems.




By W. M. SELVEY.

Mr. Royds is to be heartily congratulated in producing this trilogy of books which are really in a sense three sections of the same treatise. We are not quite certain whether he is writing for students or for engineers, but, in either case, both classes will be benefited by having these books on the bookshelves. There is very little that is new in any of the volumes, nor do they aim at giving a very exhaustive criticism or examination of any of the subjects they touch, yet they do, with few exceptions, give much of the information extant relating to the subjects of which they treat.

THE WORK OF OSBORNE REYNOLDS.

Mr. Royds approaches his subject from the point of view of applying the classic work of Prof. Osborne Reynolds to the analysis of published results with regard to heat transmission. Most engineers are familiar to some extent with the work of Osborne Reynolds, but very few writers have taken the trouble to set his ideas out so plainly and in such an understandable form as in this case. Briefly speaking, Reynolds was concerned with the general conditions of interchange of heat between a surface and a fluid. To the ordinary engineer it would be better said that using this idea in practical analysis results in finding out how the heat transmission coefficient varies in terms of the velocity of the fluid passing over the surface. While providing for the fact that the coefficient does not entirely depend on the velocity, all engineers are aware that it largely depends on it, and hence in the very many sets of experiments which Mr. Royds has analysed he has generally plotted the heat-transmission coefficient against a value which he calls Wl in which $\frac{Wl}{A_1}$ refers in suitable units to the weight of fluid being passed over a surface of area A_1 .

THREE NATURAL SECTIONS.

Having approached his subject in a general way, and, in our conception, being desirous of placing the matter rather fully before engineers, he immediately comes up against the consideration that there are three natural sections to his subject. The first is that of instruments and their use, the second is that of a theoretical consideration in which results can be generalised and a third is the consideration of the actual apparatus which is used in industrial work, the design of which must be based to some extent on the second branch, that is, the developed theory. Mr. Royds, therefore, takes the drastic step of making three separate books, which, until the matter of the whole three is thoroughly mastered, leads to constant cross-references between them.

TEMPERATURE MEASUREMENTS.

Dealing shortly with the contents of these books, the first one relating to measurement of steady and fluctuating temperatures gives very fairly an account of the instruments which are available to the engineer. It naturally draws largely on what we may call the classic work of "Burgess-Le Chatelier," which is a book probably only in the hands of advanced students, and of the few engineers who have a penchant for physics. Obviously, the scope of the book does not allow him to go very deeply into such matters, but we think he has very fairly covered the essential points of all instruments. The term "fluctuating temperature" seems a little unusual, but is made clear by saying that the author has dealt particularly with the work of Prof. Callendar with regard to the variation of temperature of the walls of a steam cylinder, and later with Hopkinson and Coker and Scoble's work on

the "Measurement of Explosion Temperatures." This, of course, is all pretty well-known ground to gas-engine makers, but we do not recollect any book in which all these various kinds of experiments have been correlated between a single point of view.

THE THEORY OF THE SUBJECT.

Turning to the second book on the theory of the subject, Mr. Royds has carefully taken advantage of the standard work on "Heat," by Preston, which, again, is a work only in the hands of advanced students.

Mr. Royds' analysis is in a useful form, and yet he has not quite gone the whole way necessary to help the engineer. Some of the matter is rather discursive, and what an engineer most misses is a clear and critical summing up at the end of his analysis and argument. What the engineer wants is, when he has finished a book like this, a short essay stating:—

1. What is it that is generally accepted as an approximate theory?
2. What does this theory tell us as to the manner in which this approximate theory should be amended or extended?
3. What would the replacement of this advance by a more ordinary design?
4. How much is still left to do to complete the theory, and what is the extent of the uncertainty.

If Mr. Royds could, in some future edition, write a summing-up chapter on these lines it would certainly add crispness to a very valuable book. A table of symbols at the beginning of the book would also be an improvement.

THE APPLICATION OF THE REYNOLDS THEORY.

The application of the Reynolds theory is, in practice, a narrow one. Conditions other than relating to heat transmission generally settle the rate of flow and, in many cases, no considerable variation from such rate could be entertained. Engineers are much interested in how the heat co-efficient varies as between a small temperature gradient and a large temperature gradient. This, the author does indicate in several places, but he is so intent on the dependence of the co-efficient on velocity that he does not emphasise the very important results which he himself records. Another point is a matter of much interest, namely, does the heat co-efficient for a given temperature gradient depend on the absolute temperature? A critical analysis of these questions would be valuable to engineers.

PRACTICAL APPLICATION OF THEORY.

Turning to the third book which attempts to be the practical application of the theory, one is rather disappointed. A great deal of the author's careful and thoughtful analysis is spent on experiments, the force of which has been entirely lost by more recent work. We are pleased to see the work of the late Prof. Nicholson now made more available to all and sundry. It is a very fine investigation which probably has had no influence worth speaking of on practical work. The only real outcome of it was perhaps the "Bouecourt" boiler in which the idea of high speed gases were applied. But curiously enough Mr. Royds omits all mention of this boiler and the results obtained.

Again, his critical faculty might well have been directed to a strict examination of the return to be got from low-temperature gases measured against the mechanical work to be expended on them. We are very tired of the cool way in which everybody dismisses the question of exhaust steam from auxiliaries by assuming that it can be suitably absorbed in the feed water.

Again, we would point out that Mr. Royds could have better spent his time on analysing those very fine results on the Detroit boilers which have been given by Dr. Jacobus over a series of years, and which are very well known to all electrical engineers. These results seem to have escaped Mr. Royds' notice altogether. He seems to be rather unduly impressed

* (1) "The Measurement of Steady and Fluctuating Temperatures," Pp. xi+162. Price, 16s. (2) "Heat Transmission by Radiation, Conduction and Convection," Pp. viii+238. Price, 24s. (3) "Heat Transmission in Boilers, Condensers and Evaporators," Pp. viii+302. Price, 24s. By R. Royds, M.Sc., A.M.I.M.E. (London: Constable & Company.)

with the difficulty of conducting and managing large boiler tests, probably based on his experience of small hand-fired boilers.

THE LIMIT OF CONDENSER VACUA.

It seems a pity also that so much trouble should be taken over out-of-date condenser experiments. Leblanc, to whom the writer refers, was quite clear as was also Josse, on what was limiting the vacuum in condensers for turbine work. Sir Charles Parsons was perfectly clear a long time before, and his augmentor is one of his many inventions which has never been clearly appreciated, and which was largely before its time. The great step forward was to get a type of air pump which preserved its volumetric efficiency independent of absolute pressure. This was only really given by a steam jet. Once

Given this solution to the problem, the whole of the condenser work becomes very simple, and the conditions of condensation of practically air-free steam, present no difficulties other than friction on the steam side, a thorny subject which the author has rather carefully avoided. There is no difficulty to-day in designing a condenser for the highest possible vacuum far beyond the power of any large turbine as now made to economically utilise.

The book concludes with a very complete analysis of evaporator work.

Having said so much in detail, we would heartily commend the author for his excellent work. We think it is a matter of regret that the price of these books is so high, but we take it this arises out of the exigency of the present times and not out from the author's own desire.

Electrification of the French Railways.*

A Comparison Between the Different Systems.

An important memoir on this subject has been published by the two engineers, Messrs. Japout and Ferand, who represented the P.L.M. Company in the mission sent to U.S.A. in 1919 to study electric traction. The authors have examined in detail the following American railways: The New York Central Railroad and Pennsylvania Railroad (continuous current at 600 V); the New York, New Haven & Hartford Railway (single-phase); the New York, Westchester & Boston Railway (single-phase); the Norfolk & Western Railway and Pennsylvania Railroad (single, three-phase or split-phase); the Butte, Anaconda & Pacific Railway, and Chicago, Milwaukee and the St. Paul Railway (continuous current at 2300 and at 3000 V). The authors' conclusions in favour of the continuous-current system are analysed below:—

COMPARISON BETWEEN THE DIFFERENT SYSTEMS.

Alternating-current systems produce disturbances in the telegraphic and telephonic systems which are parallel and close to the track. In consequence, the communication circuits may have to be removed to a distance from the track, laid in underground cables, or transposed, or the number of feeder sub-stations largely increased. All these solutions are very expensive; moreover, the last three are not absolute remedies.

The high-tension continuous-current system, like the single- and split-phase systems, needs only a single overhead conductor, and not two overhead conductors, like the three-phase system. The latter is very costly to install and to maintain, necessitating every day prolonged interruptions on the Italian railways. For low or moderate pressures, continuous current permits the use of a third rail, which is easy to install and to maintain.

THE ROTATING MACHINERY FALLACY.

It has been objected to that the continuous-current system needs sub-stations with rotating machinery, which are more costly to build and to operate than sub-stations with the purely stationary apparatus necessary for alternating-current systems. But the latter systems, as a rule, avoid rotating machinery only by erecting special power stations with low-frequency (15-16 cycles) traction generators, which are of no use for other purposes. Such stations are nearly always inefficiently utilised. In Europe, one remedy for this has been to mount two alternators on the shaft of the prime mover, one supplying power at the railway and the other at the industrial frequency. In this case it is none the less necessary to have separate transmission lines for the traction service on the one hand, and for industrial service on the other.

On the other hand, the use of sub-stations with revolving machinery fed from a general network leads to great economy in transmission lines. With transformer sub-stations, the advantages exist only if 25 cycles is adopted for all purposes, as in the American single-phase installations; but, for traction, this frequency is rather high, and for general purposes 50 cycles is better.

LOW POWER FACTOR AND ALTERNATING CURRENT TRACTION.

Lastly, the low power factor with alternating-current traction acts adversely on the generating station when the sub-station contains only stationary apparatus; while with sub-stations containing running machines having a high power factor the conditions on the primary side of the network can be improved.

In the continuous-current system the tension of the overhead conductor is much lower than in the alternating-current system, so

that the sub-stations must be nearer together. Though this is an unfavourable feature of the continuous-current system, the avoidance of interference with communication from single-phase circuits also entails a considerable increase in the number of sub-stations, so that the advantage of using the higher pressure is lost.

REGENERATION IN THE DIFFERENT SYSTEMS.

With regard to the rolling stock, continuous-current locomotives have been developed for recuperative braking at different speeds on falling gradients. Successful regenerative braking has been obtained on recent single-phase locomotives on the Swiss Federal railways.

On three-phase and split-phase locomotives, regenerative braking is obtained at a constant speed; this automatically prevents the speed of a train on a falling gradient from rising appreciably above the synchronous speed of the motors. But it is not possible to run at a higher speed, nor can the speed be diminished without applying the brakes.

With continuous current, on the contrary, it is possible to descend gradients regenerating energy and varying the speed within assigned limits without applying the brakes.†

On the other hand, in the alternating-current systems the power factor is low during regeneration, thus making utilisation of the energy returned difficult. With continuous current the energy recovered can be effectively used.

It may be pointed out that, whatever the system of regeneration, braking on long and steep gradients has not the same security as rheostatic braking. If for any reason the circuit is broken (due to operation of a cut-out, accident to overhead line, &c.), the braking effort at once ceases, and unless the brakes are immediately applied, the train may run away. This danger is not so great in America, where all the trains have continuous brakes,‡ but might be very serious on European goods trains.

OBJECTIONS TO CONTINUOUS-CURRENT LOCOMOTIVES.

Continuous-current locomotives have been objected to because resistances must be inserted in passing over the speed range, whereas this is not necessary in single-phase locomotives. Actually, by using several motors and various series-parallel combinations together with shunts across the field winding, a range of speeds sufficiently wide for the most varied service can be obtained. The losses in the resistances are sensibly reduced in this way, though admittedly at the cost of complicated equipment.

Three-phase or split-phase locomotives have usually only two speeds; though four have now been obtained, by sacrificing simplicity, on certain Italian locomotives.

From the point of view of starting, all types of electric locomotive can exert a sufficiently powerful torque from rest, without damage to the motors.

The upkeep of continuous-current locomotives, even at 3000 V, is less costly, and the need for overhauling rarer, than with single- or split-phase locomotives; only three-phase locomotives can compare with continuous-current in this respect.

* † Attention may be drawn to the serious accident which recently occurred on the 3000-V continuous-current electrification on the Chicago, Milwaukee & St. Paul Railway, where the driver failed to switch in regenerative braking within the permissible limits of 15-20 miles per hour. The accident was reported in the "Electric Railway Journal," Vol. LVI, p. 371.—Ed. E.

‡ This does not appear to have been the case in the accident just referred to.—Ed. E.

Messrs. Japiot & Ferrand conclude that from a *technical* standpoint, the continuous-current system is clearly the best.

THE ECONOMIC STANDPOINT.

From an *economical* point of view the advantage is less certain; here the single-phase system in its simplest form proves to be the best. But if all the additional charges are taken into account, such as arise from the avoidance of disturbance to communication circuits, improvement of the power factor, linking up with the general net-work, &c., the advantage is found to lie with continuous current, both as regards capital cost and maintenance.

The conclusions arrived at by Messrs. Japiot & Ferrand and the other railway representatives on their return from the United States, to the Committee appointed to study the question, agree entirely with those arrived at by the chief reporter, M. Mauduit.

THE ADVANTAGES OF MODERATE VOLTAGES.

The authors then show that the moderate voltages of 1 200 V to 1 500 V possess certain incontestable advantages over the higher pressures of 2 400 V to 3 000 V.

The pressure of 1 200 V to 1 500 V permits the use of a third rail, which has strong advocates in France, England and America on account of the ease with which it can be laid and kept in repair. In the present stage of development it is not possible to have more than 1 500 V between the third rail and earth. On the Michigan Railway a third rail was installed at 2 400 V, but the voltage was later reduced to 1 200 V. Some engineers advocate two rails—one 1 500 V above, the other 1 500 V below earth. An arrangement with ± 600 V is used on the Nord-Sud de Paris, a third rail and an overhead line being used, but the installation costs are high. The wear of an overhead conductor is often excessive, particularly in tunnels with mixed traffic, because the gases corrode the metal.

With 1 200 V to 1 500 V, rotary converters can be used in the sub-stations; while for 2 400 V to 3 000 V more costly and less efficient motor generators have to be used. Also, if it is hoped to use mercury rectifiers in the future, it will be easier to install equipment for 1 200 V to 1 500 V than for double these pressures.

CONSTRUCTION AND MAINTENANCE SIMPLER.

The construction and maintenance of 1 200 V to 1 500 V motors are simpler and cheaper. In this connection it is noteworthy that American designers show a marked tendency to reduce the voltage at the commutators of traction motors. In the earliest machines built for the Chicago, Milwaukee & St. Paul Railway by the General Electric Company, the motors were built for the maximum pressure of 1 500 V per commutator; in the ones built more recently by the Westinghouse Company for the same line the voltage is halved.

The lower voltage is also very important for motor-coaches, for the weight, price, &c., increase rapidly with the pressure. Costs are lower both for coach and sub-station equipment, and this must be set off against the superiority of 2 400 V to 3 000 V in respect to distance between sub-stations and feeders. It must not be concluded *a priori* that as high a pressure as possible should be chosen. Though this is justifiable for lines with sparse traffic where the cost of the motor equipment is but a small part of the total cost, and the possibility of increasing the distance between sub-stations becomes an important economical factor; yet with heavily-worked lines, it is better to reduce the capital costs of the motor equipment at the expense of sub-stations and feeders. Further, the lower pressure reduces the costs of upkeep while the higher efficiency of rotary converters, compared with motor generators, reduces the cost of energy.

APPLICATION TO FRENCH RAILWAYS.

Through the *Office Central d'Etudes de Matériel de Chemins de fer* (the common organisation of the State, Midi, P.O. and the P.L.M. Railways), the Committee has examined the electrification of French railways on the continuous-current system, (1) at 1 500 V with rotary converters and third rail, (2) at 2 400 V with motor generators and overhead conductor. This comparison has been made for a number of lines with different profiles and densities of traffic. It shows the 1 500 V case to be better as regards installation costs and very much better as regards maintenance costs. The Committee has recommended its adoption on the French railways, either with overhead or third-rail conductor, with the reservation that all locomotives shall be built to be suitable for both methods of collection. Nevertheless, the 3 000-V system may prove more economical on certain lines with but little traffic, and this can be used, provided the locomotives are also made suitable for working on 1 500 V. A report drawn up on these lines has been submitted by the Committee of Study to the Ministry of Public Works. This was adopted and published on August 29, 1920. In England and Belgium the authorities have arrived at similar conclusions; in North Italy, where the three-phase is already installed on numerous

lines, the same system will be used on extensions; but continuous current has been adopted for the projected electrifications in South Italy. On the other hand, Switzerland, Germany and Sweden have decided definitely to use the single-phase system.

COMPARISON BETWEEN THE RECENT TYPES OF ELECTRIC LOCOMOTIVES.

The three types of electric locomotives to be considered are: The geared type, the connecting-rod type, with or without gears, and the gearless type, where the motors act directly on the axles. Transmission *through gearing* from the motor with nose or tram suspension to the axle—the standard method on tramcars, motor-coaches and small locomotives—has important drawbacks; part of the weight of the motor is taken directly by the axles, which may lead to violent shocks and breakdowns at high speeds; the low centre of gravity may produce severe lateral shocks between wheels and rails; the motors are not easily accessible for repairs. The first defect is lessened by inserting springs between the rim and hub of the gear wheel (elastic gears); these springs also serve to equalise the effort when two motors are mounted on the same shaft. To reduce side shocks, the motors have been raised above the axles—in some cases, twin motors have been used by the Westinghouse Company, as on the locomotives for the New York, New Haven & Hartford Railroad and the Chicago, Milwaukee & St. Paul Railway. With continuous current this arrangement has the advantage of halving the commutator voltage.

CONNECTING ROD LOCOMOTIVES.

Connecting rod locomotives are developed from steam locomotives in the same way as geared locomotives are developed from tramcars. They have been widely used because this construction enables a few powerful motors to be mounted inside the locomotive above the framework. These motors, which with their accessories are easy to mount and supervise, drive jack axles through oblique connecting rods or gears, the jack axles being coupled to the driving wheels through either horizontal rods or triangular frames (Scotch yokes). Neither variation of this drive mechanism is free from drawbacks. Messrs. Japiot & Ferrand say: The jack axles are fixed with respect to the framework, while there are springs between the framework of the driving axles. The oscillations of the chassis on the springs set up violent parasitic forces in the short coupling rods, so that the adjustment of the jack axles, &c., becomes very troublesome. No such action occurs in the steam locomotive, owing to the elastic connection formed by the cylinder. This is an essential difference which must not be lost sight of, and the difficulty can only be overcome by inserting an elastic member in the driving mechanism of the electric locomotive—the elastic member playing the same part as the cylinder in the steam locomotive. Again deformations in the framework during running, as well as the least inexactitude in workmanship, introduces dangerous forces in the connecting rods and bearings.

THE MOST COMMON TYPE OF DRIVE.

The type of connecting-rod drive most common in Europe has a triangular frame joining the two motors and acting directly on to the middle driving axle, which is coupled to two or four other axles by horizontal coupling rods. As examples may be mentioned some of the three-phase locomotives used on the Simplon line and on the Italian railways. A better arrangement is to mount the Scotch yoke on two jack axles which are connected to the motors through elastic gearing, as on the single-phase Loetschberg locomotives and a single-phase Midi locomotive built by the Westinghouse Company. The principal difficulty in the triangular frame is to provide an unchangeable connection between two axles fixed rigidly on the same chassis, which demands that the adjustment must be perfect, and remain so in service. Means have been taken to overcome this drawback on some of the latest Simplon locomotives by Brown Boveri and Swiss Federal locomotives by Oerlikon.

THE MOST LOGICAL METHOD.

At present, at least in America, there seems to be a movement towards the more logical method of *driving direct* from the motors to the driving axles. Only two types have been experimented with on a wide scale: The first single-phase Westinghouse locomotives on the New York, New Haven & Hartford Railroad—the quill drive, since abandoned as being too heavy and insufficiently suspended—and the General Electric gearless type used on the New York Central Railroad and on the Chicago, Milwaukee & St. Paul Railway. The cost of the latter gearless type was \$205 000, compared with \$192 000 for a Westinghouse geared locomotive on the same line.

The authors think that the question has not yet been finally settled, and that it will be necessary to try all three types in France in order to determine which arrangement is best for goods and which for passenger locomotives.

American Efficiency.

Can We Stand Against It?

By ERNEST J. P. BENN.

The common ambition of the American is to be efficient, nothing strikes the stranger more forcibly. The awful fact is impressed upon the mind as one travels from city to city, that there are 110 000 000 human beings, all of them as keen on efficiency as we are on cricket. Efficiency and its obligatory servitude to the dignity of a nation, to which has lately been added a sanitary craze, and the combination is indeed formidable as an industrial force.

READY ACCEPTANCE OF MACHINERY.

The outstanding difference between the workers of America and of England is, of course, that the former have always readily accepted machinery. The result of this in the second and third generation is a general mechanical sense, the equal of which I have never seen anywhere. The existence of this peculiar national qualification explains the ready market which is to be found for all sorts of new devices, patent gadgets, system stunts and time- and labour saving appliances which could not exist anywhere but in America. The American workman is as keen on doing things quickly as the Englishman is on sharing a job with a pal. I walked through many factories and never saw anything hand lifted; overhead carriers, magnetic hoists, travelling cranes and electric trolleys are as common as spade and shovel.

EFFICIENCY AND PROHIBITION.

In the matter of his person, the American workman is proud to be efficient. I was a week in New York wondering where the working classes hid themselves. I saw nobody that could be classed as a labourer. I moved about in buses and subways, trolley-cars and overheads, and never found a suit of clothes contact with which would be likely to soil my best travelling rig-out. After a week I discovered the secret. The American working man from the top to the bottom, goes to work and comes home in his best clothes. He changes for his work or puts on overalls if his work is dirty; he wears gloves; before he leaves at night he generally takes a bath, almost always a shower, and turns out for his homeward journey like a member of the Stock Exchange. I paid a visit to the gallery of the cheapest music-hall I could find on Manhattan Island, and I thought I was in the dress circle at H's Majesty's. Incidentally, this personal efficiency goes a long way to explain the absence of classes on the railways of America. There is no need for them. The risk of getting the dust from a coal-heaver on to one's white waistcoat simply does not exist over there. The length to which this determination to secure personal efficiency has gone is, of course, shown by prohibition. Prohibition is nothing but an efficiency scheme. Notwithstanding all that is said to the contrary, I found it working well, and I found everybody enthusiastic about it. I did not discover any earnest temperance advocate anxious to abolish liquor for moral reasons; I found none of the old teetotal arguments; in fact, most of those with whom I discussed the matter looked upon prohibition as a sort of serious joke; but it gave them more production, and no argument could appeal more strongly to the American worker than that. Prohibition is, therefore, in my judgment, an assured success from the American point of view, and there is no risk of a change of policy. It is without question the most serious industrial force in the world to-day.

THE SANITARY CRAZE.

The sanitary craze is the latest development of the science of efficiency. You cannot be efficient unless you are clean and healthy, and the Americans are determined to realise that ideal. Thus it comes about that all the drinking fountains, and there are many, many thousands of them in the dry climate of those lands, have been altered, and every one of them fount upwards. Cups are no longer necessary. When requiring refreshment you put your mouth over the upward fountain, and take the water without the slightest risk of contamination. In railway stations, hotels, and clubs where the water comes from filters and other receptacles, you are provided with individual envelopes or individual paper cups, so that each drinker uses his own receptacle once. The length to which this same idea has been carried is in no way better illustrated than by the horse-drinking troughs of New York State. There is no longer a trough, but a receptacle, and each horse shall drink from his own individual bucket, and thus avoid the risk of glanders.

HABITS OF PUBLIC VEHICLES.

The difference between ourselves and the Americans in this matter of personal efficiency is brought out by the habits of the common

people as one travels about in public vehicles. It takes not half the time to load and to empty a tram in New York that it takes in London; everybody enters at one end and alights at the other, and it is not necessary to placard the vehicle with frantic instructions to ensure this simple time-saving practice. Even better, the travellers who desire to alight, move to the end of the car before it reaches the point at which they wish to leave it. The motor speed limit is 30 miles, reduced, if you please, to 15 miles in the thickly populated parts of the city. This is only possible because people cross the road in an efficient manner. Motor-drivers in England know all too well that on approaching a female figure they must put their foot upon the brake until they have assured themselves as to which direction the lady is likely to take at the critical moment; the motor-driver in America can forge ahead at his 30 miles, confident that the American woman will take care of herself.

THE IDEA OF SERVICE.

The efficiency idea breaks out in another way, which they call "Service." The word "service," strange to say, is used by this capitalistic, individualistic people on every possible occasion. Everything is a service, every man is out to render service, every service is boosted as an improvement on some other service; indeed, the country is full of service. When it comes to office, warehouse, or factory these dual notions of efficiency and service form a combination which makes things run at a pace and with a smoothness which cause the heart of the Englishman to sink when he thinks of the disgruntled conditions at home, and the way in which ideals of a very different kind are operating to destroy both efficiency and service.

SOME CRITICISMS.

It is easy to criticise. The American has by no means succeeded in reaching the highest forms of efficiency. He interprets the term to mean time-saving, and that is about all. Time is not only with him the essence of the contract, but it is the contract itself. The universal race after efficiency in the time sense leads to shoddy work. A good proportion of the mass production of America is shoddy work, looked at through English spectacles. When I made that point I was told that the work was good enough for its purpose, and no doubt it was. The subject of discussion was a moving-machine which had been dipped into a pool of paint, and had bubbles and blobs all over it. I was told that the paint was there to keep off the weather and not to provide the buyer with a work of art. He wanted to cut his grass, and the machine would perform that function satisfactorily.

CHEAPNESS AND PRODUCTION.

The American workman, no doubt, likes efficiency because it pays him; measured either in money or in values, he is even to-day the best paid workman in the world. His money, after all the recent drastic reductions, is still at least twice the highest rates paid in England. Although prices are high, very high, he gets enough to enable him to buy some sort of a motor-car, and to secure an interest in, if not complete ownership of, his house. Notwithstanding this, I am of opinion that American labour is cheap, far cheaper than our labour. An American worker may get twice the money, but he produced four or five times the goods. He does not work as hard as the Englishman, but he applies to his job a point of view which is utterly foreign to us; he accepts gladly and readily any suggestions for speeding up, and is the most persistent force in the land hammering for production.

The American workman is not organised, and this is often represented as due to the power of capital. I question that. He is not organised because he does not feel the need of organisation. He is the most independent, self-respecting, self-assertive, high-minded creature that it has been my pleasure to meet, and if he wanted organisation he would "damned well have it." If he thought he would get anything by it, he would be organised 100 per cent., but having found that he can lead the world in the matter of wages, social position, and prestige without the aid of organisation, it makes no particularly strong appeal to him. He finds that efficiency and production serve him better.

In such circumstances, it is for us to consider how long we shall be able to stand up against such forces, and what will happen to us when the American becomes efficient in other matters as well as time-saving. We still have British quality to our credit, but a nation which will gladly accept prohibition in the interests of industry cannot be long before it will absorb the quality idea also.

Sir George Beilby on Fuel Problems of the Future.

There is a good deal of justification for the contention on its physical side is based on fuel. This inter-relation has developed new features during and since the war and the future production and use of fuel has become clearly associated with social ideals which involve the raising of the standard of living among the mining classes. The most pressing of the fuel problems of the near future is, therefore, whether coal can be produced at a price which will enable this country to take its place in the markets of the world if the present standards of wages and working hours are maintained. Careful students of the economic facts of the situation tell us that this is impossible. To regain a place in the iron and steel markets of the world we are assured that coal must not cost more than 18s. to 20s. per ton. For the great transporting services of the country a slightly higher cost of coal might be faced if all the available measures of economy in the use of fuel are effected.

It is obvious then that without a greater increased output per man the earnings of the miners cannot be maintained at their present figure or there must be co-operation between coalowners and miners so that if a permanently higher cost of fuel has to be faced its availability must be correspondingly increased.

THE QUALITY OF COAL AS AN ECONOMIC FACTOR.

In this connection the quality of coal when raised to the surface and distributed, a matter which, at present, is entirely in the hands of the mineowners and the miners, is of the greatest importance. The decrease in quality which has recently taken place has affected most adversely the operations of both gas and electricity undertakings. In the latter, coal costs have been trebled since 1914, largely, no doubt, owing to the direct rise in the price of coal, but also to a substantial extent, to the deterioration in quality of the coal supplied. In the case of the Central Electric Supply Company, for instance, the calorific value of the coal received for thirteen weeks in 1920 averaged 10 581 B.Th.U. The cost per ton was 45/2d. and the ash content was 18·4 per cent. The weekly ash figures ranged from 16·3 to 20·1 per cent. In the winter of 1914-15 corresponding figures were: calorific value 10 800 B.Th.U., cost per ton 14s. 6d., ash content 13 per cent. This means not only the transportation of from 5 to 10 per cent. of inert material from the pits to the power station, but extra cost in handling and disposing of the ash clinker at the station.

THE VITAL INTERESTS OF CONSUMERS.

The time has therefore come when the vital interests of the consumers must be regarded. These interests require that the mineowners and the miners alike must realise their responsibility does not end with the output of raw materials at the pithead and its distribution to consumers. For, in whatever way it is consumed, what counts is its thermal value, and though it may seem revolutionary to pay the miner by the therms he sends to the surface, he cannot logically ignore the effects on the consumer and on the nation at large of the permanently increased cost of fuel which must result if his claims for a higher standard of living are to be realised. If the miner is to have a steady amelioration of working conditions and if more efficient methods of using fuel are to be worked out it can only be on the condition that there is genuine co-operation between coalowners and miners, not only in the organisation of output on modern lines, but in an endeavour to sort out and prepare that output by screening and washing at the pit head, so that the consumer only pays carriage on the actual fuel value received. Gas and electricity undertakings are certainly entitled to press home the fact that, as the consumers of gas and electricity only pay for the therms or units received, they should pay the coalowners and miners on the same basis.

PROSPECTS OF FUELS OTHER THAN COAL.

After considering the application of this argument to the iron and steel industry and pointing out the rapid increase there has been, especially in Germany, in the winning and use of brown coal and lignite so that coalowners and miners of this country would be well advised to keep an eye on these developments, the lecturer discussed the likelihood of the greater development in the use of various sorts of oil fuel, especially with regard to the restrictions placed by the Customs authorities on the free use of alcohol for this purpose. He also pointed out that though great hopes were placed on the use of peat as a fuel, the fundamental difficulty of winning that substance in quantities sufficient to meet the day-by-day requirements of any large central station was generally ignored.

COAL LIKELY TO BE THE FUEL OF THE FUTURE.

Considering of these facts led Sir George to the conclusion that coal is likely to remain the chief source of fuel not only in Great Britain but in the world at large. Problems of its winning, preparation and use will, therefore, occupy the foremost position in all

the problems of the future. In the solution of these problems there is ample scope for the skill and enterprise of an increased number of fuel experts and engineers not only in pioneering work on experiments and enquiry but in the organisation and development of new methods.

THE GREATEST FUEL PROBLEM.

The greatest fuel problem of the future is to decide what proportion of the present output it will pay to subject to a preliminary operation of carbonisation or gasification with the object of sorting out the potential thermal units of coal into groups of higher availability or greater convenience as fuels. Such a treatment might be more than compensated for by the increased value of some of the new fuels obtained and especially in replacing the higher form of driving motor spirit by much less expensive fuels. The most hopeful prospect in this direction appears to be based on the designing of small suction gas producers with definite types of solid fuel such as anthracite, low temperature coke, wood charcoal and peat charcoal. The production of a solid smokeless fuel for domestic purposes by the carbonisation of selected coals at 550° to 600°C. is also a matter of importance, as, if this smokeless solid fuel could be produced at a cost permitting of its being sold at little more than the price of coal, which it would replace, it would lead to a complete revolution in domestic heating and, among other good things, to the abolition of black smoke from house fires.

A TECHNICAL AND ECONOMIC QUESTION.

The problem really has two sides, the technical and the economic. On the economic side the data for a final solution will only be obtained if the technical solution has been reached, and, on the engineering side, when an efficiency of not too costly apparatus can be designed and constructed in the working of which manual labour, fuel consumption and maintenance costs are all reduced to a minimum. Only when this ideal has been realised practically can the future of low temperature carbonisation as a business proposition be put to the test of continuous working on a large scale under the labour and market conditions of to-day. This applies equally to the application of low temperature carbonisation to raw coal which is used in industry. When coal is used for steam raising under the best known conditions it is obvious that there is little to be gained in thermal efficiency by any preliminary sorting out of the thermal units of the coal into fuels of higher availability. In fact, solely from the steam raising point of view thermal loss and not a gain would result from the operation, though, in certain cases, the loss might be compensated for if a local market for the rich gas were available. In most cases this margin of profit would be too small to justify the extra capital expenditure which would be required. As Mr. Brownlie has shown, for steam raising in this country the cheapest form of fuel is coal or coke if it is used under reasonably scientific conditions, and, so long as this is the case, the use of fuels of higher availability will only be economically practicable under very special conditions.

COAL STILL THE CHIEF FUEL.

It appears, therefore, that coal is likely to remain for a long time the world's chief fuel, though its more efficient use may be secured by its more careful preparation at the mines, by improving boiler firing on well-known lines, by sorting out its combustible constituents into fuels of higher availability or convenience, by preliminary carbonisation carried out either at high or low temperatures. The development of oil shales as a source of liquid fuel is still only in its initial stages, but has evidently a great future before it. Though the problems of utilisation of peat are mainly of local importance and are not likely to affect the fuel supplies of the world to any great extent, the production of alcohol on a really large scale bristles with economic and technical difficulties and it is still too soon to pronounce an opinion on the possibilities of the future. The main factors in all these problems on their technical side are probably capable of solution by the skill and application of the industrial pioneers of the world. The most difficult of the fuel problems of the future are those into which the human element enters so largely. At home, the relation of the wage-earning classes with the actual leaders who initiate and direct our industrial policy, and, abroad, our relations with other nations who are equally interested with ourselves in the natural resources of the world, are profoundly affected by the spirit of the time. This spirit, as it is manifesting itself to-day, is vital to the progress of reconstruction and development on any extensive scale, and we, whose chief interest in life lies in the control and use of the powers and resources of nature for the service of man, can only continue to do the work next our hand, while we cherish the hope that the better side of human nature, which we know is only temporarily overshadowed, will gradually re-assert itself.

will be noted in the illustration a further stop screw (*h*), and this, together with the screw (*g*) previously referred to, are the only adjustments necessary. The adjustment of the limiter in fact is exceedingly simple and can be carried out by practically inexperienced people quite readily.

It will further be noted that in addition to the limiting device proper, the case contains the lamp resistance (*f*), the two single-pole fuses (*j*) and (*k*), a terminal board (*l*) (for connection on the loop-in system), and a sealing chamber (*m*) (for use where lead-covered paper cable is employed); in addition an earthing clamp (*n*) is supplied. Therefore the case, which is exceedingly robust (being made of cast iron), contains absolutely all that is necessary in order to give service to a consumer. It is unnecessary for the Supply Authority to buy separately the limiter, the fuses, sealing chamber, &c., and to mount them all upon a separate board and to inter-connect them. Fig. 2 shows view of the interior of the limiter.

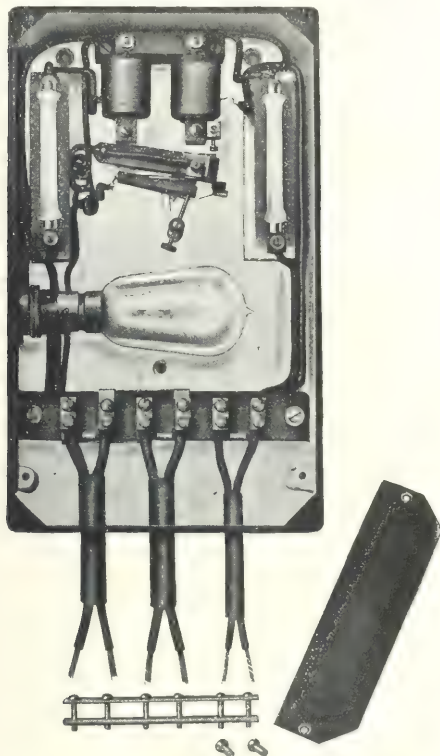


FIG. 2. THE EDISON LIMITER WITH COVER REMOVED.

Of course all Supply Authorities do not use the loop-in system, but at least one corporation which uses this system in combination with the Edison limiting device states that they can by this means give service at *one half pre-war cost*. Such a result in itself would be sufficient to commend the Edison current limiter to the serious consideration of all Supply Authorities, when considering a supply to housing schemes, thus ensuring a reasonable revenue from the small user, sufficient to justify the capital outlay necessary to give him a supply.

Substantial progress has been made by Marconi's Wireless Telegraph Company with their preparations for carrying out wireless telephony experiments between BIRMINGHAM and LONDON. A station is being erected at Frankley Boreas, a few miles from Northfield, and although work did not begin until May 2, already two of the three masts have been completed. Each "mast" will be 100 ft. high. The hill on which they are erected is about 800 ft. above sea-level, so that the total elevation of the aërials will be 900 ft. The new station will work in conjunction with the existing one at Hendon.

The Work of the National Physical Laboratory.

The annual report of the Executive Committee of the National Physical Laboratory for 1920 opens by recording the appointment of Sir Arthur Schuster, F.R.S. to the position of Vice-Chairman of the General Board, vacated by the death of Lord Rayleigh. It also records the retirement from the membership of the Executive Committee of Sir Alfred Kemp, F.R.S., who since the foundation of the Laboratory has acted *ex-officio* as treasurer.

SIR RICHARD GLAZEBROOK AND THE LABORATORY.

Action has been taken during the year to provide a fitting tribute to the work done at the Laboratory by Sir Richard Glazebrook in the form of a bas-relief portrait in bronze to be executed by Cluysenaar, of Brussels. This will be erected in the main administrative building.

The erection of various new buildings for which sanction was received during the year is now well advanced. These comprise a substantial addition to the engineering department, an extension of the tank building, and some alterations to the electro-technics building. An underground range for experiments on the flight of projectiles is also to be provided. The space available at the Laboratory for further extensions is very limited and the future needs are therefore receiving careful consideration.

CO-ORDINATION OF RESEARCH.

In connection with the co-ordination of the Research Boards for Physics, Chemistry, Engineering and Radio work the fullest possible use of the facilities for research at the Laboratory are to be made use of, and as a first step the Admiralty decided to ask the Laboratory for accommodation for their own experimental work in physics closely adjoining the National Physical Laboratory. This building is now in course of construction. The Committee welcome this arrangement as highly conducive to efficiency and economy.

It is clear that the demands of these Boards will tend to increase the research programme of the Laboratory. A scheme of radio research to be carried out at the Laboratory has been drawn up and approved by the Radio Research Board. The Physics Research Board recently constituted had indicated certain lines of research which it is considered desirable should be taken up at an early date.

THE WORK OF THE STAFF.

Attention is called to the service rendered by members of the Laboratory staff on various boards and committees. These attendances occupy a not inconsiderable amount of time, but the services thus rendered are of importance both to the Laboratory and to the public, as such Committee work serves to keep the Laboratory in touch with the most recent technical developments in all branches of its activities.

THE WORK OF THE YEAR.

Owing to the loss of Mr. F. E. Smith's services on appointment as Director of Scientific Research at the Admiralty, the work in the electricity department on primary electrical standards has been largely in abeyance. Various improvements have been made in methods of measurement of condensers and inductances. Much work has been done in radio standards, measurements of effective resistance at radio frequencies, on the testing of magnetos and magnetic materials, and on the devising of a method for measuring the effective permeability and energy losses in thin sheet iron at radio frequencies.

ELECTROTECHNICS AND PHOTOGRAPHY.

In the electrotechnics division the demands for tests of apparatus for power measurements have been considerable, and in view of modern developments the equipment for such tests needs to be extended. The maintenance of the existing equipment involves much investigatory work and some improvements in method have been introduced. In the direct current section progress has been made with the researches on buried cables and on resistance materials. In the photometry division the work done includes experiments on ships' navigation lamps, on miners' lamps, on motor-car headlights, with the appropriate Government departments, while an investigation has also been carried out with a view to improving the lighting of some of the galleries of the National Portrait Gallery, while experiments are in progress with the same end in view on the lighting of public buildings and offices. The Laboratory has also carried out investigations with regard to the lighting of the House of Commons. Though unfortunately little time has been available for the measurement of new high efficiency standard lamps this is a matter of some urgency.

THE ENGINEERING DEPARTMENT.

In the Engineering Department further results of interest have been obtained in the research on lubricants and lubrication. The investigation of the D. partment of the boundary of a fluid in turbulent motion has led to the conclusion that there exists at the boundary a layer of fluid of finite thickness which is in lamina-motion and has zero velocity at the boundary. The measurements of skin friction near the surface of thin plates exposed to a current of air are being continued. Progress has been made with the research relating to hardness and wear tests and the research on the mechanical properties of insulating materials.

MAGNETOS AND SEASON CRACKING.

Among the special investigations have been tests on magnetos in connection with fire prevention on aircraft. In the department of Metallurgy and Metallurgical Chemistry a large amount of work of a fundamental character has been done in connection with light alloys, while the phenomena of season cracking has been further investigated. Researches relating to iron and steel have been in progress, and a large amount of work has been done in the investigation of causes and failure and the difficulties arising in the industrial applications of metals.

WORK PROPOSED FOR 1921-22.

With regard to the work proposed for the year 1921-22, in the Physics Department it is proposed to continue the work at present in progress on the question of X-ray measurement, particularly such matters as dosage and hardness, while an examination of the wave form of coil discharges will be undertaken. Researches into the absorption of X-rays, radiometallurgy, the relation between the total ionisation of a beam of X-rays emitted by a bulb and the ionisation produced in a short chamber and the investigation of luminous compounds and piezo-electricity and its application to measurements of pressure will also be undertaken.

PRODUCTION OF RADIO-FREQUENCY OSCILLATIONS.

In the Electrical Department experiments are to be carried out to obtain information relative to the production of radio-frequency oscillations from the shortest wave-lengths used up to 20 000 meters. The equipment when set up in its final form will be a permanent installation using a three-electrode valve from which undamped oscillations of any frequency may be obtained immediately for the calibration of wave meters and general radio measurements. To extend the range of the standard wave meter a new design of variable condenser has been got out using amber insulation, and a specially wound inductance coil of 20 millihenries has also been designed and is under construction. This coil is for the standard wave meter and will be of a minimum resistance and self-capacity and permanent. The range of the wave meter will be extended by this condenser and inductance coil nearly 20 000 metres wave-length. A very complete mathematical investigation has been made into the effective resistance of radio frequencies of various types of coil such as are used in wave meters and other radio apparatus. The results so far obtained show very good agreement with the experimental results by other investigators, but further experiments are desirable to find the mathematical formulae for flat coils and for regions of frequencies not covered by other investigators. It is proposed to carry out a comparison of primary standard marble mutual inductance with the absolute ohm as determined by Mr. F. E. Smith in order to locate discrepancies which exist in the present comparisons.

It is hoped to construct an Abraham-Bloch multivibrator as a standard radio-frequency and to carry out the method of comparison by the help of a special Braun tube. Investigations into the errors in which alternating current measuring instruments are liable, into dielectric hysteresis and into the development of the measurement of power at radio frequencies will also be made. At the request of the Air Ministry an investigation into moulded insulating materials is to be made, while the research on magnetos for aircraft engines will be continued.

Books Received.

Copies of the contents of this column can be had from THE ELECTRICIAN, Offices on the Strand, London, W.C.2.

"Dielectric Properties of Solids." By Dr. A. Bolliger. (Berlin: Julius Springer.) Pp. 82. 18s.

"Exponential Made Easy." By M. E. J. Gheury de Bray. (London: Macmillan & Company.) Pp. x+253. 4s. 6d. net.

"Engineering Directory," May, 1921. (London: Engineering, Ltd.) Pp. 120.

"Dielectric Properties of Solids." By N. A. Halbertama. (Berlin: M. Krayn.) Pp. 62. M. 20.

Miners' Electric Safety Lamps.

The Safety Lamps, hereinafter issued by the Mines Department under the name of "Type G.I." are given for the consideration of the new miners' electric safety lamps which have been approved for general use.

THE PEARSON LAMP.

The Pearson Lamp, Type G.I., comprises a case of pressed steel, with a false bottom of steel shrunk thereon, fitted with a bayonet-joint for the attachment of the cover.

(1) A cover or lantern of steel. The lamp bulb is protected by a glass, held in position by four pillars of steel, with a crown of steel, to which a handle ring is attached. Electrical connection with the bulb holder is secured by two strips of brass cast and embedded in a disc of non-inflammable insulating material which is fastened to the underside of the cover by two screws and retains the bulb holder and protecting glass in position. The cover is fitted with a bayonet-joint for attachment to the case and is locked thereto by either a magnetic or a lead plug lock. Electrical connection is made with the battery when the cover is in position by turning it to the right, and broken by turning it back again; or the contacts may be so arranged that connection when made cannot be broken again until the lamp is unlocked.

(2) A battery or accumulator of the nickel-iron alkaline type, giving when fully charged, 2.5 to 2.7 V., with a current capacity of not less than 6 Ah, with a voltage drop to not less than 2.25 V. The case of the accumulator is of steel.

The total weight of the lamp is not to be more than 4½ lb., and the lamp must have been made at the works of the Alkaline Miners' Lamps, Ltd., Stratford.

THE ADAMS LAMP.

The "Adams" Hand Lamp has (1) A cylindrical metal case, to which the cover or lantern is attached by means of a screwed metal ring within, closed at the bottom by a screwed base plate.

(2) An acid accumulator with celluloid casing and fixed spring terminals so constructed as to prevent escape of any liquid whatever the position of the lamp. The accumulator has a capacity of not less than 16 Ah, with a voltage drop to not less than 1.85.

(3) A cover or lantern containing the two lamp bulbs, each with a current consumption of 0.8 A, connected in parallel with a plate of unflammable insulation material in which are embedded segments of brass; these establish electrical connection between the lamp bulbs and the accumulator when the lamp is assembled. The bulbs are protected by a cylinder of thick glass and by metal pillars and crown piece.

(4) A magnetic lock which secures the baseplate to the case when the former has been screwed into position, and so constructed that the bolt can only be withdrawn by applying the pole of an electric magnet to the face of the lock.

The total weight of the lamp is not to be more than 6½ lb., and the lamp must have been made at the works of Messrs. Adams Bros. (Longton), Ltd., at Longton.

THE PATTERSON LAMP.

The Patterson Lamp, Type G.I., has (1) a case of pressed steel, with or without a false bottom of steel shrunk thereon, provided with a screwed ring for the attachment of the cover or lantern.

(2) An accumulator with celluloid case, fitted with a special device for preventing the escape of liquid whatever the position of the lamp, whilst allowing the escape of gas generated by chemical action. The battery has a capacity of 12 Ah, with a voltage drop to not less than 1.8.

(3) A cover or lantern of brass or steel with screwed ring for attachment to the case. The lantern carries (a) a lamp holder on a disc of insulating material in which are embedded contact plates to make electrical connection with the battery when the lamp is assembled; the insulating disc can move against spiral springs enclosed within the glass retaining ring; (b) a lamp bulb, which has a current consumption of 1.0 A; (c) a glass to protect the bulb; (d) a glass retaining ring and pillars and crown protecting the glass.

(4) The lamp may be locked with either a magnetic or lead rivet lock. The light may be switched on and off after the lamp is locked by revolving the case, whilst holding the lantern; or the lock may be so arranged that the light cannot be switched off after the lamp is locked.

The total weight of the lamp is not to be more than 5½ lb., and the lamp must have been made at the works of Messrs. Patterson & Co., Newcastle-on-Tyne.

THE FEDERATION HAND LAMP.

The Federation Hand Lamp has (1) a case of drawn or welded steel, lead lined, containing circular positive and negative plates surrounded by a semi soiled or "dry" electrolyte. The plates and electrolyte are retained in position within the case by a cover of steel (or other suitable material), fitted at the centre with an insulated (positive) contact piece, and having a filling orifice and gas vent. The negative contact is a brass square-threaded screw ring which serves also for the attachment of the cover. Provision may be made for withdrawing the positive elements of the accumulators, without removing the whole of the cover. The capacity of the accumulator is not less than 6 Ah with a voltage drop to not less than 1.85.

(2) A cover or lantern of brass, steel or iron, fitted with a square-threaded brass screw ring, for attachment to the case, protected by an outer vertical flange. The cover is fitted with a plate of non-inflammable insulating material carrying the lamp bulb, outer glass and centre plunger contact (or, contact pieces may be provided if a switch is desired, the positive contact being placed eccentrically). The bulb has a current

consumption of 0.65 to 0.70 A. The outer glass, either of well or "dome" pattern, is protected by a crown of iron, or brass supported by pillars of iron, steel or brass; or an inverted U-shaped bridle may be provided to the top of which a disc, eyelet and carrying ring, of steel or brass, is attached.

(3) A magnetic lock. The total weight of the lamp is not to be more than 5 lb. 14 oz., and the lamp shall have been made at the works of the Federation Lamp Company, Sheffield.

THE OLDHAM CAP LAMP.

The Oldham Cap Lamp has a lens of tempered glass and an accumulator. The case is of metal, having two flat parallel sides and semi-circular ends, and it is closed by a hinged lid which can be locked by a lead rivet or a magnetic lock. The lid is provided with a fuse and metal contact pieces, embedded in an ebonite plate, which established electrical connection between the lamp bulb and the accumulator, a flexible cable leading to the former and the latter being fitted with fixed spring terminals. The accumulator is of an acid type with celluloid casing constructed as to prevent escape of any liquid whatever its position, the electrolyte being either liquid, semi-solid (jelly) or absorbed by glass or wood wool. It has a capacity of not less than 6 Ah with a voltage drop to not less than 1.85.

(2) A flexible cable of rubber covered twin insulated wire firmly attached to the lid of the accumulator case and to the lamp bulb fitting; at each point of attachment the cable is protected by wrapping it with steel wire.

(3) A lantern containing the lamp bulb, so arranged as to be capable of being carried on the head in a fitting secured to the front of the cap of the user. The bulb has a current consumption of 0.7 A. It is fitted with a reflector and is protected by a lens or a plate of glass held in position on the lantern by a screwed metal ring, locked by a lead rivet.

A belt is provided to which the accumulator case can be secured, either at the back or at the side of the user. A switch may or may not be provided, either at the accumulator case or at the lantern.

The total weight of the lamp is not to be more than 5 lb. 9 oz., the weight of the accumulator and its case being not more than 4 lb. 4½ oz. without acid, or 4 lb. 11 oz. with free acid, or 4 lb. 11½ oz. with jellac. The lamp must have been made at the works of Messrs. Oldham & Sons Ltd., Denton.

Correspondence.

CONDUIT VERSUS CASING.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: The question of the superiority of conduit over casing for the protection of electric wiring introduced in THE ELECTRICIAN of June 3rd, is a matter of considerable interest to me, whose opinion has, for some years, coincided very closely with the views expressed by "Electricity."

My own experience has been largely derived from a district where the regulations seemed unwisely inconsistent, in that they absolutely vetoed the use of casing; but any advantage in reliability that might have been secured by this means was entirely negated by the permission to use slip conduit, which is not only much inferior to heavy gauge screwed conduit, but is even less safe than wood casing itself.

The question as to the relative merits of screwed conduit and casing is not one that can be dismissed off hand with a bare statement, and it may, therefore, be worth while to consider the question according to the criteria of first, serviceability; second, appearance; and third, cost.

NEW WORK AND EXTENSIONS.

There are two distinct conditions under which wiring is to be carried out. One of these is that of a building in the course of erection, in which electric light is installed concurrently with the building operations. Here the wireman has a virgin field in which to place his wires. They can be enclosed in the walls, which are actually built round them, and they can be placed below the floors before the latter have been constructed. In this case there is no doubt whatever that heavy gauge screwed conduit is the best solution. Its installation is rendered easy by the practical absence of obstructions, sharp bends may be eliminated, as there are no awkward corners that must be negotiated; while the attachment to and transit through the walls is a simple matter. The screwed conduit provides a complete and mechanically perfect enclosure for the cables, at a minimum demand of skill, and probably of cost also.

A PERMANENT SYSTEM.

A wiring system has thus been built up which is absolutely permanent, which protects the wires completely against

mechanical damage and moisture, which is not damaged by fire, and which is more fireproof than any other system, and the cost as carried out is not excessive as compared with other methods. The

The second condition is that of an existing building. Here a different state of things exists altogether. If conduit is used throughout, many difficulties are met with. To obtain the best results a great number of floor boards must be taken up, walls must be drilled and plugged, and surface pipes, revolving shafts, angles and sockets are necessary.

In a brick house, of which the partition walls are usually made of brick also, the conduit can either be run over the surface, when the appearance is unsightly in the extreme, or the plaster and the brickwork can be channelled to conceal the conduit, involving extensive redecoration after wiring is completed.

A GENEROUS ALLOWANCE OF DEFECTS.

Thus the result is a compromise between the evils of high cost, unsightliness and poor work; and in the case of too many small installing firms, when left to their own devices, the product consists of a generous allowance of all three defects, especially the last. It seems to require an exceptional workman to carry out mechanical work well, and also to preserve the appearance of a home interior, including the integrity of the floor boards.

Under such conditions the casing system affords great advantages, in that it may be run over the surface of the walls, to which it can be attached with comparative ease, without ruining the decorative effect of the building. Its great defect is that it is difficult to support, when situated below the flooring, in such a way as to ensure the permanence of the joints. The latter are not efficient mechanical unions as with screwed conduit, but really depend for their strength upon the support to which the casing is attached; and when this support is non-existent the joint is flimsy in the extreme, and apt to be dislocated by the first shock to which it is exposed.

Unfortunately, when the work is concealed, as it is below the floor, the old principle that what the eye doesn't see the heart doesn't grieve after, comes strongly into operation, and such work is likely to be scamped to the danger of the building. The celebrated "nail" danger also exists, although I quite agree with your contributor in considering this to be over-rated.

Special points of weakness exist with casing where the wires have to pass through walls and ceilings, in that the covering is usually not made continuous. A good job is not by any means impossible under these conditions, but there are many varieties of poor jobs which an indifferent workman is apt to employ, with unfortunate consequences.

CASING AS INSULATION.

As regards insulation, casing offers the great advantage that a further barrier is interposed between the conductors located in opposite channels. The wires are not drawn in and are therefore not likely to damage during insertion. Joints between conductors are of no particular detriment when made in casing, although they are not justified in view of the advantages of looping in.

Thus the conclusion is reached, when wiring is contemplated in an existing building, that conduit is better where the work is concealed, as for example below the floors; while the casing has the advantage where it is to be attached to walls or ceilings. Thus a composite system is indicated in which each method is employed in its appropriate place.

THE QUALITY OF CONDUIT.

All is not plain sailing, however, even by adopting this compromise, unless the work is done by competent labour. The men must be skilled at both pipework and wood jointing, although the variety of operations is small, and these requirements should be comparatively easy to fulfil. The great enemy of good wiring is deliberate scamping. Capping and flooring cover a multitude of sins, and where there is no

threat of inspection, the temptation to take advantage of the prospective concealment in order to omit necessary precautions and safeguards is too strong for many consciences. The fact that a dual system is in use opens the way to two sets of abuses which chiefly appear at the junctions of conduit and casing, as, for example, where the wire penetrates the ceiling or walls. It is not a very uncommon experience to find that the cable has been left absolutely bare at these points, unless a firm of high standing has done the work.

COMPLETE COVERING ESSENTIAL.

Now if covering is at all necessary, it is essential that it be complete. It is true that bare cables may exist in a building for years without their being eaten by rats, or being short-circuited by nails, or encountering the other insidious dangers against which casing and conduit have been specified; but this does not excuse the omission of these safeguards even at awkward parts of the system.

The purchaser is handicapped in securing a sufficiently good job in that there are apparently no standard methods of overcoming the number of little difficulties that are met with. There are many text-books written on the subject of wiring, but one usually seeks in vain for any mention of these really vital features. There is a great need for a standardisation committee to lay down methods of overcoming these small problems, for example, that of wiring behind a skirting board, and in other doubtful places where trouble is apt to occur. Personally, I am satisfied if the conduit penetrates a substantial wood block in contact with the ceiling, floor, or wall, and if the casing makes efficient contact with the front side of the partition in question; provided the end of the conduit is suitably belled to obviate chafing of the insulation.

SLIP CONDUIT UNJUSTIFIED.

No further mention has been made of slip conduit as the writer considers that its use is quite unjustified, in that it is impossible for even a good workman to effect a satisfactory job with it. However well the grips may be tightened at the

time of installation, the ordinary vibrations to which buildings are subjected will be sufficient to loosen most of the joints in the course of a few years. The result is that the tubes part company, and the vibration now expands itself in sawing the edges of the two tubes into the insulation. Thus this form of conduit should be condemned.

From the above discussion, it will be seen that the conclusions arrived at, though not quite the same as those of your correspondent, are yet generally in accordance with his views. In my opinion the subject is of great importance, in view of the very large number of installations that are in existence. The general standard of work seems to be sufficiently low to warrant attention being given to it at the present time, and this has influenced the writer in making these comments.—I am, &c.,

Birmingham, June 25.

W. WILSON.

MONEY FOR NOTHING.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Judging from the account given of them by "Electrocynic" in his article in your issue of June 17, the electrical manufacturers of this country must be of all men most gullible and philanthropic. Apparently their one object is to pour money into the laps of undeserving, and, in many cases, antagonistic, contractors.

May I be forgiven for suggesting that "Electrocynic's" experience in the electrical showroom was a somewhat unusual one, and may I enquire whether his nether limbs were the same length when he came out as when he went in?

Your correspondent asks for information and I would ask him to consider that by allowing the contractor a discount off a fixed list price the electrical manufacturer is affording to the consumer protection which, as in the case of the sale of the carpet, is not afforded in other trades where there are no fixed list prices.—I am, &c.,

Putney, June 25.

H. C. MARGRETT.

London Electricity Inquiry.

Financial Details and the Conference Scheme.

During the week the Electricity Commissioners continued their investigation of the schemes for the improvement of the electric supply organisation in the London and Home Counties Electricity District.

FINANCIAL DETAILS.

Mr. C. D. JOHNSON, Comptroller to the L.C.C., said the capital for new plant for grouped and other stations was treated as having been provided for in course of being raised. The charges on capital of the existing undertakings he had worked out as 7.82 per cent., 7.12 per cent. in the case of local authorities and 8.23 per cent. for companies. The whole thing was calculated on original cost. The figure of 9.5 per cent. for new capital had been worked out by taking interest as $\frac{1}{2}$ per cent., sinking fund as 2½ per cent., and 6½ per cent. as the rate at which local authorities could borrow. Undertakers could only claim compensation to the extent to which their position was worsened. He agreed that the words "substantial increase" might be added to the provision as to compensation in the event of increase of cost of current, to provide against frivolous claims. The Joint Authority could advance money to local authorities and the L.C.C. could come to its assistance under the terms of the Bill before Parliament. The income from the sale of current was estimated at £5,800,000, and that would meet the expenses of generation and capital charges on existing capital at present rates and on the new capital. The financial situation was improving; capital could be raised more easily and cheaply than it could have been 12 months ago. The difference in the rates at which a company and a local authority could raise capital was, he thought, between 1 and 1½ per cent.

THE EFFECT OF THE ELECTRICITY BILL.

Replying to Mr. TURNER, he agreed that the L.C.C. scheme depended on the passing of the Electricity Bill, but he could not state the extent to which the Council would give financial assistance to the scheme in the event of the Bill passing. New capital of 9½ millions would be required in the second stage. It should be raised by stock or bonds. Clause 49 of the L.C.C. scheme might be amended by adding a provision that in the case of capital which would not be immediately remunerative, the period of repayment might be suspended for five years. If the present undertakers were secured in the possession of the distribution powers they would have no claim to compensation. The distributing part of the

companies' business only lasted until 1931, so far as any certain tenure was concerned. The proposed heads of agreement by which the distributing powers would be extended beyond 1931 looked very generous. He had no objection to the principle of clause 15 of the Conference scheme which provided that the Ministry of Transport might order that a distributor's undertaking should be transferred to the Joint Authority if the distributor failed to give reasonable facilities for the supply of energy. In the L.C.C. scheme it was contemplated that the cost of production and transmission should always be covered by the price charged. There was a clause in the L.C.C. scheme providing for meeting deficiencies out of reserve. He agreed with the principle of Clause 43 of the Conference scheme that deficiencies should be met by authorised undertakers in the area in proportion to the value of the annual amount of energy supplied.

To Mr. KENNEDY, witness considered the terms proposed for the purchase of the Companies' undertakings were fair. He would like to consider further before replying to the question whether there was any objection to granting a lease to the Companies.

THE L.C.C.'S REPRESENTATION.

Interrogated by Mr. DONALD (for Poplar) Mr. JOHNSON said the Electric Lighting Clauses Act of 1899 made provision for the application of any surplus, and the L.C.C. were satisfied with that. It meant that the money would be disposed of as directed by the Minister of Transport.

Witness admitted to Sir HERBERT NIELD that the North Metropolitan Company was doing very well in regard to the supply to Hertford and St. Albans, and he thought the Watford Council was doing better still. The question whether the Council had it at the back of their minds to take over the distribution as well had not been reached yet. At the moment they were dealing with the generation. In regard to the representation of MIDDLESEX, and other county councils, on the Joint Authority, the constitution of the Authority might be altered at any time with the approval of the Electricity Commissioners.

In regard to a question, asked on behalf of the RAILWAY COMPANIES, whether, in the event of the local authorities not wishing to contribute, the Joint Authority could raise its capital, on the security of its undertaking, cheaper than the railway companies, witness said he did not think it would have any substantial advantage. He did not think the local

authorities would be induced to pledge their rates unless they saw something material to be got from it. A fifth of a penny per unit was not a small advantage, and it was not merely a matter of price, but the benefit of having an adequately considered and concerted scheme for supplying the whole of the area with electricity.

Sir JOHN SNELL mentioned that even a tenth of a penny per unit was something in the neighbourhood of a million pounds.

THE BASIS OF THE AUTHORISED UNDERTAKERS' CONTRIBUTIONS.

In response to inquiries by Mr. ARCHER, witness admitted that, according to the scheme, the METROPOLITAN ELECTRIC SUPPLY COMPANY would have to contribute to the administration expenses of the Joint Authority. It was not an easy matter to decide whether the contributions of the undertakers should be on the basis of the number of units bought from the Joint Authority or the number of units sold by the undertakers. He could not put forward any tangible benefit to the Metropolitan Company.

Mr. JOHNSON, in response to Sir Harry Haward, said the capital expenditure of the London companies at the end of 1919 was 16½ millions, and their annual provision for reserve and depreciation funds amounted to about £500 000. The reserve and depreciation funds at the end of 1919 amounted to 3½ millions. At March, 1919, the capital expenditure of the local authorities was 12 millions, and, allowing for some £300 000 sinking fund in hand, the loans outstanding were £7 335 000. The local authorities set aside £435 000 for repayment of loans in the year ended March, 1919. If that continued for five years, the amount written off by both the local authorities and companies would be about 5 millions. Cheap capital was a vital factor in securing a cheap supply for the area. According to the tables, 40 per cent. of the cost per unit consisted of capital charges, or 0.474d. By the time the first capital station was erected it was hoped that capital could be obtained more cheaply, and therefore that the proportion of capital charges would be much less. The amount of the capital expenditure at the beginning of the second stage would probably be from 40 to 50 millions. If the L.C.C. and other County Councils gave a guarantee for capital the money would have to be raised by a precept on the local authorities. He thought that the L.C.C. would prefer to have the co-operation of other County Councils, but it would not prevent them from going on if one or two of the others remained out. He agreed with a suggestion that had been made at an inquiry previously held by the Commissioners that local authorities who pledged their rates in support of the scheme should have favourable treatment in regard to the price of a bulk supply. According to his estimate the Joint Authority if they raised capital without the security of the rates could do it at slightly less than 1½ per cent. higher than if they had such security. The Authority would be faced with capital charges of 9 per cent., including sinking fund of 2½ per cent. He accepted Sir Harry Haward's statement that the Yorkshire Electric Power Company's and the Nottinghamshire & Derbyshire Power Company's capital charges were 12½ per cent.; he thought that the County of London Company's capital would have been raised, as a whole, at less than 10 per cent. They proposed to spend four millions on their Barking station. Their return on their capital was 7 per cent. on the debentures, 7½ per cent. on the cumulative preference, and something over 10 per cent. on the ordinary shares. He thought they would get their new capital at less than 10 per cent.—probably at 9 or a little more. Last year the company put aside for depreciation 2 per cent. That made the total 11 per cent., compared with 9 per cent. in the case of the Joint Authority. The G.E. and L.B. & S.C. Railways would hardly be likely to raise capital for electrification at anything like 6½ per cent.; it might average more than 8 per cent. He thought the sinking fund period for the Joint Authority should be as long as possible, in order to keep down the price of electricity. Capital charges in the case of the London companies were nearly twice as much as in the case of the local authorities. Broadly speaking, the terms of acquisition by the Joint Authority would be capital expenditure, less depreciation of buildings and plant.

RATING OF UNDERTAKINGS.

Mr. F. HUNT, valuer, said the rateable value of the whole of the electricity undertakings in the County of London, over 20 000 kW capacity, was about £200 000. It worked out at 30s. 5d. per kilowatt per annum on the whole undertakings for generation and distribution. The rateable value per kilowatt on generating stations of over 20 000 kW varied considerably—from 10s. 5d. per kilowatt up to 26s. 5d. per kilowatt for the half-year—the average being about 15s. 4d. The average for all generating stations, both over and under 20 000 kW, would be about 14s. 3d. In arriving at the average rate on the 633 000 kW, which it was proposed should be transferred to the Joint Authority, he would take an average figure of 16s. per kilowatt, giving a total rateable value of £475 000. The rates in the £ had probably reached their high-water mark in the second half of the year 1920-21, when the average rate in London was about 16s. per year. For the first half of 1921-22 the average was equal to 15s. 9d. per kilowatt. In 1925 he had taken the average rate as 15s. in the £. At present, undertakings were assessed as a whole. In the case of undertakings owned by the Joint Authority the rating might be dealt with on the contractors' basis, entirely on the capital cost, but rateable value, as a rule, was less than capital charges.

In response to questions by Sir Harry Haward, Mr. JOHNSON said in addition to the risk of increase of assessment when the generation and distribution were separated there was also the risk of increase when an electrical undertaking was extended into another parish. Each parish would assess the sections of mains separately. The rating of trunk mains was on the five per cent. basis, not valued on the distribution side, but on the indirectly productive side.

This closed the case for the London County Council scheme.

THE CONFERENCE SCHEME.

Mr. SYDNEY TURNER, in opening the case for the Conference of Local Authorities owning electricity undertakings in Greater London, said the Conference had been in existence a good many years—before the Act of 1919 was passed—and had endeavoured to make themselves familiar with the problem of electricity supply in the area which was now being considered. Every Metropolitan Borough was included except Poplar, all the three County Boroughs in the area were members, and all the other boroughs were members except Reigate, as were all the Urban Councils, except Watford, who wished to be excluded. The kilowatt capacity of the undertakings of local authorities who were members was 199 751, and of those not represented by the Conference 18 160 kW. The statistics as to number of stations, units sold, capital expenditure and population were in about the same proportion.

CONSTITUTION OF THE JOINT AUTHORITY.

The Conference seemed to be in agreement with the L.C.C. and other schemes that it was desirable that the Joint Authority should be a comparatively small body.

The Conference proposed that the representation of the local authorities and companies should be equal (12 for each), and that the latter should be divided in the proportion of two for the purchasing authorities to each one for the companies. The scheme also proposed that there should be three seats for representatives of large consumers and of labour, and possibly two additional seats, if the chairman and vice-chairman were elected from outside. Under the L.C.C. scheme the authorised undertakers had only 12 out of 28 or 29 members.

THE QUESTION OF CONTROL.

He submitted that clause 14 of the L.C.C. scheme dealing with control, was *ultra vires*. The Act of 1919 provided that undertakings might be transferred to the Joint Authority in the event of failure of the undertakers to carry out certain requirements, but no such undertaking should be transferred except with the consent of the owners.

Sir JOHN SNELL said if all the local authorities except four had agreed to the technical scheme, which embodied the clause in effect, it did not matter what form of words was used.

Dr. NEWMAN (for Groydon) said a number of authorities who were members of the Conference had put in objections to the Conference scheme in so far as it could be said to be compulsory.

Sir JOHN SNELL remarked that he did not think a scheme would satisfy the Commissioners which only gave a pious promise that something would be done in the future; there must be some guarantee that the scheme was going to bring about a real improvement.

Mr. TURNER said section 19 of the 1919 Act provided for mutual assistance during the period between the passing of the Act and the establishment of the Joint Authority, and the scheme bringing the authority into existence should make that mutual assistance permanent. He hoped to satisfy the Commissioners that the terms of the Conference scheme were sufficient in regard to the provision that in certain events, the Minister of Transport might order the transfer of undertakings. The Conference would not oppose the erection of a station for supplying railways if the railway companies guaranteed a sufficient demand for a given period. With regard to the Poplar scheme, there was nothing in the Conference scheme which would prevent the Joint Authority considering the proposed district in sections. Poplar's objection to the scheme was that the proposed linking up would be to their injury, but Poplar was proposing to treat its neighbours in the same way. The Conference would be content to leave the question of the inclusion or exclusion of certain districts in the hands of the Commissioners, except that they objected to the exclusion of Middlesex, which comprised Ealing, Willesden and Chiswick.

THE VIEWS OF THE CONFERENCE.

Mr. DUNCAN WATSON, chairman of the Conference, confirmed Mr. Turner's statements as to the history and objects of the Conference. According to the proposed method of representation on the Joint Authority, if a local authority had a population less than 10 000 it would be represented through its county council. The Conference was against acquisition of generating stations now, because raising money at 6½ per cent. to take over stations which had been equipped by means of capital raised at 4 per cent., or less, would, to some extent, defeat the object of the scheme. Some local authorities in the East of London and also certain undertakings in the West End had already linked up and had demonstrated the saving in cost of plant and coal that could be effected by that means. Every use should be made of existing stations before spending one penny on capital stations or even extending existing stations. The question could only be dealt with effectively and permanently by a co-ordination of all the interests—company and local authority. He thought the tenure of the companies should be extended, that could be arranged so that they came into line in something like the conditions of the Gas Light and Coke Company. He did not see why their terms of tenure should not be extended indefinitely. The local authorities, with four exceptions, were willing to raise the necessary capital under their existing powers, and to submit to the Joint Authority's control in regard to linking up, &c.

Commenting on Mr. HENDERSON, he stated that the Joint Authority could not exercise its functions properly unless it had decisive control in certain matters. The Joint Authority would be an effective link between the Commissioners and the distributors. When the distributors disapproved of the decisions of the Joint Authority there should be a right of appeal to the Commissioners, and he did not think that would make the scheme unworkable. When the capital stations were erected those difficulties could not arise. According to the con-

the Authority could only consider supply in the part of the local undertakers' area in which the undertaker had failed to supply. It would be unfair for the unremunerative part to be left to the Joint Authority. As far as he knew the local authorities would have no objection to transferring their stations to the Joint Authority, provided the rates would justify it.

THE LONDON TRANSMISSION

Replying to Sir JOHN SNELL, a witness said the Conference would not agree to the Joint Authority taking over the local authorities' stations on the terms of the Authority relieving them of their capital charges. That did not, in their opinion, represent reasonable terms. The local authorities had paid a much larger amount in sinking fund and interest than other bodies had written off for depreciation.

To Sir HARRY HAWARD witness said the Conference had passed a resolution expressing the opinion that reasonable terms of purchase of local authorities' undertakings would be the payment of the unexpired portions of the loans, or cost, less depreciation, whichever was the greater.

Witness admitted that clause 45 of the Conference scheme gave very large powers, but many of them were necessary for the scheme. Representation was given to local authorities who were not undertakers and had no purchase rights because they were representatives of consumers, and they might assist in matters of finance. The City of London was put in because it was the purchasing authority of a portion of one undertaking, and also because it might assist financially. That purchasing right passed to the L.C.C. if not exercised by 1928. It was proposed to pay the chairman and vice-chairman of the Authority, and also pay compensation to the members for loss of remunerative time.

By Mr. KENNEDY, the Conference did not suggest any terms of purchase of the companies, as it had not considered the matter. The Conference did not desire to swallow up the companies without reasonable compensation. In addition to cost, less depreciation, there should be some further valuation. It was not intended that the local authorities should take over the generating stations during the interim period.

THE PROVISION OF CAPITAL

He was of opinion that the local authorities could provide the capital for new plant, for linking up and accessory operations. It was more than a pious hope that the members of the Conference would raise the capital.

Sir HARRY HAWARD said by implication the Conference had assumed that the rates would be pledged. They had assumed that the capital would be raised with the collateral security of the rates, because the estimates that had been adopted were based on a rate of 6½ per cent., and that rate could only obtain if the Joint Authority had the collateral security of the rates.

Mr. DUNCAN WATSON said the Conference would not object to the companies taking the place of the County Council representatives, provided there were equal representation between the local authorities and companies. He did not agree that those who found most money should have the preponderating voice. A large insurance company might find money, and they should not have a preponderating voice. Representatives with experience of the industry were required.

LINKING-UP AN ADVANTAGE

To Mr. DONALD, witness said the fact that linking-up had been done in London would not be a difficulty, but an advantage. It would be unfair to charge the cost of linking-up on the authorities who had already done their linking-up. The intervening links would be taken into account, and the undertaker would get the benefit of it. The Conference would not accept an amendment to the effect that where a number of local authorities promoted a combined scheme and could satisfy the Commissioners that they were large and numerous enough to absorb the activities of a capital station they should be allowed to set up such a station. It would perpetuate an unsatisfactory state of affairs.

THE CONFERENCE'S POLICY

The Conference in 1918 disapproved of the idea of grouping together the company interests and also grouping the local authorities' interests, each group operating in its separate sphere. It would undoubtedly cost less to administer electricity in London under the Conference scheme or the L.C.C. scheme than it cost now. As to the saving in administration, when the capital stations were built and the other stations shut down the local authorities would not retain their technical staffs doing nothing. He thought that in the early stages the administrative staff could be run on an expenditure of £20,000 a year at the outside. If the East London authorities were allowed to set up a committee for their district, the whole of the proposed area under the Conference scheme might be sub-divided into different districts, and the objects of the scheme might be defeated. The area delimited by the Commissioners had been decided upon after having heard the views of the different authorities interested. He admitted that before the Conference scheme was drawn up the Conference passed a resolution to the effect that any combination of municipal and company interests presented so many difficulties that immediate action in the formation of an administrative scheme could not be taken unless the interests of municipal and company undertakings were kept, as far as possible, distinct. At that period they had not entered into discussions with the L.C.C. and ascertained on what basis it was possible for the companies to be brought into the scheme. It was then thought that compensation for the capital of the companies would involve too much expense, but under the arrangement now proposed all that went. In the future there might be as good a load factor in the west end as in the east.

In answer to the representative of the ELECTRICAL POWER ENGINEERS' ASSOCIATION, he agreed with Mr. Hume that one of the three repre-

sentatives of large consumers and of labour on the Joint Authority should be a member of the technical staff.

Mr. BAGLEY, for the Middlesex County Council, said they had been under the impression that they were precluded from putting forward a scheme for a variation of the area delimited by the Commissioners, but he now asked for and obtained permission to put forward some new proposals which would be largely on the lines of schemes already submitted.

In reply to Sir HERBERT NIELD, Mr. DUNCAN WATSON said he did not know any authority in Hertfordshire which adhered to the Conference scheme. He agreed with previous witnesses that under the L.C.C. or the Conference scheme supply could be given in Hertfordshire more cheaply than it was done at present. He could not see why Watford did not want to be included in the scheme, and he thought it only required proper explanation to induce Hertford and St. Albans to wish to be included.

INCIDENCE OF COST OF MAINS

Replying to Dr. NEWMAN, WITNESS said there was nothing in the scheme stating how the bulk current charges were to be made. The load factor, maximum demand and other particulars had to be considered. Even on the question of charges there was the right of appeal. It would be cheaper to supply West Ham than Croydon, even assuming the same load factor. Croydon would have to pay the interest and sinking fund for the capital spent for the convenience of Croydon.

MIDDLESEX COUNTY COUNCIL'S ATTITUDE

On the resumption of the proceedings on Thursday last, Mr. WROTESLEY (for Middlesex County Council) said as there were features in the Conference scheme which appealed to his council, he would probably be in a position to withdraw his objection if the scheme were modified in certain respects. The Middlesex Council had not submitted a scheme, as it had understood that the area could not be varied, and not having submitted a scheme was, strictly speaking, precluded by Section 5 of the 1919 Act from being heard at the Inquiry.

Sir JOHN SNELL said the Commissioners would be pleased to hear Mr. Wrotesley's cross-examination of witnesses, in which he could elucidate the Council's position.

Replying to Mr. BAKER (for North Metropolitan Electric Supply Company), Mr. DUNCAN WATSON said under the L.C.C. scheme the company would have to contribute to the Joint Authority's expenses in the preliminary stage in the proportion that the company had an output of their own. Under the Conference scheme it was intended that those should pay who took a supply.

Mr. TURNER said such payments would come from authorised undertakers and consumers taking bulk supplies.

To Mr. BAKER, Mr. Watson admitted that the larger a distributor's business the greater would be his contribution to the expenses of the Central Authority, even if he were getting no benefit from it. He did not agree with Mr. Rider's statement that for many years the North Metropolitan Company would get no benefit from the Central Authority. Mr. Rider, however, did not bind himself to any period. Assuming the hypothesis that it would get no benefit for many years to be correct, it would be unreasonable that the company should be compelled to contribute to the expenses.

REPRESENTATION ON THE JOINT AUTHORITY

He agreed that the allocation of seats on the Joint Authority was based on the assumption that four of the company seats should be regarded as local authorities' seats, because of their right of purchase of the company undertakings. As the North Metropolitan Company's undertaking was not purchasable, that might necessitate amendment of the representation.

Cross-examined by Mr. HENDERSON: The Conference would not mind whether the representatives of local authorities other than undertakers were representatives of County or District Councils. It was never intended by the Conference that London should be divided into four areas of supply, but that there should be four district committees. He did not approve of a separate area being formed in the East End. Clause 14 of the L.C.C. scheme was, in his opinion, indefinite and too drastic. Croydon and Kingston were the only authorities who had raised their objections in the form of demanding a right to be taken over. Those were not the most economical stations, and would probably be amongst the first to be shut down under the scheme. The intention was that charges for bulk supply would be on a zone basis. The cost of a main trunk line passing through several authorities' districts would not be put upon a particular authority.

PLEDGING THE RATES

The Conference had not passed a resolution that the local authorities should pledge their rates in support of the scheme, but he was satisfied that they would do so.

Sir HARRY HAWARD said he did not think Mr. Watson's statement that the local authorities would raise capital for the Joint Authority quite answered the question. At present the Metropolitan boroughs got most of their money from the L.C.C. Would Maylebone, say, borrow money from the L.C.C. and lend it to the Joint Authority? Surely the matter would resolve itself into the Joint Authority getting its loans guaranteed by the London and possibly other County Councils?

Mr. WATSON admitted that probably Sir Harry Howard was right in saying that on the basis of capital outlay, plant installed, output, &c., the companies' representation should be in the proportion of three to two as compared with the local authority representatives. The Conference held that the companies and the purchasing local authorities should be regarded as one for representation purposes. There was no

reason why the North Metropolitan Electric Power Company should not have a vote in the representation of it and when it came under the purview of the Joint Authority. The L.C.C. refused to transfer their franchise rights to the Joint Authority. The Conference would not agree to this. The L.C.C. should only have one representative instead of three. In that case the other two seats would go to the companies. He admitted that it appeared from that that the principle of regarding the local authorities as freeholders and the companies as leaseholders and allocating seats on that basis was not very sound. He agreed that in districts where local authorities were not the electricity undertakers the County Council were the proper representatives of the consumers.

MR. HADLEY HAWKES said it appeared from the County Council's attitude contemplated it would necessitate considerable alteration of the constitution of the Authority. If Middlesex had representatives, Surrey, Kent and Essex would also demand them.

MR. WATSON agreed. The Conference did not object to revision of the representation. With regard to the representation of labour, in addition to one labour representative, probably labour would also be strongly represented amongst the other members, as there were labour majorities on many local authorities. He was absolutely clear that the expenses of the Joint Authority during the preliminary period must fall on the industry—the authorised undertakers.

THE CONTROL OF UNDERTAKINGS

The London County Council representatives thought the interim period could not be successfully negotiated unless control were exercised in the terms of the L.C.C. clause 14. But local authorities' undertakings had been interlinked satisfactorily without any supervision, and when the local authorities and companies got together for similar purposes he was sure a good deal of the existing prejudice would disappear, and it was worth while modifying the terms of control for the purpose of bringing them into line.

In answer to MR. PAGE, WITNESS said it was estimated that the administration expenses in the first stage would only be about half what was estimated in the original scheme. At least half those expenses would be for a skilled engineering staff, and therefore any increase in those expenses would be in proportion to the growth of the load. The conference agreed in principle with the L.C.C. clause 14, but felt that it might go too far. Clause 14 would only come on in the second stage, and would not necessarily have to be enforced. If the good will of all parties was secured, he saw no reason for putting the clause into language such as that. He would agree that the provision in clause 14 might be put in, so that it might be applied if necessary. The conference scheme had in view the entire renewal of the Joint Authority every three years. He agreed that it would be desirable to renew a third of the members each year, so as to secure continuity of policy.

Interrogated by MR. LACKIE, MR. WATSON said there was no reason why eight stations interlinked should not work as satisfactorily as two. It had been found in practice that the engineers of stations so connected worked harmoniously; but if an authority could be superimposed to direct their co-operation that was just what the conference wanted.

Witness informed SIR JOHN SNELL that 34 authorities were members of the conference. Of these, Bromley Rural, Twickenham Urban and Slough Urban Councils had not approved the scheme. The Electricity Committees of Southwark, Hammersmith, Shoreditch and St. Pancras had recommended their Councils to approve the scheme, and all the remainder had already approved it.

THE COMPANIES' TENURE

The conference had not considered the question of giving extended tenure to the companies in the event of their agreeing to make certain extensions of their plant. The conference left that to the County Council and to the Joint Authority when formed. He would go so far as to give perpetual tenure to the companies if it rested with him, on similar terms to those of the Gas Light & Coke Company. He thought that was the only satisfactory solution of the problem. It was essential and urgent that some general principles should be laid down as soon as possible in regard to the terms of transfer of the generating stations of both companies and local authorities. If the Commissioners were satisfied that the engineering scheme was a proper one for the district under consideration, and if they recommended some amendments of the representation on the Joint Authority, the loyalty of the conference could be depended upon to accept the commissioners' impartial decision.

MR. WORDINGHAM ON CONTROL OF UNDERTAKINGS

MR. C. H. WORDINGHAM said he agreed that automatic control of the undertakers was necessary. It would be desired by those operating a Joint Authority. Everybody who was endeavouring to frame a scheme under the Act of 1919 was faced with a very serious difficulty, because the Bill on which the Act was founded, whatever its demerits, was a coherent consistence whole. Most of the contentious clauses were dropped out of the Act, with the result that those framing schemes had to do what the Bill contemplated without having the tools provided for them. Clauses 15, 18 and 21 of the conference scheme gave a considerable amount of control, but not automatic control. The Engineering Committee took the area laid down by the Commissioners and devised what they conceived to be the best scheme for that area. They assumed that the Commissioners wanted a large area, and that they considered the area delimited was one in which improvement could be effected. Four factors had to be borne in mind: The capital expended to date, additions to plant now on order, present day costs and present-day prices. These considerations led to modifications of the scheme compared with what might have been the policy before the war. There was an important difference in the two schemes of erecting capital stations and of linking

stations. The first scheme was based on the assumption that the capital expended to date was the only capital expended, and that the only capital expended was the capital expended to date. The second scheme was based on the assumption that the capital expended to date was the only capital expended, and that the only capital expended was the capital expended to date. The first scheme was based on the assumption that the capital expended to date was the only capital expended, and that the only capital expended was the capital expended to date. The second scheme was based on the assumption that the capital expended to date was the only capital expended, and that the only capital expended was the capital expended to date.

Authority could do it. They could use single units of the most suitable size for their load, and they could defer provision for depreciation. Mr. Wordingham then gave figures showing the estimated total demand at different stages, and the plant that would be available. He said if the general supply and the railway supply were generated in a common station or system of stations, and the railway supply were given from that system, the average cost of the whole supply should be the lowest possible, but he thought the railway companies could generate their own supply for a lower cost than they would have to pay for their share of the cost of the combined station. The general supply benefited by the combination with the railway load, but the railway lost by combination with the general supply.

MR. JOHN SNELL'S STATEMENT

He agreed with SIR JOHN SNELL that there was a general saving if the two supplies were merged under one roof, but the railway company lost on the combination. These extra charges must be greater if the railway company had to pay towards the cost of the transmission system of the general supply, he thought they must be shared amongst all consumers. There would be a better load factor in the railway generating station than in the joint station; therefore the capital charges per unit would be less.

At the conclusion of Mr. Wordingham's evidence the case for the conference scheme closed, and MR. KENNEDY addressed the Commissioners on behalf of the companies' scheme.

MR. W. L. KENNEDY, Secretary of the London County Council Electricity Supply Company, and chairman of the Committee of Companies promoting the scheme, gave details of the inception of the scheme, its objects and the methods proposed to attain them.

A New Secondary Battery for Telegraph Work.

It is well known that one of the most costly methods of producing electric currents is by means of primary batteries, since the total quantity of chemical energy included in a supply of yielding material, while often limited and unreplaceable, is relatively high.

It has often been suggested that extensive application of which primary batteries have found in telegraphic, telephone and railway signalling installations, is a most important factor in the substitution of this



FIG. 1. A NEW SECONDARY BATTERY FOR TELEGRAPH WORK.

method of apparatus, which is necessary in such circumstances. Owing, however, to the special conditions under which accumulators have to operate in these installations, a very great number of their charges for long periods with practically no utilization, the ordinary storage cells would have to be recharged every two to three weeks, even when they stand on open circuit do not meet requirements, with the result that the maintenance of these accumulators is greatly restricted.

With the invention of the "Depot" secondary battery, described by Messrs. F. G. Lums & Co., however, the problem has been solved. It is claimed that this battery is so constructed that it can be charged and discharged as often as required, without any loss of capacity, and that it can be used for long periods of time without any need for recharging.

longer, without being recharged or filled—depending, of course, upon the work it is called upon to do.

The "Duros" cell, however, has other distinctive features which greatly add to its usefulness. It is, for instance, the only accumulator which is ready for discharge when filled with dilute sulphuric acid, without requiring the usual tedious "first charge"; after complete discharge it can be recharged in the ordinary way. Its electrodes will not buckle or cause internal short circuits. It has incorrodible and non-interchangeable terminals. Its solid construction will appeal to all experts. It will operate satisfactorily for many years in all climates.

The "Duros" cells are made in three sizes, viz., with capacities of 20, 45 and 90 Ah at an intermittent discharge. Their general appearance is shown in Fig. 1. The small and medium sizes are specially suitable for the substitution of Leclanché and dry cells for all purposes, whilst those of the large size are widely used

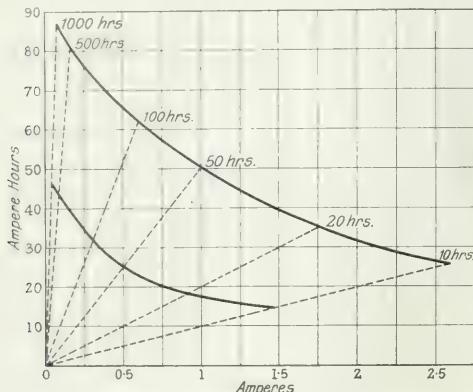


FIG. 2.—CURVES SHOWING PERFORMANCE OF THE "DUROS" CELLS.

in telegraph, telephone and railway signalling installations. The cell consists essentially of a strong glass box, provided with special grooves in which the massive plates (one positive and one negative) are rigidly mounted and to prevent evaporation of the acid, the box is sealed. The terminals of the large-sized cell extend well above the top of the container and are composed of a special acid-resisting material, so that the trouble usually experienced, of corrosion with metal terminals, is avoided. Another point is that the polarity is marked on the terminal screws, and as an additional precaution these are of different sizes, so that it is impossible to interchange them.

Owing to the high voltage of the "Duros" cell as compared with the ordinary primary cell, a saving of about 40 per cent. of space is effected, which is a consideration if many are in use. The operation of the Ad and AC₂ type of "Duros" cells at various rates of discharge is given in Fig. 2.

Engineering at the Royal Agricultural Show.

A feature about the Royal Agricultural Show at Derby, which was opened on Tuesday last and remains open until to-morrow, is the very extensive display of engineering exhibits prepared by Messrs. AGRICULTURAL & GENERAL ENGINEERS, LTD. As is well known, this is an association of a number of firms who, for many years, have been concerned in this branch of engineering, and the exhibit generally enables a very good idea of what is being done by them in this field to be obtained.

The exhibits include the "Bull" electric light and power plant, which is especially designed for farm, estate and country residence work. It is robust in construction, simple in design, and reliable in operation. It should, therefore, prove of considerable value to the agricultural community as it is suitable not only for lighting purposes, but for driving all types of machinery, either direct or through the medium of an electric motor.

The PAXMAN wood refuse gas producer, which is suitable for burning sawdust, wood chips, &c., and producing sufficient gas to drive a 65 B.H.P. plant, is also shown, and there is a selection of the same firm's well-known steam and gas engines and steam boilers on view.

Messrs. RICHARD GARRETT & SONS, in addition to showing their

well-known traction and semi-stationary engines, exhibit a 2½ ton electric vehicle and a steam trailer wagon and sleeping van.

Electric motors and parts manufactured by the A.G.E. ELECTRIC MOTORS, LTD., and other of the associated firms, are also to be found on this stand.

Not only are the exhibits interesting, but the general appearance of the stand deserves some special remark, the colour scheme being carried out effectively in yellow and brown. The display generally is an excellent illustration of what can be done in centralising exhibits on such occasions, and forms an example which might well be widely followed.

Another 33 000 V Cable.

Messrs. JOHNSON & PHILLIPS, LTD., are among the firms which have recently been engaged in the manufacture of a 33 000 V cable. The cable in question was manufactured at their Charlton works for an important northern steel undertaking. Fig. 1 shows a

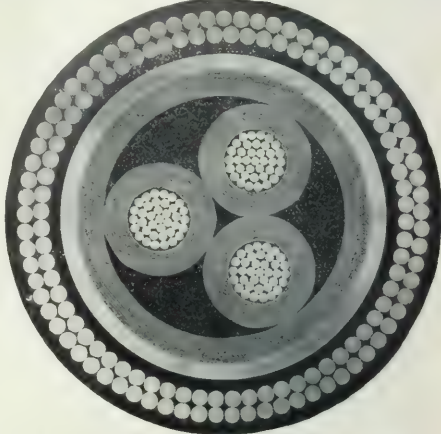


FIG. 1.—SECTION OF 3.02 SQ. IN. 33 000-V CABLE. (Johnson & Phillips, Ltd.)

section of the cable, which has three cores, and is designed for a working pressure of 33 000 V three-phase. The insulation is paper and a lead covering with double steel wire armouring served and compounded is provided. Each of the conductors is 0.2 sq. in. in section, and there is a thickness of insulation between the cores of 0.5 in. and a similar thickness between the cores and lead sheathing. Each of the galvanised steel armouring wires is 0.16 in. in diameter.

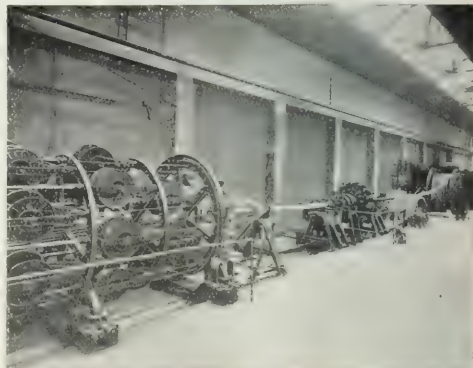


FIG. 2.—LENGTH OF CABLE IN THE FINAL STAGE OF MANUFACTURE.

and the cable is embedded in compounded jute between the lead and the armouring, as well as between the two layers of the armouring wires, and is finally served over all with jute yarn and heavily compounded. The weight of the complete cable is 72 lb. per yard.

Fig. 2 shows a length of the cable on the machine in the final stage of manufacture—i.e., being double wire armoured and served. This view gives a good idea of its size.

Wireless Novelties.

A demonstration of several interesting wireless novelties was recently given by R. M. RADIO, LTD. (whose name is derived from its founder, Mr. H. R. Rivers-Moore), at their new premises, 5, Regent-square, Gray's Inn-road, W.C.

The exhibits included the "R.M.R. Triode," the "Thermagnion," a development of the above, and the R.M.R. wireless tape machine.

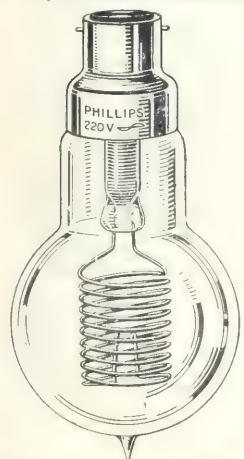
The R.M.R. triode valve*, which is due to Capt. H. de A. Donnis-thorpe, differs from the usual type of valve in the arrangement of the filament and metal sleeve. The ordinary type of thermionic valve commonly utilises a horizontal spiral filament with a cylindrical metal sleeve. In the R.M.R. valve the filament is connected to a metal network forming a cap of a sphere. Concentric with this and above it is a cup-like metal surface of similar shape. The advantage claimed for this arrangement is that the ionic stream is more efficiently utilised, the number of ions repelled sideways and escaping being much diminished. It is stated that the efficiency is 50 per cent. above that of the ordinary valve and furthermore that owing to the substantial and relatively rigid form of the filament-network, there is less liability to extraneous noises from mechanical vibration.

In the "Thermagnion" an interesting attempt is made to secure increased magnification of the effect by enclosing the valve in a flat solenoid. This is fed from a battery and has approximately 600 A turns. The steady flux induced being coaxial with the valve, the stream of ions is concentrated downwards and the tendency to straying is diminished. Demonstrations of this effect were given, observers noting a substantial increase in sound when the coil was brought into position or when the current through it was increased by cutting out adjustable resistance in the magnetising circuit. It is stated that a magnification of 100 to 200 per cent. can be obtained in this way, so that a single R.M.R. valve may replace three of the ordinary variety. The effect is compared with the influence of the earth's field in deflecting the discharge in the aurora borealis, of which a miniature demonstration was given by bringing a horseshoe magnet near a valve in which a luminous discharge was evident.

The third novelty shown, the R.M.R. wireless tape machine, is stated to be due jointly to Mr. H. F. H. Haynes, of R. M. Radio, Ltd., and Mr. V. Ramage, of the Central News, Ltd. The apparatus transcribes on an ordinary tape machine wireless messages received from Paris, Moscow, Portsmouth, &c. and it is hoped that it will prove particularly useful to newspapers.

The Phillips Night Lamp.

An interesting electrical nightlamp has been placed on the market by the SLOAN ELECTRICAL COMPANY. It consists essentially



GENERAL VIEW OF THE PHILLIPS NIGHT LAMP.

of a spiral about 1½ in. long and 1 in. in diameter, which is arranged vertically in a bulb filled with neon gas. Light is produced by a discharge from this spiral in a similar way to the Moore light or mercury vapour lamp, and the resulting illumination is of a beautiful orange colour with a soft rich effect. The rating of the lamp is about 5 W. and its life is said to be considerably greater than that of the ordinary metal filament lamp. It is supplied for alternating-current circuits from 110 V upwards, and for continuous-current circuits from 150 V upwards, with either bayonet or Edison screw caps. Lamps of this kind should find a useful application in nurseries, dormitories, hospitals, hotels, theatres, etc., as they present a difficult to obtain the necessary reduced illumination without an expenditure of an exorbitant amount of energy. The accompanying illustration shows the general arrangement of the lamp.

A 500 Watt Turbo-Generator Unit.

One of the most interesting engineering achievements of the WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY, East Pittsburgh, U.S.A., during the past year is the development of the 500 W turbo-generator unit. This equipment was made primarily for the purpose of locomotive headlights. One of its great advantages, however, is its adaptability to many other applications, such as industrial and wrecking cranes, saw-mills for furnishing electric light, cotton mills and flour mills, well-drilling apparatus, &c., where there is steam available. In fact, wherever there is a steam pressure of 100 to 250 lb. available these sets can be used to furnish 500 W at 32 V, or at 110 to 120 V if desired—that is, they can provide sufficient amount to light a good sized home, and they are, therefore, also adaptable for farm use where steam is available.

The voltage variation of these sets when working on steam pressures between 100 and 225 lb. is approximately 5 per cent., depending upon the compounding. The no-load and full-load voltage regulation will also be approximately 5 per cent. after the unit has reached full-load temperature. However, in starting, the machine may reach approximately 5 or 6 V above normal, but will quickly adjust itself when the full-load temperature is reached. Some of these units have been sold for furnishing 110 to 120 V instead of 32 V. This besides necessitating changing the winding of the generator requires some additional field resistance.

Electrically Operated Gramophones.

In a recent issue we suggested the operation of gramophones electrically as an outlet for the activities of the fractional horse-power motor. It is obvious, however, that this is not the whole of the problem, and that some ingenuity must be exercised in providing the necessary automatic link between the motor itself and the delicate gramophone mechanism. We are therefore interested to see this matter has already been gone into in this country, and that the object of a recent invention by Mr. C. J. BARNETT is to provide an automatic means for starting the motor by means of the tone arm and equally for stopping it when the desired point on the record has been reached, as well as to provide efficient illumination for operating the instrument at the commencement of the record. The arrangement of the mechanism is novel in as much as all the essential parts of the instrument are combined so as to form a complete unit capable of being played apart from the cabinet in which it is usually contained. The actual assembling into the cabinet is a comparatively simple matter all adjustments being carried out in the manufacture of the unit which is marketed by ELECTRIC GRAMOPHONES, LIMITED.

DETAILS OF THE ARRANGEMENT.

The body of the starter, as it may be called, consists of two aluminium castings in the larger of which is formed the sound duct. The motor is of the series type with laminated pole and operates direct on a 50 V circuit. For higher pressures a carbon filament lamp is used as resistance and this lamp provides illumination on the face of the record by means of a periscope reflector. Automatic control is effected by means of a two-way switch, which is operated by a spring controlled lever depending for its movement, against the spring tension, on a projecting pin which is rigidly connected to the tone arm by a vertical tube. Through this tube passes a setting rod, the upper end of which is used to place a friction tight tripping member in the position for stopping the mechanism. When starting the gramophone the cabinet lid is raised. This causes the rod to rise, its lower end being connected to the spring controlled bell crank lever. The front edge of the bell crank lever presses against a lever which moves the switch contact to a midway position. The motor is now short circuited and the lamp directly connected to the supply so that a beam of light falls on the record at the point of the needle. This latter is placed in the last groove of the record and while resting there the milled knob is rotated in a clockwise direction bringing the lower end of the setting rod against the projecting end of the friction tripping member which in turn is rotated on its drum until the finger comes to rest on the stop. The tone arm is now moved to the sound box, a button on the side of the pin is pressed, the switch lever to the right, putting the motor in series with the lamp across supply terminals and the record is then played in the usual way with the cabinet lid closed. In moving the sound box to the edge of the record the friction band is moved bodily on the drum to the right following the motion of the pin and the trigger is moved against the buffer by the light spring, bringing its upper end against projection. This prevents the switch member following the pin to the left as the needle runs down the record in course of playing until the projecting end of the friction band arrives against the trigger when the needle is at the end of the record. By the time the last line is reached the trigger is moved clear of the projection and the switch is then operated by the action of the spring acting on the lever and moving it into the extreme left-hand friction against the buffer. The switch contact being clear of the terminals the apparatus is thus completely disconnected from the supply.

* See THE ELECTRICIAN, June 10, 1921, p. 722.

Legal Intelligence.

Re National Electric Supply Co.

was incorporated in 1889, and the issued capital included 16,345 shares of £1 each. The company had a balance of £1,000 in cash and the remainder would be satisfied by the issue of mortgages secured on the borough rates. Doubts had arisen as to the rights of the various classes of shareholders, but a scheme had been approved at meetings of the shareholders, and the Court was asked to sanction it. The sum as compensation to the directors had been disclosed to the shareholders, the Vice-Chancellor sanctioned the scheme.

An Excess Profit Duty Appeal.

Last week the Court of Appeal (Lords Justices Bankes, Scrutton and Atkin) heard the appeal of Messrs. J. P. Hall & Company, electrical engineers, from the judgment of Mr. Justice Bailhache in favour of the Crown. Appellants, by Petition of Right, claimed to recover the cost of providing a canteen for their workers during the war. They were tried by the Ministry of Munitions to supply adequate facilities for the supply of food and refreshment for their workers, and appellants expected £1,500 in erecting the canteen. The Liquor Control Board recommended that £1,500 should be returned to the firm. When the Excess Profits Duty Act came into force the authorities decided to deal with the matter under that Act and said they would only get 60 per cent. of the £1,500. Mr. Justice Bailhache held that the authorities had treated the matter properly and discharged the petition.

At the conclusion of the arguments Lord Justice Bankes, in giving judgment dismissing the appeal, said that the agreement was that the cost of the canteen might be written off against current profits. Under that provision and the then existing legislation the whole cost would have been thrown upon the Government, but excess profits duty became applicable to suppliants' business before the time came for ascertaining how the agreement was to be carried out. Therefore, instead of the Government paying the whole of the cost, they would only have to pay a portion of it if the essential term of the agreement were complied with—namely, that the cost should be written off against current profits. Therefore, the cost must come out of current profits and not out of the sum payable to the Government by way of excess profits.

Industrial Week-Ends.

The Industrial League and Council is arranging, as in previous years, a number of week-end conferences, and the first of these took place on Saturday and Sunday, June 25 and 26, at Blunt House, Oxford, the residence of Mr. and Mrs. Ernest Benn. Trade unionism and the community was the subject of discussion, opened by Mr. F. S. Button, of the Industrial Court. Among those who attended were Sir George Paish, Sir Ernest Clarke, Mr. G. E. Roberts, President of the National City Bank, New York, Mr. W. J. Richardson, of the Barlock Typewriter Company, Mr. A. R. Stelling, Mr. W. T. Kelly, of the Workers' Union, Mr. T. E. Naylor, of the London Society of Compositors, Councillor Jackson, of the National Union of Railwaymen, Councillor Weaver, of the General Workers' Union, and others. Four sessions were held on Saturday evening and during Sunday.

The Industrial League and Council is anxious to extend this week-end conference movement which for three years has now proved its value. The more opportunities this open for leaders of thought on both sides of the industrial controversy to come together and get to know one another and to thoroughly investigate each other's point of view, the greater the prospect of that mutual understanding upon which alone can we hope to found industrial peace. Mr. John Ames, General Secretary of the Industrial League, 82, Victoria-street, S.W.1, would be glad to receive offers from owners of country houses who would be willing to act as hosts in this connection.

Joint Industrial Councils.

It is announced that the number of Joint Industrial Councils and Industrial Reconstruction Committees established in accordance with the recommendations of the Whitley Committee on Relations between Employers and Employed is now 71. In addition there are over 400 Joint Standing Conciliation, Arbitration Boards or other bodies, representative of employers and workpeople with power to deal with wages questions. This machinery covers about 6,000,000 workpeople.

According to Dr. Macnamara, these joint bodies have proved very successful, and every practicable assistance is given by the Ministry of Labour in the establishment of some such form of conciliation machinery in any case where it does not already exist.

Electricity Supply.

HASLINGDEN Corporation have applied for sanction to borrow £10,000 for mains services, &c.

BRADFORD Corporation has applied to the Electricity Commissioners for sanction to borrow £10,000 for extensions of mains and services.

HULL Tramways Committee recommends that the salary of the Manager (Mr. E. S. Rayner) be increased by £100 per annum as from December last.

STIRLING Corporation has applied for sanction to a loan of £8,700 for additional generating plant, &c. A 300-kW set has been purchased from Hereford at £2,000.

The Minister of Transport has revoked the MIDHURST & DISTRICT ELECTRIC LIGHTING ORDER, 1914, and the BUDLEIGH SALTERTON ELECTRIC LIGHTING ORDER, 1911, as from June 20.

The BRIMINGHAM Finance Committee has sanctioned the proposal of the Electric Supply Committee to raise a loan of £390,000 for part of their extension scheme, to be spread over a period up to 1925.

FOLKESTONE Electricity Supply Company has applied for a special order to enable them to supply electricity in the urban district of Cheriton, in the parishes of Saltwood, Newington and Hawkinge in the Elham, rural area.

HAMILTON Town Council has authorised an expenditure of £9,000 on extensions of mains, services, &c., and, in addition to this sum, sanction is to be sought to borrow £3,000 for prospective expenditure during the ensuing three years.

From the June meter readings, the price of all units of electricity supplied by the SHEFFIELD Corporation electricity department at the 2d. rate and under will be only subject to an increase of 125 per cent. in lieu of 150 per cent. hitherto charged.

The SWANSEA electric supply department has sufficient coal to maintain a supply of electric power and light for two or three weeks more, and the equipment of the plant for the use of oil fuel is proceeding satisfactorily, so that the service is assured for all purposes.

A company has been formed for the purpose of carrying out an electric supply scheme for THORNTON DALE, near Pickering, Yorks. It is proposed to utilise water power for generating electrical energy and the engineers for the scheme are Messrs. Walker & Hulton.

Application has been made to the Electricity Commissioners by the NORTHAMPTON ELECTRIC LIGHT & POWER COMPANY, LTD., for their approval to an arrangement under which the applicants will supply electricity in bulk to the Wellingborough Electric Supply Company, Ltd., and the Rushden & District Electric Supply Company, Ltd.

BURNLEY Electricity Committee has adopted a revised scale of charges for electric current as follows: For power, for first 39 hours used per quarter of maximum demand, increase from 2-57d. to 2-90d. per unit; and for all units above, from 1-75d. to 2-08d. For heating and domestic purposes, from 2-2d. to 2-53d. per unit. Lighting, from 5½d. to 6d. per unit. Traction, 1-9d. to 2-1d. per unit.

HACKNEY (London) Establishment and General Purposes Committee recommend the Borough Council to suggest to the London District Council (Area No. 10) for the Electricity Supply Industry that they should invite the Electrical Power Engineers' Association to membership of the NATIONAL JOINT INDUSTRIAL COUNCIL, so that the whole of the staff in the Electricity Department would be under one body, and it is also recommended that other municipal authorities should support this action.

INVERNESS Town Council has received a report from Messrs. Buchan & Partners on a proposal to establish hydro-electric works for supplying current in an area from Strathpeffer and Dingwall to Inverness and Nairn, and possibly to Invergordon, Tain, Elgin and Lossiemouth. The approximate capital expenditure of the initial scheme is estimated at about £2,300,000, and the output at 85,000,000 units per annum. Current could be delivered in bulk at Inverness at about 3d. per unit and at Strathpeffer and Dingwall at about 1d. per unit.

BRIGHTON Corporation has authorised the use of oil fuel at the Southwick generating station. In a report on the question, the engineer (Mr. John Christie) stated that for some years he had advocated the installation of oil fuel firing for a portion of their steam raising plant. As the chain grates on the boilers are over 10 years old and pretty badly worn out, it will be necessary to renew them at an early date and reconstruct the fire brick arches and linings of the furnaces. This would entail an expenditure out of revenue of at least £3,000, and he considers the time opportune for adapting these boilers for burning oil fuel, and the £3,000 which would have to be spent on renewals could be better utilised on a scheme for oil burning. For the piping, valves, pumps, heating, filtering plant and burners about £4,500 would be required, and suitable oil storage capacity another £2,500. By dismantling the three iron water tanks at North-road works and re-erecting them at Southwick storage tanks for about 350 tons of oil would be provided. The alterations would enable one-third of the present boiler plant to be run independently of coal and in an emergency it could maintain an efficient supply for the ordinary needs of the undertaking. If the boilers were equipped for oil firing at least 5,000 tons of oil would be burnt under them per annum, which would mean a reduction of about 10,000 tons of coal on the present output, and as the harbour dues on oil are only 10d. against 1s. 8d. per ton for coal, it would effect a saving of over £2,000 per annum. The cost will be met out of the past year's profit.

Representatives of the local authorities supporting the "Conference" scheme for the reorganisation of electricity supply in the West Riding (TABLE A) ALTHOUGH ELECTRICITY DISTRIBUTION WAS CALCULATED TO amount at Bradford last week by Ald. W. Turner, chairman of the Conferences and of the Bradford Electricity Committee. The Lord Mayor of Bradford (Lieut.-Col. A. Gadie), who proposed "The Conference," paid a tribute to the good work of Ald. Turner, Mr. T. Roles (city electrical engineer), and of the officials of the Corporation in connection with the scheme. Alluding to the clearness of the atmosphere in the West Riding recently, the Lord Mayor said that if a scheme could be evolved by which all machinery could be driven by electricity it would be a great march forward.

In responding, the Mayor of Wakefield said that no other authority than that which the conference proposed to set up could be as competent to provide current cheaply and efficiently. Ald. Marsden (Huddersfield), Ald. A. Smith (Keighley) and Mr. F. Rhodes (Shipley) supported and acknowledged the ability with which Ald. Turner had conducted the business of the conference and the valuable assistance given by Mr. Roles and the other officials.

In replying to the toast of the chairman, Ald. TURNER said he believed no one had ever had the opportunity of being associated with a scheme, comprising such a variety of authorities, concerning which such a magnificent spirit had prevailed. The conference had been piloted by that spirit rather than by anything he had done. Their most sincere thanks lay in the consciousness that they had been associated in something calculated to make things better. In the possibilities which delimited areas for electrical purposes opened up he had felt that there was something that would give effect to ideals he had secretly held for a long time, namely, that the opportunities for good of neighbouring public authorities became enormously greater by the exercise of the spirit of co-operation and by a little mutual sacrifice for the common good. The Chairman also acknowledged the gift of three silver fruit dishes for which the representatives present had subscribed in honour of his labours for the "conference" scheme.

Electric Traction.

THE BRADFORD Tramways Committee proposes to substitute one-man railless trolley vehicles for the present vehicles, as they become incapable of further repair, and the tramways manager has been authorised to provide six cars at a cost of £1 800 each. Tenders will be invited for the chassis and equipment, but the bodies will be built in the tramway workshop.

THE HULL Corporation Tramways department claims to be the first to convert entirely from coal to oil fuel as a strike emergency, and the comparative costs of the two kinds of fuel will be of interest. Two separate fortnights are taken, one under coal and one under oil, and fairly comparable because of the number of units of electricity generated in each being practically identical. In one 384 tons of coal was used; in the other 232 tons of oil. With coal at an average of 42s. per ton and oil at 105s. (in each case delivered) the average cost per unit for coal was 0.860d. and for oil 1.223d., an increase of 0.363d. per unit. Therefore, the cost of oil was 42 per cent. more than that of coal, and to make fuel oil at 105s. per ton compare evenly with coal the latter would have to be not less than 63s. per ton. During the strike in October and November last a reduced service of cars resulted in a loss of nearly £1 900 a week in fares but by the extra expenditure of £200 on oil a week the revenue has been maintained in the present instance.

The annual accounts of the tramways department were presented to the London County Council on Tuesday. The net capital expenditure for 1920-21 was £587 818, including £211 334 for half the cost of track renewals. The total capital expenditure at March 31, was £14 475 451, including obsolete expenditure £2 812 380 (horse £2 024 688, electric £157 692). The total debt was £14 816 985, and the outstanding debt £8 473 699. Deducting value of surplus lands (£131 112), the net debt was £8 342 587. The provision for the redemption of debt out of revenue and rates and from the proceeds of sales amounted to £6 343 284, or 43 per cent. of the total. The debt still to be provided includes £831 580 in respect of obsolete capital debt on horse traction (59 per cent. of the debt on this item has been paid off).

During the year 689 452 036 passengers were carried, against 685 124 156 in 1919-20; the car miles run 57 488 232 (53 156 000), the receipts 19-1d. (18-62d.), and the working expenses 19-30d. (16-62d.). The total revenue receipts for the year were £4 904 427, against £4 295 846, and the working expenses (including special charges) were £4 623 654 (£3 680 899), the surplus being £280 773 (£614 947). The proportion of renewals charged to revenue was £215 639. The increase in working expenses was due mainly to increased prices of materials and the cost of additional concessions to employees. The charges against the surplus were as follows:—Interest (gross), £202 443, and redemption of debt, £328 222, and after deducting debt charges recoverable (£4 432) and adding income tax and other items (£69 481), the total charges were £655 714, leaving a deficiency of £590 580. Of this sum £381 186 has already been raised in the special county rate, and the balance is being raised in the special county rate for the half-year ending Sept. 30 next.

In the estimates of the Highways Committee for the year 1921-2 the total tramway receipts (including advertisement rents, &c.) are put at £5 496 130 and the working expenses (including proportion of cost of renewals) at £4 847 230, leaving a surplus of £648 900. The debt charges (£333 636 for repayment of capital and £297 291 for interest) and income tax will be £650 927, leaving a net deficiency of £7 117. It is estimated that the passenger receipts will average 22d. a car mile on an estimated mileage of 58 500 000, the working expenses (excluding special charges, but including half cost of renewals) being 19-77d.

Imperial and Foreign Notes.

THE STATE Hydro-Electric Department, in consequence of the impossibility of housing sufficient generating plant on the Council's power-house site to meet the anticipated requirements of the city, The Government is constructing a line to Launceston capable of transmitting 10 000 h.p., and the Council is negotiating for an option over the remaining 7 000 h.p.

THE GOVERNMENT MALAYA STATES GOVERNMENT, in view of the urgency of securing expert advice on the development of the country, Mr. C. G. Reade, of the Town Planning Department of South Australia, has been engaged for a year to give general guidance on town-planning. Prof. Gilbert J. Fowler, D.Sc., of the Indian Institute of Science, Bangalore, is occupied with 8-wage Disposal in the four largest towns in the States, Kuala Lumpur, Ipoh, Seremban and Klang. Mr. F. Bolton has also recently visited the country to give advice on the provision of electric power and light in the larger towns, and for the question of irrigation the services of Mr. C. E. Dupuis were secured.

An interesting pamphlet on the advantages and economies effected by the MELBOURNE SUBURBAN ELECTRIFICATION SCHEME has been issued by the Agent-General for Victoria. Five routes, representing 443 route miles, are already operated electrically, and it is anticipated that the whole scheme, comprising 981 miles (145 miles of track), will be finished by February, 1923. The power house is at Newport and its capacity will be 100 000 h.p. Owing to the higher schedule speed of electric trains a much better and more economical service will be given. As far as possible only Australian manufactures will be employed; the condensing plant, the copper wire for the overhead equipment and the steel for the tracks are all Australian. The following is a summary of the savings effected on the five electric lines in operation:—Savings in coal £46 000, and in staff and rolling stock £30 000, while increased revenue from the better service given is put at £95 000, or a total of £191 000 per annum. Other advantages include the elimination of smoke, the postponement of costly duplications and extensions of the steam lines, &c., and the accumulated saving in interest alone on these for 10 years is put at £1 500 000. It is stated that when the suburban electrification is completed, the savings in operation and the enhanced revenue will more than cover all additional expenses involved in connection therewith.

THE TIENSIN-PUKOW RAILWAY COMPANY proposes to install electric generating plant at Pukow, on the Yangtze River, China. The cost will be about 8900 000.

THE JAPANESE GOVERNMENT, through the KAGOSHIMA RAILWAY STATIONS near Okinawa (Liu-Kiu Islands) and Kagoshima for receiving ships' messages, and military and naval stations will be equipped at Hokkaido and Otaru.

It is announced that the Nauen (Berlin) Tel-funken station has been able to communicate with the Argentine station at Bahía Blanca, 2 712 miles. The experiment was carried out with the Argentine steamer "Bahia Blanca," which was on the return voyage to South America, and on board which messages were distinctly heard. Beyond the distance given the vessel entered an area of the Atlantic where atmospheric disturbances interfered with the experiments. Communication from Nauen to Bahía Blanca was maintained for 2 185 miles.

The acting British Consul at Dairen (Mr. W. B. Cunningham) reports that of a total estimated expenditure of 55 960 000 yen by the SOUTH MANCHURIA RAILWAY COMPANY during the financial year 1921-22 a sum of 2 485 961 yen is earmarked for electricity works. It is proposed to establish an electric experimental station at Dairen and to erect a second power station at Dairen, and a third at Antung. The extension of the Dairen electric tramway system is under consideration, and further extensions of the existing plant at the Fushun mines and the Anshan steel works are projected.

Institution Notes.

THE WESTERN CENTRE OF THE INSTITUTION OF ELECTRICAL ENGINEERS have been making a determined effort to obtain £250 in order to secure Mr. E. M. Hughman's offer of £250 which expired yesterday. We regret to learn that up to a short time ago there had been but a small response to this appeal, but we hope that by this time it has been successful.

THE MANCHESTER ELECTRO-HARMONIC SOCIETY which was formed in 1912 has decided to resume its concerts next year, after seven years interval. These gatherings will be held on the last Fridays of October, November and December, 1921, and January, February and March, 1922, at the Albion Hotel, Piccadilly, Manchester. Mr. W. J. Smith, Manchester, as hon. secretary.

about to publish Vol. IV. of "Tables Annuelles de Constantes et Données Numériques." This work which appears under the authority of the French Government, is a valuable work, and is of great interest to all voluntary subscriptions with the intention of advancing scientific knowledge particularly in the interests of industry. Subscriptions both for this volume and the preceding three volumes should be sent to M. C. Marie, 9, Rue de Bagnoux, Paris 6e.

Miscellaneous.

A new semi large-scale laboratory at the IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY was formally opened by Mr. A. J. Balfour on the 23rd ult. The laboratory is the gift of Mr. G. W. Whiffen, a former student.

The following companies were struck off the REGISTER OF JOINT STOCK COMPANIES on June 21: A. B. Vibro & Domestic Electric, Carbonite, Derby Day & Night Sign Company, Feltham & District Electric Lighting Company, Snyder Electric Furnace Company, Whole sale Battery Company.

The EASTERN TELEGRAPH COMPANY and its associated companies are actively engaged on a big programme of cable laying and renewals. Recently a new cable, of 1 700 miles in length, was laid between Madras and Singapore, and work is proceeding on the renewal of cables in the Red Sea. When the scheme is completed communication with the Far East will be much better, and delays in transmission will be avoided.

"Printers Pic" for 1921 is as good as ever, and that is saying a great deal. It is illustrated throughout in colour, four different tints being employed. There are a number of good stories by popular authors and some excellent drawings. We have no doubt that readers of THE ELECTRICIAN will make a point of obtaining this publication, not only for its literary value, but because each copy bought assists in the upkeep of a very deserving institution.

The staff of the GENERAL ELECTRIC COMPANY, LTD., were favoured with beautiful weather for their THIRD ANNUAL SPORTS, which took place at the London County Ground, Heme Hill, on Saturday last. A large gathering of members of the staff at Magnet House and of the other establishments and associated companies of the company, with their friends, witnessed the proceedings, the directors being represented by Mr. Hugo Hirst and family, Mr. and Mrs. Mac Railing and family, and Mr. S. D. White. A long programme was carried through with a promptness which reflected great credit on the welfare superintendent, Mr. H. B. Duco, who was responsible for the organisation of the meeting.

The performance of some of the competitors indicated that the General Electric Company have some very promising athletes. Among the more notable achievements may be mentioned the High Jump (5 ft. 7 in.) won by Mr. Rutherford of the Express Lift Company, and the 120 yds. Championship which was carried off by Mr. Bird, of Witton Works (10-2/5 seconds). Witton Works were also successful in winning the quarter-mile championship and the relay race. The Express Lift Company were successful in the Tug-of-War, easily beating teams from head office and Fraser & Chalmers' Engineering Works. A similar event for ladies was won by the staff of the Entering Room, Magnet House. In a competition for fire brigades, the team from Fraser & Chalmers' Engineering Works were successful.

At the conclusion of the sports, the prizes were distributed by Mrs. Hugo Hirst. An excellent military band was in attendance during the afternoon and provided music for dancing on the green until late in the evening.

Bankruptcies, Liquidations, &c.

In the Winding-up Court on Tuesday Mr. Justice P. O. Lawrence made a compulsory winding up order against SWARREN, LTD., electrical engineers and dealers in machinery, &c.

A meeting to receive an account of the winding up of the ANGLO-FOREIGN TRAMWAY SYNDICATE, LTD., will be held at Sardinia House, Sardinia-street, London, W.C.2, on July 27.

A first and final dividend of 2s. 8d. is payable at the Official Receiver's office, St. Mary's-chambers, Great Grimby, to creditors of GEO. DOLBY, electrician, 39, East Marsh-street, and 129, Freeman-street, Great Grimby.

An order has been made that the discharge of DAVID SUCHOSTAWER, engineer, 1, First-avenue, Acton, shall be suspended until a dividend of not less than 15s. has been paid, with liberty to apply after two years (from May 27 last) for a modification of the order.

A receiving order has been made against BERTRAM THOS. DALE, electrical engineer, Erick-street, Newcastle-on-Tyne. The first meeting of creditors will take place on July 6 at 4, Northumberland-street, Newcastle-on-Tyne, and the public examination on July 14 at the County Court, Westgate-road, Newcastle-on-Tyne.

Claims against Arthur Kershaw and Chas. Herbt. Wood, trading as KERSHAW & WOOD, electrical engineers and merchants, 9, Bradford-road, Dewsbury, and against the separate estates of ARTHUR KERSHAW and CHAS. HERBT. WOOD are to be sent to Mr. Chas. Turner, 155, Norfolk-street, Sheffield.

Personal and Appointments.

The Home Secretary has appointed Mr. WILLIAM BROWN and Mr. H. W. SWANN as electrical inspectors of factories.

Mr. J. A. WEST has been appointed engineer-in-charge at the Hammer-smith Borough Council's electricity works at a salary of £412, plus bonus.

Mr. Gilbert Cook, D.Sc., A.M.I.C.E., senior lecturer in engineering, has been appointed to the University Chair of Mechanical Engineering in King's College, London.

Mr. D. CLARK, B.Sc., senior assistant at the Royal Technical College, Glasgow, has been appointed to the Chair of Engineering at Trinity College, Dublin, vacant by the resignation of Prof. Alexander.

Catalogues, Price Lists, &c.

An illustrated leaflet, giving particulars, with diagrams of connections of their DOUBLE-TARIFF METERS has been issued by Messrs. LANDIS & GYR, LTD., Elgee Works, Windmill-road, Hampton Hill.

List No. LL229 of the EDISON SWAN ELECTRIC COMPANY, LTD., Ponders End, gives prices and particulars of the Royal Ediswan "Ful-lo-lite" and "Daylight" gas-filled lamps.

The SIMPLEX CONDUITS, LTD., Garrison-lane, Birmingham, have recently published their List No. 885, which gives prices and particulars of their conduits and conduit fittings, of their "Diaduct" patent distribution boards, bowl fittings, domestic apparatus, &c.

A well illustrated pamphlet has been issued by Messrs. GEORGE ELLISON, of Perry Bar, Birmingham, containing descriptions of some of the circuit-breakers, starters, motor control panels, crane control equipment, circuit-breakers for trailing cables, disconnectors, &c., manufactured by them. The firm are specialists in the manufacture of electric control gear for all industrial power purposes, and the new list gives some typical examples of their products.

An illustrated catalogue and price list of air-break and oil-immersed auto-transformer starters has been issued by the ELECTRICAL APPARATUS COMPANY, LTD., South Lambeth-road, London, S.W.8. The company reports that it has considerably increased the range of its oil-immersed starters, and the leaflet (H.42/6) gives a considerable amount of technical information which will make the publication of assistance to users. The starters are of drum type for two and three-phase squirrel-cage motors, and are standardised in two forms, air-break and oil-immersed. The whole apparatus is totally enclosed, while the oil-immersed form can be made flame-proof. The contacts are self-aligning with coil-compression springs which do not carry current. The wearing parts are renewable and good insulation is ensured by all live metal being clamped on to mica insulated steel bars. The transformers are three-phase, with tapplings giving approximately 40, 60 and 75 per cent. of the line voltage, unless otherwise specified. Copies of the leaflet can be obtained, on application, from the company.

Particulars of the design and construction of the "Bull" lighting sets, electric motors, dynamos, switchgear, &c., are given in the new catalogue issued by the A.G.E. ELECTRIC MOTORS, LTD., one of the associated firms of the Agricultural & General Engineers, LTD., Central House, Kingsway, W.C.2. The information given includes a specification of the Bull dynamos and motors, tables of dimensions, standard outputs, prices, &c. There are a number of good illustrations of typical machines and diagrams of connection. The plant is manufactured under mass production conditions and the firm are preparing new designs of dynamos and motors for outputs up to 50 H.P. They conform to the British standard specification and one of the special features is that the machines can easily be converted from open bracket to semi-enclosed, totally enclosed, or pipe-ventilated types.

The demand for improved lighting in collieries and the growing popularity of the miners' electric lamp have resulted in a number of new types of lamps being placed on the market. One of these is the "KINGSWAY II" MINERS' HAND LAMP, which is illustrated and described in a pamphlet recently issued by the GENERAL ELECTRIC COMPANY, LTD., Magnet House, Kingsway, W.C.2. The lamp, which is of simple though sound construction, is one of those in the list of electric lamps approved by the Mines Department of the Board of Trade. Details of the construction, dimensions and weight, with particulars of spare parts, are set out. It is supplied with an Osram lamp with special "bow" filament, giving uniform brilliancy throughout the whole length of the filament, and the minimum illumination is one candle power at the rated voltage. The weight of the complete lamp with the accumulator is 5½ lb. Descriptions and prices of the "Kingsway" charging and standing racks, the "Kingsway" opening magnets, a specific gravity tester and accumulator filler and some accessories are also included in the pamphlet.

Business Items, &c.

The new telephone numbers of the TELEPHONE MFG. COMPANY (1920), LTD., are Sydenham 2460 and 2461.

The CITY OF LONDON ELECTRIC LIGHTING COMPANY has purchased a site of 30 000 sq. ft. in Aldersgate-street, on part of which it is intended to construct a substation.

Eleanor Elsie Hall and Leighton Ingall Austin, trading as the RAINBOW MFG. COMPANY, electric welders, 75½, New Summer-street, Birmingham, have dissolved partnership.

Having just completed considerable alterations and extensions at their City warehouse, 123½, Queen Victoria-street, E.C.4, the Edison Swan Electric Company, Ltd., desire it to be known that as from the 1st inst. large stocks of lamps, fittings, accessories, &c., will be held at this address and all orders, inquiries, &c., in the London area will be dealt with from there instead of from the works.

In consequence of the many alterations and extensions carried out by Messrs. C. A. VANDERVELL & COMPANY, LTD., at their Acton Works during the past year they have now decided to launch out into fresh fields of manufacture in addition to that of small hand tools, gauges, jigs, &c., which they have already announced. Evidently these new activities have been misunderstood, and the firm ask us to deny the statements that have been made to the effect that they intended to associate themselves with the manufacture of a car. They have not nor have they ever had any connection with the manufacture or marketing of motor-cars, as they consider such a policy most detrimental to their own interests as manufacturers of electrical equipments for cars.

Tenders Invited.

HULL Corporation require tenders by July 18 for machinery oils for their electricity undertaking. Forms of tender from the Electricity Works.

SOUTHAMPTON Corporation invite tenders for 6 or 12 months' supply of meters. Specifications from the Borough Electrical Engineer, and tenders to the Town Clerk (Mr. R. R. Linthorne) by July 9.

MANCHESTER Tramways Committee want tenders by July 12 for granite sets, steel tramway poles, and silicon bronze trolley wire. Specifications, &c., from Mr. J. M. McElroy, 55, Piccadilly, Manchester.

The LONDON COUNTY COUNCIL invite tenders (by July 11) for the supply and laying of h.t. electric cables, &c. Specifications from and tenders to the Clerk County Hall, Spring Gardens, S.W.1.

LONDON County Council invite tenders for the supply, delivery and erection of one 8 000 kW steam turbo-alternator and exciter, condensing plant, &c., and seven 1 000 kW rotary converters, static transformers and accessories. Specifications from the Clerk of the Council, County Hall, Spring Gardens, S.W., to whom tenders by 4 p.m., July 11.

EDINBURGH Corporation also require tenders by July 11 for high-pressure steam pipes and valves in connection with the Portobello generating station. Specifications from Sir Alexander Kennedy, 17, Victoria-street, Westminster, S.W.1.

The District Committee of the Lower Ward of the COUNTY OF LANARK require tenders by July 11 for electric light wiring in 50 dwelling houses at Gartcosh. Forms of tender from the District Clerk, 15, West George-street, Glasgow.

The GOVERNMENT OF MALTA invite tenders for a 1 000 kW single-phase steam alternator (2 200-2 500 V, 100 cycles). Particulars and forms of tender from the Crown Agents for the Colonies, 4, Millbank, S.W.1, and tenders to Malta by July 7.

The BULGARIAN DEPARTMENT of Posts Telegraphs and Telephones invites tenders (by July 11) for the supply of various tools, instruments and materials. Specification (in French) at the Department of Overseas Trade, 35, Old Queen-street, S.W.1.

MEXBOROUGH Borough Council invite tenders for supply and erection of e.h.t. switchgear and l.t. d.c. switchboard. Specifications from the engineer and manager (Mr. J. B. Feltham, A.M.I.E.E.), and tenders to the Clerk (Mr. J. W. Hattersley) by noon, July 23.

EDINBURGH Corporation invite tenders for the supply and erection of a storage battery at Portobello station. Specifications from the consulting engineer (Sir Alexander Kennedy), 17, Victoria-street, Westminster, S.W.1, and tenders to the Town Clerk (Mr. A. Grierson, S.S.C.), City Chambers, Edinburgh, by July 11.

It is notified that the date for tenders for the supply of plant and material for the electrification of the CAPE TOWN-SIMONSTOWN & DURBAN-PIETERMARITZBURG RAILWAY lines has been extended to noon, July 5. Tenders to the High Commissioner for the Union of South Africa, Trafalgar-square, London, W.C.

The WAIROA (N.Z.) Electric Power Board invite tenders for the supply of material for an 11 000/3 300 V 600 kW outdoor sub-station, including four 200 kVA transformers (11 000/1 900 V), insulators, air-break switches, fuses, lightning arresters and choke coils, accessories, &c. Tenders (by July 31) to Messrs. Hay & Vickerman, Wellington, N.Z.

The QUEENSLAND Water Supply Department require tenders in connection with the Inkerman Irrigation Scheme, for the supply of 54 000 yards of h.d. copper cables of various diameters for overhead transmission wires, and 2 980 ft. of lead-covered and steel band armoured copper cables of various gauges with accessories. Tenders to the Under-Secretary, Treasury Department, Brisbane, by July 18. Local representation is essential. Specifications at the Department of Overseas Trade.

The Ministry of Posts and Telegraphs, BELGRADE, invites tenders (by July 13 and 14) for the supply and delivery of telephone material. Tenders should bear a 10 dinars duty stamp and should be addressed "Ekonomsko Odeljenje Ministarstva Posta i Telegrafa," Belgrade. A deposit of 20 per cent. of the total value of the tender is required from foreign firms. A translation of the specifications may be inspected at the Department of Overseas Trade, 35, Old Queen-street, S.W.1. British firms should compete through a local agent.

Tenders are invited for the supply of the following plant and material for the Municipality of BULAWAYO (Rhodesia):—(A) Two sets of gas-producing plant, (B) gas engines, (C) 3, with alternative of 4, three-phase 300-kW generators, (C') alternative steam plant, (D) main switchboard, (E) switchgear distribution and transformer houses, (F) poles and cross-arms, (G) insulators and shackles, (H) h.d. copper wire, (J) three-core cable, (K) insulated cable, (L) lightning arresters and choke coils, (M) transformers, (N) bus-bar copper, insulators and Crosby clips, (P) stay rods, stay wires and swivels. Specifications from Messrs. Davis & Soper, 54, St. Mary Axe, London, E.C.3, to whom tenders by Aug. 3.

The VICTORIAN GOVERNMENT RAILWAY COMMISSIONERS invite tenders (by July 27) for the supply and delivery of 24 000 metal filament lamps for electric car lighting (46-W, 116-V) and 4 000 carbon filament lamps (32-W, 140-V), and (by Aug. 3) for a 5-H.P. electric motor, controller, &c.; by Aug. 10 for 250 impedance bonds for power signalling (Contract 34 130) and 56 miles of insulated copper wire (Contract 34 131); by Aug. 17 for renewals for 3 000 sets of caustic soda primary cells (Contract 34 145); and by Aug. 24, for motor generator set, accessories and switchgear for automatic telephone exchange (Contract No. 34 132). Tenders to the Commissioners, Spencer-street, Melbourne, and must be accompanied by a preliminary deposit of 4 per cent. of the total offer. Local representation is essential. Specifications at Department of Overseas Trade.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by MESSRS. MUEBURN, ELLIS & CO., Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.

- 138 367 SIEMENS SCHUCKERTWERKE Ges. Protective devices for alternating-current electric supply systems. (26 11 18.)
- 139 613 SIEMENS SCHUCKERTWERKE Ges. Cooling arrangements for dynamo-electric machinery. (7 10 18.)
- 139 494 PUFIN. Multi-step thermionic amplifiers. (4 2 18.)
- Relates to the receiving circuits of a wave signalling system, and comprises a multi-step amplifier consisting of a plurality of simple amplifiers reactively connected by a pilot conductor, the electrical constants of the circuits being such as to afford a large attenuation for the frequencies of the internal disturbances which normally occur in the amplifiers.
- 142 806 THERMOS AKT-Ges. Electric-heating appliances. (5 12 14.)
- 143 263 MURRAY & SROTTER. Electric switches. (14 5 19.)
- 145 040 MARCONI'S WIRELESS TELEGRAPHY CO., LTD. Radio-transmitters. (14 6 19.)
- Relates to radio transmitting apparatus comprising a valve having a plurality of plates and a plurality of influencing members, the latter being connected to points in an inductance connected to the antenna and to the plates, at points at which the potentials are substantially out of phase and preferably 180° out of phase.
- 145 262 Soc. H. TRENTELIVRES et Cie. Sparking plugs for internal combustion engines. (25 1 14.)
- 147 127 KRUPP AKT.-Ges. F. Apparatus for the electrical long distance control of the valve gear of a hydraulic gun-pointing gear. (14 12 14.)
- 147 591 KRUPP AKT.-Ges. F. Automatic starters for electric motors. (5 5 19.)
- 147 754 Ges. Fur DYNALUXE TELEGRAPHIE. Electric high-frequency current transformers. (29 7 15.)
- 151 237 AUTOMATIC TELEPHONE MFG. CO., LTD. Trunk circuits more particularly for automatic or semi-automatic telephone systems. (18 9 19.)
- 151 550 FRASER. Electric power transmission systems. (19 9 19.)
- 152 968 CHOLLET & LEPAPE. Sparking plugs. (22 10 19.)
- 153 894 HERRMANN. Manufacture and production of a material suitable for use as an insulator for electric purposes. (7 11 19.)
- 155 256 KAISER. Mercury switches for electrical apparatus. (15 12 19.)
- 162 246 MORGAN CRUCIBLE CO., LTD., & SPIERS. Electrically heated melting and other furnaces. (7 10 19.)
- 162 310 BROWN. Combined electric bell and battery. (19 8 19.)
- 162 320 SHANAHAN. Contacts for electrical switches, switch fuses, plug connectors and the like. (20 11 19.)
- 162 338 DONISTHORPE. Thermionic valves. (23 12 19.)
- 162 353 B. T.-H. Co. (G. E. Co.) Rotary apparatus for converting electric currents (12 1 20.)
- 162 356 LINES. Mouth-pieces for telephone transmitters.
- 162 367 MACROBIE, FORTESCUE & BRYAN, & AIREY. Electric valves or tubes for use in wireless telegraphy and telephony. (23 11 20.)
- 162 391 FLETCHER. Electro-deposition of metals upon iron and alloys of iron. (28 1 20.)
- 162 394 BERRY. Electric transformer arrangements. (29 1 20.)
- 162 412 HARRIGAN & LYER. Electro-magnetically-operated valve-mechanism for internal combustion engines. (3 2 20.)
- 162 415 AKTIESELSKABET JYDSKE ELEKTRO. Alternating current induction motors. (4 2 20.) (Addition to 141 671.)
- 162 428 WOLFF. Apparatus for use in testing electric lamps, fuses, sparking; plugs and induction coils. (10 2 20.)
- 162 449 MIDLAND ELECTRIC MFG. CO., LTD., & SUTHERLAND. Electrical distributing fuse-boards, fuse boxes and the like. (19 2 20.)
- 162 461 JARVIS & MORGAN CRUCIBLE CO., LTD. Carbon brushes for dynamo electric machines. (23 2 20.)
- 162 470 ABBOTT. Fuse boxes, switchgear and other electrical gear contained in boxes or cases. (27 2 20.)
- 162 471 NALDER BROS. & THOMPSON, LTD., & LIPMAN. Alternating current electric instruments for indicating synchronism power factor, phase difference or the like. (27 2 20.)
- 162 487 SHERGOLD & MAXWELL. Electric fuse holders. (15 3 20.)
- 162 546 HALL & HALL. Electric switches. (13 5 20.)
- 162 552 SIEMENS BROS. DYKAMO WORKS & JANTZEN. Dynamo electric machines. (20 5 20.) (Addition to 146 624.)
- 162 553 TYER & CO. & DOWNES. Electric apparatus for railway signalling. (21 5 20.)
- 162 579 WEAUGH & SONS & AUBREY. Joint-covering sections of electric cable conduits. (7 2 20.)
- 162 587 DAS. Electric emergency lighting installations. (5/8/20.)
- 162 602 HENLEY'S TELEGRAPH WORKS CO. & WAKEFIELD. Spring contacts for electric fuse-carriers and like electric fittings. (29 11 20.)
- 162 606 SMITH. Electric coupling devices. (15 12 20.)
- 162 636 BECKER. Incandescent electric lamp. (26 9 19.)
- 162 639 HARRIS. Electric switches particularly applicable to alarm circuits. (6 10 19.)
- 162 702 LAWSON. Electricity meters. (19 11 19.)
- 162 707 B. T.-H. Co., CLOUGH & TAYLOR. Windings of alternating current dynamo-electric machines. (2 12 19.)

APPLICATIONS FOR PATENTS.

January 10, 1921.

- 1 433 MOLL-WERKE AKT.-Ges. Electrically welding sheet metal. (29 10 19, Germany.)
- 1 434 VOOT, ENGL. & MASSOLLE. Connections for reinforcements of currents and voltages. (19 19, Germany.)
- 1 446 VOOT, ENGL. & MASSOLLE. Arrangement for strengthening electric currents and tensions. (9 10 19, Germany.)
- 1 450 VOOT, ENGL. & MASSOLLE. Differential wire system for controlling amplitude of high-frequency currents by low frequency. (3 5 19, Germany.)
- 1 451 VOOT, ENGL. & MASSOLLE. Differential connection system for controlling amplitude of high-frequency vibrations by low frequency. (3/3/19, Germany.)
- 1 463 ENGL. & MASSOLLE. Electrically-driven glow lamp for reproduction of acoustic electric frequency. (3/1/19, Germany.)
- 1 486 BONNEFANT. Crystal detector for wireless telegraphy. (13 11 19, France.) (8 20, Germany.)
- 1 494 CHOMEN. Wireless signalling by arc system. (13 11 15, U.S.)
- 1 500 SATVAREH. Electrolytic separation of platinum from other metals. (19 12 19, Switzerland.)
- 1 514 WALLER. Trip switches for railway, indicating mechanism, &c.
- 1 522 KELLER. Rheostat resistance grids. (6 1 14, U.S.)
- 1 540 LAY AUTOMATIC TELEPHONE CO. Automatic telephone systems. (31 12 19, Sweden.)
- 1 564 HEILERUN. Connections and switches for enabling consuming devices to be used on circuits of different voltages. (18/2/14, Germany.)
- 1 592 ADAM & ANTONAP. Batteries.
- 1 596 BEISELMANN. Regulating central station and substation. (15 9 19, Germany.)
- 1 605 MEYSTRE. Electrically-heated boilers. (5/12/18, Germany.)
- 1 612 KROGER. High ohmic resistance.
- 1 616 MADLER. Electric ignition apparatus. (7 5/19, Germany.)
- 1 633 MACK. Electric welding. (5 11 19, Germany.)
- 1 635 HUTH (Dr. E. F.) Ges. Strengthening electric oscillations by inductant outside
- 1 639 HUTH (Dr. E. F.) & ROSENBAUM. Production of undamped oscillations. (24/1/19, Germany.)

Companies' Reports, &c.

BRITISH ELECTRIC TRACTION COMPANY, LTD.

The 25th ordinary general meeting of this Company was held on Friday last, Mr. J. S. Auston (chairman) presiding.

The CHAIRMAN, in moving the adoption of the report and accounts, said for many years past it had been the custom of Mr. Garcke at those meetings to make an exhaustive statement upon the condition of the electrical industry in this country, which had always been listened to by the shareholders with interest, and had been regarded by the outside world as an exhaustive exposition of the position. It was not his intention to seek to emulate Mr. Garcke, because he could speak with authority and he did not possess his knowledge. But there was a reason for the change, because a year ago it was recognised by Mr. Garcke that the nature of the business done by the Company had undergone a change. Previously the business consisted in the construction of electrical undertakings, but to-day it was doubtful whether any electrical undertaking could be constructed with any prospect either of selling it or running it at a profit. It was true that electrical undertakings which were built before the war could be now operated at a profit, and that was because, speaking generally, fares and rates had been raised to an extent sufficient to meet the increased cost of operation and made a fair return upon the pre-war capital cost; but if such undertakings were built to-day they could not be run with any prospect of receiving a fair return upon the capital. Consequently that department of their business had, for the time being at any rate, gone, and their business now might be said to consist of managing those undertakings of which they held the control, and financing them. He might almost go so far as to say every company in the kingdom required more money to run its business to-day than it did before. Take a company like a tramway. A tramway always carried a certain amount of stores. These stores cost more money, and consequently it required more capital. In a power company the position was accentuated, because, there, in addition to stores, one must keep extending, and these extensions again cost money, and the capital cost of them was probably double what it was before. These extensions were rendered more necessary because the operative side of the board informed him there was evidence that the use of electric power was increasing.

COMPANY'S UNDERTAKINGS.

He would deal specifically with one or two of the undertakings in which the Company's stake was a large one. The Rio Grandense Light & Power Syndicate, which operated the tramways and supplied electricity to the city of Pelotas in Brazil, was started before the war, but had not been completed when war broke out. The electrical portion had been practically finished, but only a section of the tramway had been completed. Increased working costs rendered it necessary to apply to the city authorities for leave to increase rates, and this permission was only obtained upon the condition that a further portion of the tramway was completed, and it had been found necessary to find additional capital. Then it was necessary for the Brush Electrical Engineering Company to extend its plant, and the British Electric Traction Company had largely increased its interest in that company. They received a dividend of 15 per cent. last year, so that it was a very profitable investment. They had to find the money for the calls upon their shares in Stoll Picture Productions. Those had been their chief outgoings during the year, and the money had come chiefly from the sale of Northern Ontario Light & Power bonds and preference stock, war stock and from the repayment of the debentures held in the Yorkshire (Woolen District) Electric Tramways.

MOTOR OMNIBUSES.

A considerable time before the war the directors of the Company appreciated the use and future of omnibuses in rural districts, and with that in view they formed the British Automobile Traction Company. That company, before the war, was earning a handsome dividend, but then the war came and most of their omnibuses were commandeered. As soon as the war was over, the business revived in a remarkable manner; returns were extremely satisfactory, but the rate of earnings did not exceed that which obtained before the war. The business did not consist to any extent in running omnibuses in towns, but in connecting up towns. The business was carried on through the British Automobile Traction Company by means of subordinate companies.

THE FINANCIAL RESULTS OF THE YEAR'S WORKING.

The results for the past year did not vary much from those of the previous year. There had been an increase, but not sufficient to justify an increase of dividend. In some companies they had had increases, and in some decreases, but upon balance the result was a little better. As to the current year he felt himself in a difficulty. It was impossible for a company like that, with ramifications all over the kingdom, not to be affected by the coal strike. And it was not the strike itself that they feared, but the results of the strike. They might feel the result of it for three years, or even for ten years, and they could not in any way forecast the future. Of course, even the strike might not affect them everywhere. Take, for instance, the London & Suburban Traction Company, in which they had their largest holding. When he saw the queues waiting to board their omnibuses and trams he knew that company must be earning money. In his opinion the company was all right. The great strength of an old trust company consisted in what he might call its secret reserves, the amount of unremunerative investments which they held—investments which were in default. These were always coming into bearing again, and they went against those which had a way of going into default. That company's largest holding was in the London & Suburban Traction Company, in which they had over £800,000. They

- 1647 SIEMENS & HANKE AKT.-GES. Telephone installations. (18 11 16, Germany.)
- 1653 MEUSSER. Device for electrically recording or producing motions. (22 12/19, Germany.)
- 1674 MOSTOWAY. Telephone indicators for control batteries. (9/1 20, France.)
- 1675 MOSTOWAY. Telephone indicators for control batteries. (9/1 20, France.)
- 1676 MOSTOWAY. Telephone indicators for control batteries. (9/1 20, France.)
- 1677 MOSTOWAY. Telephone indicators for control batteries. (9/1 20, France.)
- 1678 MOSTOWAY. Telephone indicators for control batteries. (9/1 20, France.)
- 1679 MOSTOWAY. Telephone indicators for control batteries. (9/1 20, France.)
- 1680 MOSTOWAY. Telephone indicators for control batteries. (9/1 20, France.)
- 1681 MOSTOWAY. Telephone indicators for control batteries. (9/1 20, France.)
- 1682 MOSTOWAY. Telephone indicators for control batteries. (9/1 20, France.)
- 1683 MOSTOWAY. Telephone indicators for control batteries. (9/1 20, France.)
- 1684 MOSTOWAY. Telephone indicators for control batteries. (9/1 20, France.)
- 1685 MOSTOWAY. Telephone indicators for control batteries. (9/1 20, France.)
- 1686 NEUFELD & KUHNKE. Visible representation of electric signals. (12 5/19 Germany.)

January 11, 1921.

- 1740 BRIGGS. Swivelling shoe-collector for collecting power from overhead conductor.
- 1749 POLYBLANK. Electric terminal couplings.
- 1750 POLYBLANK. Plug and socket couplings.
- 1792 STREET. Telephone cables.

January 12, 1921.

- 1829 DAWSON. Electric-ignition of flash powders.
- 1844 VERTY'S, LTD., & L'ONS. Well-globe fittings for electric lamps.
- 1870 CROMPTON & CO. & A. E. G. ELECTRIC MOTORS, LTD., & JONES & WATERS. Automatic switches.
- 1891 FLETCHER & HILL. Prevention of sagging of heating elements of electric fires.

January 13, 1921.

- 1934 DAWSON. Unlocking magnetically locked lamps.
- 1943 TAYLOR. Electro-magnetic accumulator charging switch.
- 1960 HOCKLEY. Telephone transmitters, microphones, &c.
- 1985 & 1986 ADDISON. Step-by-step motors.

- 2018 WALLACE. Current regulator for headlights.

January 14, 1921.

- 2032 ROBERTSON. Means for electrically indicating vacant seats in theatres, &c.
- 2080 KRUPP (F.) AKT. GES. Sparkless disconnection of inductive resistance. (12 2/20, Germany.)

- 2094 BEALL. Registering telephone calls.

- 2096 SHARMAN. Apparatus for controlling and regulating electric currents.

- 2098 ALLOM. Rectifier for telephone calls.

- 2110 GUS FUR DRAHTLOSE TELEGRAPHIE. High frequency telegraphy and telephony over wires. (16/1/20, Germany.)

- 2112, 2113 & 2114 WATKINSON. Resistance switches.

- 2165 LORD & SHAUD & GUNDEL. Lighting gas fires by means of electricity.

- 2176 DYE & LUCAS. Fly wheel magneto and electric lighting generator.

- 2192 KOPFENSTEINER. Galvanic elements. (31/12/19, Austria.)

- 2204 ARMSTRONG. Lamp holders.

January 17, 1921.

- 2245 BRITISH LIGHTING & IGNITION CO. & ETCHELLES. Suspension of train lighting dynamos.

- 2274 B. T.-H. CO. (G. E. Co.) Variable resistances.

- 2298 AKT. GES. BROWN, BOVERI & CIE. Mercury-vapour rectifiers with mechanical current rectifiers. (31/1/20, Switzerland.)

- 2299 SOC. LE BASALTE. Insulators for electric lines. (23/1/20, France.)

- 2307 MEYRICK. Insulators for conducting rails, &c.

- 2309 AITKEN. Automatic, &c., telephone exchange systems.

- 2337 PIPER. Time switches.

January 18, 1921.

- 2379 WESTERN UNION TELEGRAPH CO. Balancing ocean cable systems. (28/1/20, U.S.)

- 2385 FALKING LIPS & CO. & WOOD. Electric cooking and heating devices.

- 2392 SIEMENS & RIBER. Subscribers' instruments for automatic telephone systems.

- 2410 GURNEY. Leading in tube for electric wires.

- 2416 B. T.-H. CO. (G. E. Co.) Castings for electrical apparatus.

- 2417 B. T.-H. CO. (G. E. Co.) Electric fuses.

- 2432 KIRK & MILLIKEN. Bonding blocks for metal covered wiring.

January 19, 1921.

- 2459 BASTOCK. Terminals for electric conductors.

- 2497 HARRISON. Telephone systems.

- 2499 AUTOMATIC TELEPHONE MFG. CO. Telephone systems.

- 2502 AUTOMATIC TELEPHONE MFG. CO., PASSMORE & MERCER. Telephone systems.

- 2509 MACAULAY. Fuse boxes for electric cables.

- 2519 MACFARLANE. Spring device for suspending electric lamps, &c.

- 2551 MCCARTHY, STEEL & MARTIN. Arc welding of studs, &c., to metal plates, &c.

- 2557 SIEMENS-SCHUCKERTWERKE. Apparatus for suppressing earthing currents in high-voltage nets. (27/1/20, Germany.)

- 2560 B. T.-H. CO. (G. E. Co.) Electron discharge devices.

- 2562 IGORAN ELECTRIC CO. & BERGMANN. Relays.

- 2565 AUTOMATIC TELEPHONE MFG. CO. Telephone systems. (19/1/20, U.S.)

- 2576 ROOS. Electro-magnetic wave transmitting systems.

- 2579 COLUMBUS MCKINNON CHAIN CO. Electric welding of chain links, &c. (7/7/19, U.S.)

- 2591 WHEELER. Non-luminous electric heaters.

January 20, 1921.

- 2653 CODD. Make and break devices for induction coils, &c.

- 2670 SCRUBY. Pendulum electrical indicators.

- 2677 IRELAND & LUCAS. Magnets.

- 2678 EGGERTON. Electric lamps for vehicles.

- 2683 TAKAKA. Tumbler switches.

- 2684 GRUNIG. Signalling arrangement for electric railways. (25 11/20, Switzerland.)

- 2685 B. T.-H. CO. & HASTINGS. Motor control.

- 2709 LLOYD & PEARSON. Electric contacting devices.

- 2711 WHITEHEAD. Means for enabling current of low voltage to flow across proximate surfaces of two conductors in contact.

- 2717 & 2718 NAEF & HUBER. Philips' GLOCIAMPAN FABRICKEN. Electric discharge tubes. (22/1/20, Holland.)

- 2719 BISCHOFBERGER. Induction apparatus for electro-therapeutics. (14/12/20, Germany.)

January 21, 1921.

- 2727 AITKEN. Telephone switching apparatus.

- 2729 CHAMBERS. Electro-magnetic wave receiving systems.

- 2748 MOORE. Incandescent lamps.

- 2754 ARMSTRONG. Electric egg-tester.

- 2766 RADIO COMMUNICATION CO. & LEA. Production of electrical oscillations by thermionic valves.

- 2782 WESTERN ELECTRIC CO. Telephone systems.

- 2785 REICHMISTRIE. Re-inforcing weak continuous currents. (25 2 20, Germany.)

- 2793 LEIGH. Electric irons, kettles, &c.

- 2801 REYNOLDS. Electric heater resistance elements.

- 2803 SIEMENS-SCHUCKERTWERKE. Apparatus for suppressing earthing currents in high-voltage nets. (31/1/20, Germany.)

- 2806 B. T.-H. CO. (G. E. Co.) Measuring magnetic induction.

- 2816 CONDON. Terminals for junction boxes, &c.

- 2825 DUTHALL. Hydro-electric steam power systems for locomotives, &c.

- 2841 NAKKEN. Transforming high impulses into electric current impulses.

received nothing on the matter, and the directors have decided to do so.

Mr. EMILIO DE LA PRADA (Chairman) said that for the purpose of the report and accounts, the directors recommended, and it was carried unanimously.

The LANSBERRY POWER CONSTRUCTION COMPANY, LTD., has declared a dividend of 7 per cent. on the participating preference shares for the past year, and £4 192 is carried forward. The directors state that a further issue of capital will shortly be made.

The directors of the PROVINCIAL TRAMWAYS COMPANY announce that owing to industrial troubles, increased wages and the coal strike, they are unable to recommend payment of an interim dividend on the ordinary shares for the year ending Sept. 30 next.

The directors of the EASTERN EXTENSION AUSTRALASIA AND CHINA TELEGRAPH COMPANY, LTD., have declared an interim dividend for the three months ended March 31 last, of 5s. per share payable (tax free) on the 15th inst. The share register will be closed from July 1 to 8 inclusive.

The directors of the VICTORIA FALLS & TRANSVAAL POWER COMPANY, LTD., have declared a dividend of 5 per cent. on the ordinary shares for 1920 and 4 per cent. on the preference shares in respect of 1920 and 3 per cent. in respect of 1921, all payable (less tax) on the 7th inst.

The accounts of the ARGENTINE TRAMWAYS & POWER COMPANY, LTD., for the year ended Sept. 30 last, show, after payment of interest and sinking fund on debenture stock, and transferring £4 000 to reserve for renewals, a profit of £9 569, which increases the credit balance to be carried forward to £18 324.

The net profit of the IMPERIAL TRAMWAYS COMPANY for 1920 was £24 840. Interest on debenture stock and the interim dividend on the preference shares for the half-year to June 30 absorbed £13 650. A dividend for the year at 4 per cent. on the ordinary capital has been declared and £1 390 carried forward.

The directors of the VICTORIA FALLS & TRANSVAAL POWER COMPANY, LTD., have declared a final dividend of 4 per cent. on the preference shares in respect of 1920, making 10 per cent.; a dividend of 3 per cent. on account of 1921; and a dividend on the ordinary shares of 5 per cent. (all less tax) in respect of 1920.

The Committee of the MEXICAN LIGHT & POWER, the MEXICAN ELECTRIC LIGHT, the PACHUCA LIGHT & POWER and the MEXICO TRAMWAYS COMPANIES have prepared a plan of re-organisation between the respective companies and the bondholders, and the scheme will be submitted for approval at meetings of the bondholders.

The following companies were STRUCK OFF THE REGISTER OF JOINT STOCK COMPANIES on June 3: Bourne End Electric Installation Company, Cold Light (Dussaud Processes), Kamm's Zeropgraph Syndicate (1905), Northern Power Syndicate, P-a-y-e (London) Syndicate, Premier Electric and Hardware Company.

The net profit of Messrs. RANSOMES, SIMS & JEFFERIES, LTD., for the year ended March 31, after charging depreciation and providing for interest on debenture stock, &c., was £15 457, less preference dividend for year (£11 000), leaving £4 457, plus £36 354 brought in, making £40 811. Having regard to present adverse trade conditions, fall in selling values and necessity for conserving resources, the directors do not recommend a dividend on the ordinary shares.

At the annual meeting of the MERTHYR ELECTRIC TRACTION & LIGHTING COMPANY, LTD., recently (Mr. G. J. Somerville presiding), it was stated that the past year's net revenue showed a small increase compared with the previous year, the profit, before providing for debenture and other interest, amounting to £14 473, against £13 393 for 1919. The same rate of dividend as that paid since 1916, namely, 6 per cent., was declared on the ordinary shares, £5 000 being placed to renewals and £1 200 to reserve. The carry forward was increased from £581 to £1 430.

During the year 1920 the SOUTH WALES ELECTRICAL POWER DISTRIBUTION COMPANY sold 57 043 647 units of electrical energy compared with 45 127 985 in 1919, an increase of 11 915 662. Particulars of receipts and expenses are contained in the accounts of the Treforest Electrical Consumers Company, Ltd., which operates the company's undertaking. After payment of all expenses, the credit balance of the year's working was £34 473, which, with £672 brought forward, makes £35 149. Deducting interest on the prior lien debenture stock and debenture stock of the company and depreciation of the new plant, a balance of £4 417 is to be carried forward.

Mr. Roscoe Brunner, who presided over the annual meeting of BRUNNER, MOND & COMPANY, LTD., on the 15th inst., stated that, like most other industrial undertakings, the company had suffered by trade depression, and the profit was down by about £32 000. Trade had suffered the most serious slump it had ever known and that had been aggravated by the strike. The hard logic of events had shown trade union leaders that their policy of fighting wage reductions was wrong. There must be more reduction in wages. Their fuel stocks were nearly exhausted and they had had to close their Winnington and Lostock works, but the Middlewich and Sandbach works were going on at a low rate, and the Silvertown works were going on at about the same rate as last year.

The revenue of the NEW GENERAL TRACTION COMPANY, LTD., for the year ended March 31 was £19 486, and the expenditure, including debenture interest and income tax, £8 502. To the profit of £10 984 is added £9 309 brought forward, making a total of £20 293. The directors recommend that £10 480 should be appropriated to payment of a dividend of 4 per cent. (less tax), the balance of £9 813 being carried

forward. Notwithstanding the continued satisfactory expansion of the Norwich Electric Tramway Company's traffic, the expenditure still further increased, mainly in wages, and the result was a decrease of net revenue. In view of the large amounts required for reconstruction of track and renewal of equipment, the directors of that Company considered it wise to pass the dividend and transfer the whole balance of profit to reserve. The Douglas Tramways Company has resumed payment of dividends on both classes of its shares. There is no change in the position of the guaranteed investment in the Philadelphia undertaking (the Darby, Media & Chester-street Railway Company), but the course of sterling exchange has again further benefited the Company.

The 20th report of the LISBON ELECTRIC TRAMWAYS, LTD., covers the years 1919 and 1920. For 1919, after deducting interest and amortisation on the debentures of the "Companhia Carris de Ferro de Lisboa," interest on and redemption of the debentures of the company and London expenses, the net profit was £74 505, but for the year 1920 the loss was £120 006, or a net loss on the two years of £45 500. Deducting amount brought forward from 1918 (£11 229) and the balance standing to credit of exchange reserve (£15 000) the debit to be carried forward is £19 271. The number of passengers carried in 1919 was 92 143 345 and the receipts Esc. 4 454 174, and in 1920 the figures were 80 567 940 and Esc. 6 088 286 respectively. The decrease in the number of passengers in 1920 is due to the strike, which commenced at the end of July and lasted until the beginning of September, when the service was entirely suspended, and also to some small falling off from the increased fares. Expenditure has again considerably increased from Esc. 3 294 241 826 in 1919 to Esc. 8 808 594 863 in 1920. The heavy increase in expenses in 1920 is not only brought about through the higher wages paid and the increased cost of all local supplies; but is particularly accentuated by the cost of all those supplies which have to be purchased outside of Portugal at enhanced prices, this cost having to be ultimately borne in the very depreciated currency of that country. On account of the disastrous collapse in exchange during the period, it has been necessary to make applications to the Camara for increases of the tariff, with the result that only partial relief has been granted. The last increase of fares was put into force in December last, but as it was totally inadequate to meet the expenditure, an application has been made for a further advance.

The net revenue of the BIRMINGHAM DISTRICT POWER & TRACTION COMPANY, LTD., for 1920 amounted to £94 946, and after meeting expenses, payments to local authorities, income tax, employees' benefit funds and National Insurance, the balance (with £4 354 brought forward) is £71 140. Debenture stock interest absorbed £18 161 and debenture sinking fund £8 985, provision for renewals £8 000, and after paying a dividend on the ordinary shares at the rate of 6 per cent. for the year, £4 508 has been carried forward.

At the meeting last week, the chairman (Mr. C. S. B. Hilton) stated that there was a small falling off in net receipts of £866 in the past year. The gross traffic receipts were about £12 000 more than in 1919, but dividends and interest in investments had fallen by almost a corresponding figure. The business of the Shropshire Power Company had been prejudicially affected by industrial unrest and the result of that company's operations had not come up to expectations. The net result was that they had an available balance of £71 140 compared with £73 953, and the directors recommended payment of a dividend on the ordinary shares at the rate of 6 per cent. The growth of expenses in all directions had been causing the directors grave anxiety, as it appeared that in the immediate future, unless some considerable fall in the cost of operation took place, tramway undertakings would hardly be able to maintain the small margin of profit which they now earned. In 1914 the total wages bill was £57 946 for the four tramways companies in the Birmingham and Midlands Tramways Joint Committee, but in 1920 it amounted to no less than £205 716, and in addition the cost of power had risen from £24 386 to £60 579. In 1914 wages had constituted less than one-third of the traffic receipts, while to-day the wage-earners took more than half the revenue. The Company would be unable to run the services as efficiently as in the past unless some proper relation could be reached between revenue and expenditure.

The directors' report of the GREAT NORTHERN TELEGRAPH COMPANY, LTD., for the year 1920, after setting out particulars of the interruptions of the company's lines, states that the traffic over the cables in Europe and the Far East has been satisfactory, but the economic crisis caused a decrease in Europe in the latter half of the year. Negotiations are proceeding with Poland and Russia, and the board hope to make an early arrangement with the latter for opening the company's station in Petrograd and for transmitting traffic between Europe and the Far East via the Russian land lines. Owing to the depreciation of the Danish crown in relation to sterling, Mexican dollars and yen (the currencies in which the company's principal income is received) the results are better than in 1919. It is proposed to pay a total dividend and bonus of 24 per cent., or 2 per cent. more than for each of the previous three years, and £25 500, or £44 286 more than last year, is carried forward. The traffic receipts and profit from participation in other telegraph undertakings show an increase of £90 270. A minor part of the increase is due to interest on the loan to Finland (£232 232), having for the first time been paid in 1920. Gain on exchange is also £325,863 higher. Interest has increased by £21 477 owing to larger amounts having been held in cash. The total expenditure was higher by £414 281, and £416 667 (or £111 111 more than last year) has been reserved for extraordinary taxes. The directors think that the sum allocated to reserve and renewal fund may properly be limited to the amount required by the Articles of Association, or in round figures £50 000, although the securities

The cost of cables and landlines, &c., has been raised by £282,525, a result of the increased expenditure on cables and new buildings.

Mr. Henry C. Walker, who presided over the annual meeting of WAYGOOD OTIS, LTD., last week, referred to the difficulties encountered owing to the general financial position, labour unrest and the falling off of business. The satisfactory result of the year's working was largely due to the number of contracts secured in the previous period, and in the early part of the year now under review. Owing to difficulties caused by the foundry strike and other troubles, they were unable to obtain deliveries of necessary materials to complete some of the earlier contracts as rapidly as they would have wished, but during the past 12 months they had been able to speed up production and increase the output. During the second half of the year there had been a considerable falling off in the placing of new contracts, owing to the unsettled position, and it was still very difficult to estimate the probable resumption of substantial building activities, but there were indications in some sections of the country that new construction would not be much longer delayed. The company had a number of important contracts in hand. They were fitting the new premises of Messrs. Selfridge & Company with 12 of their largest electric passenger lifts, and they were installing a number of electric and hydraulic passenger lifts for Messrs. Harrods, Messrs. John Barker & Company, Messrs. Dickinson & Jones and Messrs. Peter Robinson. They had just secured the contract for fitting electric passenger lifts in the new County Hall for the London County Council, and there was also a growing demand for the small hand-power lift for household and service purposes. The trading profit amounted to £92,264, and adding dividends on investments, &c., the total was £108,095, the net profit amounting to £83,069. They had placed £30,000 to reserve and £5,000 to pensions fund. They were paying a dividend of 9 per cent. on the ordinary shares. The profit would enable a somewhat larger dividend to be paid, but, in view of the present financial position, he thought it was wise to conserve the company's resources. It was a matter for regret that the condition of the engineering world made it necessary to reduce wages, but it was evident that until prices were reduced by lower costs a resumption of normal trading, with full employment could not be looked for.

New Companies.

The following list is compiled from information supplied by Messrs. Jordan & Sons, Ltd., company registration agents, Chancery-lane, London, W.C.2:—

ALBION PRODUCTS (1921), LTD. (175 073).—Reg. June 7, 1921, capital £500 in £1 shares, to carry on business of manufacturers of electrochemical products and apparatus and carbide of calcium. Directors, C. Bingham, C. H. Bingham (jun.), and A. S. Young. Reg. office, 11, Queen Victoria-street, E.C.4. Private company.

COWEY SPRINGS, LTD. (175 125).—Reg. June 9, capital £10,000 in £1 shares, to carry on the business of motor, electrical and manufacturing engineers, &c. Directors, L. E. Cowey and R. D. Cochrane. Reg. office, Archer Works, Kew Gardens, Surrey. Private company.

INSTALLATIONS, LTD. (174 998).—Reg. June 1, capital £1,000 in £1 shares, to carry on business of electricians, electrical and mechanical engineers and contractors. Reg. office, Coleridge House, Mount-street, Swansea. Private company.

STANLEY PEARCE, LTD. (174 921).—Reg. May 27, capital £200 in £1 shares, to carry on business of scientific instrument makers. Reg. office, 161, Wardour-street, Soho, W. 1. Private company.

VICTORIA ELECTRICAL (MANCHESTER), LTD. (175 145).—Reg. June 9, capital £6,000 in £1 shares, to acquire and carry on business of electrical engineers and contractors. Directors, R. Hodgkinson, J. R. Marsh and J. R. Reef. Reg. office, 27, Berry-st., Buxton-st., London-rd., Manchester. Private company.

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"Aeronautics."—"Machines and Pilots in the R.A.F. Pageant"; "The Loads and Stresses in Aeroplanes," by John Case; and "The Medical Aspect of Commercial Flying," by J. A. Parsons.

"The Cabinet Maker."—"The Lechlade Manor Furniture"; and "Students' Work at the Hammersmith School of Arts and Crafts"; "Efforts to Raise the Standard of the German Case and Wicker Industry."

"Chemical Age."—"Chemistry of Agriculture: The Need for Research"; and "Review of New Works."

"Farm and Home."—"Passing of Control"; "Successful Farming"; and "The Eightieth Royal Show."

"The Fruit-Grower."—"Packing and Grading Problems" (illustrated); "The Royal Show"; and "Artistic Poster Schemes for the Fruit Industry."

"Gardening Illustrated."—"Crops in Very Sandy Soil"; "The Loganberry" (illustrated); and "Winter Flowering Plants in Summer Quarters."

"The Gas World."—"Special By-Product Coking Section"; Sir George Beilby on "Fuel Problems of the Future"; and "Work of H.M. Fuel Research Station."

"Hardware Trade Journal."—"Dealing in Raw Material"; "American Efficiency: Can We Stand Against It," by Ernest J. P. Benn; and "New Implements at the 'Royal' Agricultural Show."

Forty Years Ago.

(THE ELECTRICIAN, JULY 2, 1881.)

UNIVERSITY COLLEGE.—At the conversation which took place at this college in the beginning of this week, several of the Crompton arc lights were used to illuminate the quadrangle.

A FAMILY OF INVENTORS.—Under this title the current number of "Casell's Magazine" has an article on the Brothers Siemens, with portrait illustrations of the three brothers, Frederick, William and Werner Siemens.

THE NEW AMERICAN CABLE.—The telegraph steamer "Faraday" picked up on Tuesday the buoyed end of the new American cable off Land's End, and at 7 a.m. proceeded laying the mid-ocean section of the cable to join the buoyed end off Newfoundland.

ELECTRIC LIGHT IN EDINBURGH.—The North British Railway Company are about to follow the initiative of the Town Council of this city, and will illuminate the Waverley Station on their line by the electric light in August next, on the occasion of the Queen's visit.

THE ELECTRICAL EXHIBITION.—A small pond, about 16 metres in diameter, and 70 centimetres deep, will be constructed near the Exhibition Buildings, in the centre of which a miniature lighthouse, furnished with the electric light, will be placed. M. Trouvé will also exhibit his boat on this pond. Amongst the curiosities that will be shown will be a picture of the 16th century, said to have come from Holland originally, representing an old man holding a peculiarly shaped instrument in his hand. In the corner of the picture is inscribed a latin sentence, which is construed thus: "By means of salts, I will produce light."

Arrangements for the Week.

FRIDAY, July 1st (to-day).

INSTITUTION OF CIVIL ENGINEERS.

10.0 a.m. At Gt. George-street, London, S.W. Discussion on various subjects and close of Engineering Conference.

INSTITUTION OF MECHANICAL ENGINEERS.

10.30 a.m. At Storey's Gate, London, S.W. Conclusion of Conference on The Means of Increasing the Thermal Efficiency of Heat Power Plants.

THURSDAY, July 7th.

INSTITUTION OF RAILWAY SIGNAL ENGINEERS.

6 p.m. At the Midland Grand Hotel, St. Pancras, London, N.W. Paper on "Problems of Automatic Train Control," by Mr. W. J. Thorowgood.

Prices of Metals, Chemicals, &c.

			TUESDAY, June 28.	
			Inc.	Dec.
Copper—				
Best selected.....	per ton	£71 10 0	—	£1 10 0
Electro Wirebars ...	"	£76 0 0	—	£2 0 0
H.C. wire, basis	per lb.	0s. 11 ¹¹ / ₁₆ d.	—	¹¹ / ₁₆ d.
Sheet	"	1s. 0d.	—	¹ / ₂ d.
Phosphor Bronze Wire (Telephone)—				
Phosphor-bronze				
wire, basis	"	1s. 3 ¹¹ / ₁₆ d.	—	¹¹ / ₁₆ d.
Brass 60/40—				
Rod, basis	"	0s. 8 ¹¹ / ₁₆ d.	—	—
Sheet, basis	"	0s. 11 ¹¹ / ₁₆ d.	—	1 ¹¹ / ₁₆ d.
Wire, basis	"	0s. 11 ¹¹ / ₁₆ d.	—	1 ¹¹ / ₁₆ d.
Pig Iron—				
Cleveland Warrants .	per ton	£6 10 0	—	—
Galvanised steel				
wire, basis 8 SWG ..	"	£27 0 0	—	—
Lead Pig—				
English	"	£24 10 0	£1 5 0	—
Foreign or Colonial ...	"	£23 2 6	£1 0 0	—
Tin—				
Ingot	"	£166 17 6	—	£0 2 6
Wire, basis	per lb.	2s. 4d.	¹ / ₂ d.	—
Salammoniac.—Per cwt. 75s.-70s.				
Sulphur (Flowers).—Ton £15.				
" (Roll-Brimstone).—Per ton				
£14 10s.				
Sulphuric Acid (Pyrites, 168°).—				
Per ton, £9 17s. 6d.				
Copper Sulphate.—Per ton £3c.				
Boric Acid (Crystals).—Per ton				
£69.				
Sodium Bichromate.—Per lb. 7¹¹/₁₆d.				
Sodium Chlorate.—Per lb. 4¹¹/₁₆d.				
Rubber.—Para fine, 10¹¹/₁₆d.; plantation 1st latex, 8¹¹/₁₆d. lb.				
The metal prices are supplied by British Insulated & Helsby Cables				
and the rubber prices by W. T. Henley's Telegraph Works Co.				

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Notes.

The Engineering Conference.

THE Engineering Conference, which was held last week at the Institution of Civil Engineers and of which we give a full account in this issue, may, from the electrical point of view, be written down as a success. A fairly wide range of practical subjects was covered in Section VII., which dealt particularly with electrical matters, and electrical engineers also had the opportunity of hearing and taking part in discussions on a number of analogous subjects, thus assisting the cause of electrical development in other fields. Perhaps it was because the meetings took place in the day time instead of the evening, but it seemed to us that the speakers were generally in livelier, which means more critical, vein than usual. This may easily have been due to the necessarily compressed character of the opening remarks and the consequent forcing to the front of debateable points. The result goes to show that discussions of this kind on general controversial matters connected with electrical progress might well form a part of the regular proceedings of the Institution of Electrical Engineers. The information brought to light in this way is just as instructive and, being more interesting, sticks more easily than that which emerges as a result of a formal Paper, when solemnity and involved utterance are often the rule.

Engineers as Arbiters in Trade Disputes.

IN opening the Conference Mr. JOHN BRODIE established what must be a record in the proceedings of the Institution of Civil Engineers by placing in the forefront of the problems with which engineers will have to deal in the near future, the design and construction of machinery for the proper control and handling of matters that lead up to cessation of production. MR. BRODIE suggested, as a means for preventing

such disastrous stoppages as that which has just been concluded, the appointment of an Engineering Committee charged with the duty of carefully investigating the whole question of cessation of production, of developing machinery for the proper judicial treatment of matters likely to lead to such disputes and of handling all such disputes when they arise. There are few engineers who will disagree with this view. We would go further and say that the technical and managerial staffs who, when friction of this kind occurs, are now pushed into the background could, with their inside knowledge of the responsibilities of the employers on the one hand and of the views of the workmen on the other, play a much more important part in bringing about a settlement than they are allowed to do at present. A point not mentioned by Mr. BRODIE, but to which attention must be given in this connection, is that full opportunity should be provided for the expression of the true opinion of both sides. To take only one example of the rigid control of opinion, the arrangements of the average trade union ballot are at the present time most unsatisfactory, as is sufficiently obvious when the small number of the men who have taken the trouble to vote in two recent ballots is evident, while on more than one occasion a ballot which has approved one course has been immediately followed by the adoption of an entirely opposite course. Under such conditions a ballot does not represent the true opinion of those best able to manage Labour's affairs.

An Unjustified Assumption.

THE miners' return to work and the settlement of the engineers' dispute without resource to the strike weapon have been the dual cause of a display of optimism as regards trade in the near future, which we can only hope will be justified. This extraordinary resilience from the depression of the past few months exhibits itself in attempts to show that the world's markets are ours for the asking and that before long a boom will have taken the place of a slump. We would

do nothing to quench such red-hot enthusiasm. But we must point out that those who are responsible for such outpourings have left out of account two fundamental facts. One is that the condition of affairs during the past few months has allowed other competitors to capture our markets and to entrench themselves in positions from which they can only be driven by mass attacks, which we are not yet ready to launch. The other is that peace in the industrial world for at least the time covered by the agreement recently signed between the two parties in the mining industry is taken for granted.

The Manufacture of Electric Locomotives.

A POINT to which electrical manufacturers would do well to pay great attention was made by Mr. ROGER T. SMITH in the course of a discussion on the "Mechanical Advantages of Electric Locomotives compared with Steam" at the Engineering Conference last week. As is well known the steam locomotive industry of this country has been greatly hampered, to the point almost of extinction, by the large railway companies designing and building their own locomotives. Had the policy of the railway companies been different the country, as Mr. SMITH truly said, would have taken an equal position in locomotive building as it has done in shipping. It is sincerely to be hoped therefore that with the development of electric traction the same policy will not be followed in the case of the electric locomotive, but that on the other hand, every opportunity will be given to outside designers and manufacturers to show what they can do in producing this type of equipment. Such freedom of design and manufacture is important equally for commercial and technical reasons, for if the most economic and best engineering locomotive is to be discovered it will only be through the interaction of varying ideas and methods. We were glad to see that Sir VINCENT RAVEN was impressed by the force of these arguments and sees no reason why electric locomotives should not be supplied by private firms. He, however, pointed out that recently the North Eastern Railway had found it simply impossible to get electric locomotives built outside and for that reason were forced to manufacture them themselves. Another question to which close consideration must be given is our present dependence on foreign designs for British electric traction practice. In too many cases in the past we have accepted the lead of Continental and American engineers. The time is ripe for a change in methods. This is the other side of the picture and requires immediate consideration by the electrical manufacturing interests of the country. The chance of a new market is theirs, they must not fail to take it.

Overhead v. Underground Distribution.

THE discussion on the Paper read by Mr. WELBOURN at the Engineering Conference rather misfired when it came to dealing with matters of detail. On the other hand, it led to the airing of some interesting views on the ever-green subject of the relative advantages of overhead and underground wires for electrical distribution. Apart from the æsthetic prejudices of local authorities the whole question is now one of economics, as though there are some interesting technical matters to be solved these present no great difficulties, and it is abundantly evident that no general solution of them is possible. It seems, in fact, that in the majority of cases the overhead system is more satisfactory in country districts and the underground in the more crowded areas, but even to this rule there are exceptions, so that the safest course is for each case to be considered on its merits and to trust those concerned to carry out the work in the best possible

way. For this rule does not reduce but rather emphasises the need for all work being carried out with due regard to engineering principles in accordance with sound mechanical and electrical practice, and it is here that many of the points made by speakers on Mr. WELBOURN'S Paper are well worthy of attention by those manufacturing and installing equipment for this purpose.

Speculation and Practice.

WHAT we have said about Mr. WELBOURN'S Paper might equally well be remarked about Mr. WOODHOUSE'S contribution, which was discussed at the same time, but, though Mr. WELBOURN'S outlook was practical, Mr. WOODHOUSE'S, on this occasion at least, was idealistic. For though his remarks form an interesting speculative study, they give rise to more than a little doubt of both the philosophic and the ordinary kind. It is, perhaps, regrettable, but it is none the less true that the question of power station erection, arrangement and design and the equally interesting problems of transmission and distribution are not settled by estimates, diagrams and mathematics but by the hard facts of finance and material limitations. No one knows this better than Mr. WOODHOUSE, but as Mr. ATKINSON said, though his arguments follow naturally once we accept his premises, to accept those premises is just what it is so difficult to do. This difficulty is increased by the fact that, in such matters, general principles cannot be safely laid down, but the details of every power scheme must be worked out in the light of local conditions. Mr. WOODHOUSE is the engineer of a large power company where some interesting problems, the solution of which must be of general interest, are certainly engaging his attention. We should like to hear more about them and, in exchange, would dispense with such excursions into the realms of speculation.

The Results of a Legend.

THERE is no doubt that the electrical industry and the cause of electricity supply has suffered from the legend that the Government was about to erect a number of gigantic power stations as a first step towards a State-aided electricity service. Though this has often been denied the idea still lingers, and we are, therefore, glad to see that Mr. A. H. PREECE in the course of the discussion on Mr. Woodhouse's Paper at the Engineering Conference pointed out that a 500 000 kW station could not be economically erected in this country owing to coal and water difficulties. This might well be the first step in an argument that what electrical engineers want is not a State electricity service but freedom from legislative control over thought and deed, so that cheap electricity supply may be realised. State interference will be no aid to that end. Electrical engineers, and we include the Electricity Commissioners in the term, have, apart from this desire, quite an open mind as to how cheap electricity supply is to be obtained. They are wedded to no fetish and expect the sudden discovery of no panacea for present ills. They only ask to be left alone to work out their own salvation, freed, as far as possible, from State aid and interference. When the public know this we feel sure they will be at one with them.

More Joint Authorities.

THE lull in the activities of supply undertakers framing schemes for the formation of Joint Electricity Authorities has been broken by the proposals for the North-East Midlands and the North Lancashire and South Cumberland Electricity Districts. The scheme for the North-East Midlands which has been prepared by Sheffield Corporation contemplates a Joint Authority of only 18 members, of whom 12 would be

appointed by the Sheffield and Rotherham Corporations. Of the remainder two would represent the Chesterfield and one Doncaster Borough Councils, while the County Councils of the West Riding of Yorkshire, Derbyshire, Nottinghamshire and Lindsey would also have one representative each. This is an unusually small Authority, though this is not in itself a disadvantage, for the more compact such a body is the more likely is it to do really useful work. There appears, however, to be no provision for the representation of Urban and Rural Councils, large consumers, railway companies or other interests, but as the scheme is only in draft form this omission can be rectified. All generating stations in the District will be vested in the Authority to whom the existing purchase rights of local authorities will be transferred.

Technical Details.

In the first stage, which will cover a period of five years, it is proposed to limit operations to the inter-linking of existing stations. This work will be carried out gradually, commencing with the inter-connection of the Neepsend, Blackburn Meadows and Rotherham stations; links will be effected later between Rotherham, Mexborough and Doncaster, between Neepsend and Dronfield, Sheepbridge, Chesterfield, Clay Cross, Staveley, Barlborough and Eckington, and ultimately the principal rural and industrial areas will also be joined. The maximum load of the present undertaking in the period mentioned will reach 150 000 kW and with the demands of existing private plant owners and collieries it is estimated that the total will be 227 000 kW, allowing 57 000 kW for spares. The existing plant installed and on order will provide 206 910 kW, leaving only some 2 000 kW further to be provided by the end of the period. During the second period of development it is estimated that the maximum load will have increased to 280 000 kW, due to an extra 50 000 kW from authorised distributors, 40 000 kW from the railways, and 20 000 kW from the collieries. With a reasonable allowance for spares the generating plant must have a capacity of 375 000 kW, so that 146 000 kW of new plant must be provided, of which 30 000 kW will be placed in Blackburn Meadows and 30 000 kW in Rotherham. It is also proposed to erect new stations at Doncaster and Mexborough of 90 000 kW, to be increased later to 120 000 kW. As the plants at the following stations become obsolete they will be discarded, provided an alternative and cheaper supply is available: Sheaf-street and Kelham Island stations at Sheffield; the existing stations at Chesterfield, Doncaster, Worksop, Mexborough and Rotherham No. 1 station. The system of generation will be the usual three-phase at 50 periods. The scheme also includes provision for supplying the railways in the area with an extra high-tension supply into sub-stations at convenient centres.

Belittling British Instruments.

AMONG the many extraordinary statements which have been made for and against the policy enshrined in the Safeguarding of Industries Bill surely the most extraordinary must be one which appeared in a recent issue of the "Westminster Gazette" laying down as practically indisputable that the Weston type of electrical measuring instrument was so essentially different from and superior to any electrical instrument of the same kind that it was regarded by electrical manufacturers in this country as a "basic tool." We have the greatest regard for the Weston instrument, but we doubt whether even those who sell it make that claim for it. This statement, of course, was an argument against the inclusion of electrical instruments in the schedule to the Bill and for such purposes misrepresentation is not unusual. We are glad, therefore, to see that Mr. D. N. DUNLOP has been pointing out to our contemporary that electrical instruments made in this country are quite capable of performing precisely the same functions with as high a degree

of accuracy as even the Weston instrument. It was a point which required making. For while the tendency to praise the deeds of days gone by was a habit well known even in classic ages, in these latter days there is a further tendency to rate the products of every other country but our own at a higher value than anything we ourselves can manufacture. It is a form of negative advertisement which does us a good deal of harm and should be stopped even at the expense of a virile political argument.

Dover Again.

THE letter from Mr. W. ARTHUR JONES, general secretary of the Electrical Power Engineers' Association, on the new policy of the Dover Electricity Committee with regard to the payment of their staff emphasises the point which we made in our Editorial Notes a week or two ago. We are among the most ardent supporters of the settlement of industrial disputes by constitutional methods, but we admit that no agreement can be reached by such means unless both sides show a spirit of compromise and fair dealing in issues that may happen to arise. In this particular case the authorities at Dover have thrown over a definite agreement at the shortest notice and without any resource to the machinery which exists for dealing with such matters. As Mr. JONES rightly says, it is not a matter which the Association can afford to let pass unchallenged, and, while wishing the Association every success in bringing things to a satisfactory conclusion, we hope that it, in its turn, will not forget the need for sticking to constitutional methods. More than ever it is becoming evident that the strike, and even the threat of a strike, bring more harm than good to those who wield such weapons. But that does not excuse the Dover Electricity Committee.

Progressive Grimsby.

THE private Bill legislation of the year is comparatively limited, but from several points of view the Bill of the Grimsby Corporation is of exceptional interest. It is a bulky measure of 216 clauses, with three schedules. It confers extensive and somewhat unusual health and local government powers which at least stamp the local authority as one of the most progressive and enterprising in the country. There are 19 parts to the Bill, but we shall confine our attention to those relating to tramways and electricity supply. The undertaking of the Great Grimsby-street Tramways Company being purchasable by the Corporation, authority is given for working tramways within the borough, for constructing additional lines, and for providing and operating a system of trolley vehicles. Apparently the tramway rails are to be such as the Minister of Transport may approve and plans of the proposed mode of construction, as well as a statement of the materials intended to be used, are to be submitted and approved by the Minister. A penalty of £5 a day will be imposed for not maintaining the rails and the surface of the road in good condition and repair. If such a penalty were imposed on some tramways known to us, it would cause them to go into liquidation, but perhaps things are different at Grimsby. The Corporation also desires authority to run trailer or coupled cars, to convey road materials on the tramways and light parcels (under 56 lb.) on the trolley vehicles, to purchase tramways outside the borough boundary. There are also useful powers for the regulation of motor traffic.

A Wise Financial Clause.

THE revenue of the tramways and trolley-vehicle undertakings is to be applied to paying the working and establishment expenses and to meeting the cost of maintenance, paying interest on the capital and to providing the necessary sinking-fund appropriations. If there is any balance left, it is to be used in extending and improving the undertaking and in

providing a reserve fund (if the Corporation think fit) up to two-fifths of the aggregate capital expenditure for the time being. Apparently, the relief of rates is not contemplated, and, though the provision as to the creation of a reserve might be somewhat more compelling, it is a welcome change from the usual attitude of local authorities on this important question. Any balance on the trolley-vehicle branch of the undertaking is to be carried to the credit of the tramways, but any deficiency on it is to be met out of the tramway revenue, and, if that is not sufficient, out of the borough rate.

Additional Electricity Supply Powers.

THE sections of the Bill relating to electricity supply confer some useful powers which are essential for modern supply undertakings. The Corporation may fit up showrooms, exhibit specimen installations and give demonstrations of the uses to which electrical energy may be put; it may, on giving due notice, cut off supply from any consumer who uses electricity contrary to the terms of his agreement; mains may be laid in streets not repairable by the inhabitants at large; the maximum price has been increased to 1s. per unit, but provision is made for the revision of the maximum charge at the end of three years and at subsequent intervals of two years. The Corporation is to be entitled to make agreements for the supply of electricity in bulk and to adopt any method of charging for energy that may be selected subject to the approval of the Electricity Commissioners. Though some of these powers could be obtained by provisional order, the Local Legislation Committee, which considered the Bill, recognised that the Corporation were justified in including these provisions in a General Powers Bill. This method has distinct advantages, especially if the powers desired are unopposed.

The London Electricity Inquiry.

It is devoutly to be hoped that the protracted inquiry into the existing arrangements for the supply of electricity in the London and Home Counties Electricity District will produce some practical results in the shape of a comprehensive scheme for the whole or the greater part of this important area and thus put an end to the present chaotic state of affairs. As our readers are aware the situation is complicated by the multiplicity and the conflicting interests of the various supply undertakers and by the mutual jealousy of some of the local authorities in the district. One result of this conflict of interests is that it has been found impossible to submit a scheme representative of all parties, and the Electricity Commissioners have been forced to consider no less than six sets of proposals, only three of which cover the whole district or include the formation of a Joint Electricity Authority as contemplated by the Electricity Supply Act of 1919.

ENGINEERS ALL AGREED.

It is not from the engineering side that this obstacle has arisen, for fortunately there is general agreement between the engineers of all the parties as to the general lines upon which electricity supply development should take place, but from the administrative and financial interests involved in the creation of a Joint Authority. However, the time and the energy expended on the present thorough investigation of London's electricity supply facilities will not be wasted, for though the Commissioners may not find in any of the three big schemes an acceptable solution of the present problem, each of them contains so many good points that we hope that by combining what is useful in them it may be possible to hammer out a

product which will be acceptable to the great majority of the local authorities and supply companies.

CHANGE OF PROCEDURE.

Realising the importance and complexity of the problem to be solved the five Commissioners attended, and each of them put a good many relevant questions to the witnesses. Early in the inquiry it was announced that each of the promoters of the three big schemes, the London County Council, the Conference of Local Authorities and the London Electricity Joint Committee (1920), Ltd., had reconsidered the position in the light of further particulars available, and had submitted supplementary technical particulars to the Commissioners, thus introducing a considerable modification of the original schemes. The reason for this change is purely financial, at the which we are not surprised, considering the present difficulty in raising capital while the high price of plant and buildings would handicap any new capital stations. It will be remembered that originally it was proposed to erect four new capital stations on the Thames at Beckton, Greenwich, Blackwall and Chiswick, each to have plant of 200 000 or 250 000 kW, while two of the existing electricity stations were to have been re-constructed as capital stations. This ambitious programme which was to have been carried out in two stages, has been postponed, and in its place we are to have an elaborate scheme of interlinking with extensions of plant at the more up to date and economical of the existing generating stations.

MODIFIED SCHEME.

In the first stage of the modified scheme, for the completion of which no definite date is given as this must necessarily depend upon such circumstances as the demand for energy, eighteen of the existing generating stations will be shut down progressively and forty-three retained; and in the second stage twenty-six of these would gradually disappear, leaving only seventeen, of which twelve are at present owned by companies. It is proposed to interconnect thirty-one of the existing stations in the first stage, mainly by medium-pressure cables (11 000 V), though there are to be six 33 000 V and three 20 000 V cables. Owing to the high cost of capital and the abnormal price of plant, &c., it is calculated that the erection of the new capital stations at present would not permit electrical energy to be supplied more cheaply than if the most economical of the existing stations, which are mainly in the centre of the defined area, were utilised and linked up. The supplementary particulars give the average cost of energy delivered to the feeders by authorised distributors at 1'385d. per unit, compared with 1'488d. in the first stage of the original scheme, or 1'377d. if the estimated railway load of 200 000 kW were included. By interlinking and by extending some of the existing stations there would be a total plant capacity of 577 000 kW in 1925, which should carry a maximum load of nearly 500 000 kW, allowing for reserve plant. By this means it is hoped to postpone the erection of the capital stations until 1926 or later.

THE RAILWAY LOAD.

It will be remembered that one of the reasons for passing the 1919 Electricity Act was to provide a cheap supply of electricity for the railways. It now appears that the railway companies and their advisers are confident that they can generate energy more cheaply themselves than any Joint Authority, and in this they are supported by Mr. J. H. RIDER, though some of the Commissioners appear to be sceptical. The reason given by Mr. RIDER for his opinion is that the Joint Authority would be compelled to provide a sinking fund on its capital, while the railway companies, which could raise capital as cheaply, would be under no such obligation.

Assuming this to be the case, although it is doubtful if capital could be obtained as cheaply by a railway company as by a Joint Authority with the security of the rates behind it, the railways would not come under the Joint Authority, and their generating stations would not be subject to that unified control which is so desirable, though they would sell their surplus energy to the Authority. It appears that in defining the London and Home Counties District the Commissioners had in contemplation the use of the railway supply in the outlying parts of the area, but with the modified interlinking scheme it will be some years before mains can be extended by the Authority to Dorking, Guildford, Reigate and other parts on account of the cost involved. At all events, under the modified scheme it is clear that the Joint Authority would not be in a position to meet the railway requirements, and so the railway load has been excluded from the calculations made by the engineers.

ADMINISTRATIVE DETAILS.

A good deal of time was taken up in the cross-examination of the witnesses on the question of the constitution of the Joint Authority, on the expenses of administration and other details. The representatives of the Conference scheme attacked the constitution of the Joint Authority proposed by the London County Council as the latter's representation was considered to be too high, and sec. 6 of the 1919 Act was invoked in aid of their objection. This clause, which lays down that a Joint Authority is to be representative of authorised undertakers in the electricity district, gives full powers to the Commissioners to add the representatives of the Council of any county within the district, local authorities, large consumers of electricity and other interests, and in view of the peculiar and important position which the London County Council has always occupied in connection with electricity supply it is, we think, entitled to special treatment. This question of representation is important, but it is not one of immediate urgency. Once the Joint Authority is formed and in working order the problem can be tackled, and no doubt, under the guidance of the Commissioners, some general principles can be laid down which will give equitable representation to all interests.

THE COMPANIES' POSITION.

The proposals submitted on behalf of the companies would confine the operation of the Joint Authority to an area within a radius of ten miles of St. Paul's at the outset, but the feeders and secondary transmission system would permit of extensions being made to the outlying parts of the defined district as required. In this restricted area the existing municipal and company undertakers supply 93 per cent. of the total load in the whole of the district, and for the sake of economy it is not proposed to give a supply in the outer areas until the demand justifies it. Another difference between the companies' scheme and those of the L.C.C. and the Conference of Local Authorities is that it is not considered economical administration to have one central authority for the whole of the electricity district and most of the real work would be delegated to Technical, Financial and General Purposes Committees. On the other hand, the Joint Authority of the Companies would be very large and unwieldy, consisting of about sixty-two members and depending upon a number of varying factors, such as the number of stations transferred, the amount lent to or guaranteed for the Authority, &c. No doubt most of the useful work would be done or prepared by the committees, and the Authority, by the very nature of its size and composition, would have very little real authority. In our opinion, this is not a desirable arrangement, and it would ultimately lead to friction between the various local authorities in the area.

FINANCIAL PROPOSALS.

The first stage of the amended scheme involves the provision of only £1 050 000 new capital, and the companies offer to lend this sum to the Joint Authority on certain conditions. It is also proposed to avoid the issue in the initial stage of capital or stock by the Joint Electricity Authority, by taking over on leases the generating stations of existing undertakers at an annual rent of 7 per cent. of the capital cost, less depreciation. This is an ingenious, though perhaps not the most economical, method of getting over the legal and other difficulties of the situation, and it appears to have found some favour with the Commissioners, for on the suggestion of Sir JOHN SNELL, counsel for the various schemes have agreed to confer with a view to the submission of agreed proposals on the question of leasing.

AREA OF THE DEFINED DISTRICT.

Another interlude in the proceedings was provided by the various authorities who objected to the area as defined by the Commissioners. The Middlesex County Council wanted to be excluded, while the Surrey Company Council, only part of whose territory is included, wanted to come in. Watford and Reigate Urban Councils and the North Metropolitan Electric Power Supply Company wanted to be left out of the L.C.C. scheme, and the Watford, Reigate and Epsom Urban Councils opposed that of the Conference of Local Authorities, while the representative of Poplar Borough Council, which objects to all three schemes and puts forward a fanciful one of its own, had several innings and cross-examined every witness. The moral of it all is that there is no chance of an agreed scheme, representative of all authorities and all interests, and we hope therefore that the Commissioners will not pay much attention to the petty, selfish views of some of the Municipal Councils and of one of the County Councils involved, but bear in mind the needs of the area as a whole.

THE KEY OF THE SITUATION.

Of course, finance is the key to the situation. It is essential to the success of any scheme, but until the Electricity Supply (No. 2) Bill is passed, local authorities cannot give any financial assistance to the Authority. Apparently, the advisers of the London County Council think that the Bill will become law, and their scheme is based on this assumption. We hope that they have good grounds for their belief, but as the Parliamentary Session is so advanced and the Government programme so heavy, we are afraid that nothing but an agreed measure could be got through this year. At present there are no signs of the withdrawal of opposition to the Bill, and there is, therefore, little chance of its success under present circumstances. In this connection it is interesting to notice that the London supply companies have suggested that they might provide the Joint Authority with capital, and that the London County Council should guarantee the interest upon it. This would be one way of getting over the present difficulty, but we are inclined to think that if it is *ultra vires* for the County Council to raise money for lending to the Joint Authority it would be equally illegal to pledge the county rates by guaranteeing interest on the loan made by the companies. However, so far as we can see the only alternative to this course would be a combination of local authorities under the Electric Lighting Act of 1909. The companies are an important factor in the situation, and we are pleased to see that Mr. HUME and other witnesses favouring an extension of the period of their concessions as authorised distributors. At present they are purchasable in 1931, but provided suitable terms can be arranged we see no reason why they should be disturbed in their work of distribution. Some such arrangement might easily reduce the full blast of their opposition.

The Engineering Conference—1921.

American Engineers' Tribute to British Work.

THE ENGINEERING CONFERENCE, which is held under the management of the Institution of Civil Engineers, opened on Wednesday last with the reception of a deputation from the four great engineering institutions of America who attended to present an address expressing the obligation which the United States and the world generally owed to British engineers for the part they played in winning the war and to hand to SIR ROBERT HADFIELD the John Fritz medal which has recently been awarded to him. Mr. AMBROSE SWASEY, past president of the American Society of Mechanical Engineers, headed the deputation.

THE ENGINEER AND TRADE DISPUTES.

In opening the conference Mr. JOHN A. BRODIE, President of the Institution of Civil Engineers, said that this was the fifth conference of its kind that had been held since 1897. It was long overdue owing to the war. When it was decided to resume the holding of the conference this year it was hoped that the country would have returned to more normal times, but unfortunately that had not been the case. Recent events had shown the great need for machinery for the proper control and handling of all questions which led up to the cessation of production particularly in branches of work which were of vital importance to the nation. Thoughtful people, among whom he included engineers, could not consider it creditable that the treatment of industrial disputes and their consequences should be left so largely to chance as was too often the case to-day. In these matters he felt the engineer should play the predominant part.

For the competent engineer had a special and intimate knowledge of workmen through coming into actual contact with them and it was part of his training to understand their point of view, their capabilities for producing work and their possibilities generally. Usually an engineer could take an impartial view of the questions in dispute because he had no special interest in the employers' side nor in that of labour. At the present time the prosperity of the country was being held back and being endangered by harmful differences between employers and workmen, but the whole question of production, whether the dispute be due to strikes, lock-outs or other causes, would have to be gone into, the essentials carefully considered and solutions found. Perhaps the best way of doing that would be to form an engineering committee charged with the duty of carefully investigating the whole question of stoppages in production, of developing machinery for the proper judicial treatment of matters likely to lead up to dispute and of handling all such disputes when they did arise. Such a step would be a worthy outcome of such an important conference as the one he was inaugurating. He admitted that no solution which might be found was likely to satisfy the extremists on either side, nor, perhaps, those who made these disputes their hunting ground. Engineers, however, would not easily be deterred by difficulties of this kind and he was content to leave it in their hands.

In conclusion, Mr. BRODIE offered a cordial welcome to this country to the American engineers who had come over to present the John Fritz medal to Sir Robert Hadfield and commented upon the presence of Lord Bryce, who, he said, had contributed in no small degree to the good feeling between this country and America.

A MESSAGE OF GOODWILL.

Dr. IRA N. HOLLIS, past President of the American Society of Mechanical Engineers, then delivered a message of goodwill from American engineers to British engineers. He referred at length to the manner in which the two countries had fought side by side during the war and to the important part which the engineering institutions of both countries would play in promoting good feeling between them. The most important problem, he said, was the education and training of men for industry and in this connection the amalgamation of the four great engineering institutions in America, viz., the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers and the American Institute of Electrical Engineers into the United Engineering Society and its division into three Departments, viz., the Engineering Societies Library, the Engineering Foundation Board and the Engineering Council, was important. This body, which together with the other Departments, was centred in the American Engineering Societies' Building, New York, included all the engineering societies in America, which now had one library common to them all and one central building in which their meetings and conferences were held.

Dr. W. C. UNWIN replied on behalf of British engineers and Lord Bryce also made a few remarks.

PRESENTATION OF THE JOHN FRITZ MEDAL.

The presentation of the John Fritz medal was then made to Sir ROBERT HADFIELD by Mr. AMBROSE SWASEY, Chairman of the Award Board of the four institutions which had been formed to make the award. In a brief speech, Mr. Swasey referred to the work of Sir Robert Hadfield, both as a great leader of industry and as a scientific man.

It may be mentioned that the John Fritz medal is a gold medal presented for achievement in applied science as a memorial to the great metallurgical engineer whose name it bears. John Fritz, who was born in America in 1822, accomplished many remarkable achievements in engineering during his long career. He died in 1913, but it was on the occasion of his 80th birthday in 1902 that the four American engineering societies were instrumental in obtaining a large sum of money to form the John Fritz Medal Foundation. John Fritz was largely instrumental in the foundation of the Bethlehem steel works, and erected the 100 ton steam hammer which at the time was one of the marvels of the engineering world. The medal is awarded irrespective of nationality or sex for scientific and industrial achievement in any field of pure or applied science, and it has already been awarded twice in Great Britain to Lord Kelvin in 1905 and to Sir William White in 1911.

Sir ROBERT HADFIELD made a brief speech thanking the American societies for conferring this honour upon him, adding a personal touch about the kindness of the Board of Award. It would, he said, have been his great pleasure to go to New York to receive this high distinction; owing, however, to the disturbed industrial conditions prevailing here he felt it was undesirable to leave this country at this time, and recognising the position, the Board of Award promptly replied that they would send a deputation to this country to confer the medal upon him here.

The work of the Sections of the Conference was then entered upon, and an account of some of the proceedings is given below.

PROCEEDINGS IN SECTION VII.

The meeting of Section VII, which covers Electricity Works and Power Transmission, was presided over by Mr. LLEWELYN ATKINSON, who expressed regret at the inability of Sir John Snell to take the chair, owing to the fact that the Electricity Commissioners were still considering the London electricity supply problem.

The purpose of the Conference, Mr. ATKINSON pointed out, was to afford an opportunity for the discussion of subjects which though of burning interest to the profession did not always lend themselves to the reading of formal Papers. It was a happy omen that the coal strike had now come to an end, and that our industrial and engineering life would soon be getting into motion again. He echoed the thought that had been expressed by several speakers that morning, that much might have been saved if an efficient organisation for a conference in the industrial world had existed. Some such organisation was necessary to bring the consumer as well as the skilled worker and the shareholder into phase.

A discussion on "Low Power Factor" was then opened by Mr. R. O. KAPP, whose introductory remarks we give in abstract below.

Low Power-factor.

By R. O. KAPP, B.Sc.

The principal disadvantages of a low power-factor from the supply engineer's point of view are:—

1. The capital cost of the electrical part of an undertaking is inversely proportional to the power-factor, so that if the tariff were worked out on the assumption that the average power-factor would be 0.8, it would pay the undertaking to offer a rebate of anything up to 5s. per 1 000 units to any consumer improving his power-factor to unity.
2. Wherever the station busbars are sub-divided by reactances and power has to be supplied from one busbar section to another with a bad power-factor the regulation is very bad and the alternators on the more heavily loaded sections supply an undue proportion of wattless current, so that the alternators on this section, if designed for the average power-factor of the system, are fully loaded while the steam turbines are not fully loaded. The result is high-steam consumption.
3. Wherever a district has a high-voltage supply through step-up and step-down transformers, the fluctuation of the consumer's

volts is greatly increased by a bad power-factor. So a consumer having a bad power-factor becomes a nuisance to his neighbours as well as an expense to the supply undertaking.

4. Unless special methods of power-factor improvement are installed the light load power-factor is considerably worse than that at full load on most installations. In consequence the alternators are fully loaded and the turbines lightly loaded, and the steam consumption at light load such as during week-ends and during periods of trade depression is unduly high.

The first of the points mentioned above is more important the larger the undertaking, as the cost of the distribution system increases the more the generation of electricity is centralised. Arguments 2 and 3 apply almost exclusively to large undertakings. The question of power-factor improvement is therefore one of growing importance. We could sometimes neglect it in the past; we shall not be able to afford to neglect it on the super-power schemes of the future.

EFFECTIVE POWER-FACTOR IMPROVEMENT.

To be effective, power-factor improvement must be carried out at the far end of feeders. There is no technical difficulty about this. A number of devices are on the market, and have been in use for many years. Their capital and running costs are generally much less than the cost of a bad power-factor. The difficulties of supervision and divided responsibility make it undesirable for the supply undertaking to pay for devices which are accessories to the consumer's plant, and so the problem for the supply engineer is to devise a tariff which will cause the consumer to instal such devices.

TARIFFS AS AN AID TO HIGHER POWER-FACTORS.

To be effective, such a tariff must make sufficient difference between the electricity bill for a good and a bad power-factor to make it worth the consumer's while to effect the necessary improvement, it must be simple and free from ambiguity. The consumer must be convinced that it is fair. It should be based on integrating or recording instruments rather than on indicating instruments, as the latter type of instrument may be giving anything but a fair average figure at the time when it is read. It must be possible to determine the quantities for which a charge is made with accuracy, and the instruments for doing this must be inexpensive.

A method of charging frequently employed is a slight extension of the usual two-part tariff. In addition to a small charge per unit, a fixed charge per kilovoltampere of maximum demand is made. This charge places power-factor and load-factor on the same basis, which is not quite justifiable. A bad load-factor affects the capital cost per unit sold of the whole undertaking, a bad power-factor only that of the electrical part. On the other hand, a bad power-factor has other drawbacks besides those of increasing the capital charges per unit. The power-factor is under the consumer's control; generally the load-factor is not. A tariff which deals jointly with both is not likely to make it sufficiently obvious to the consumer how he can reduce his bill by installing power-factor improving devices. Another drawback of this method of charging is that no satisfactory maximum demand kilovoltampere meter is yet in use. Those used are really maximum current meters, so they depend on the constancy of the supply voltage for their accuracy.

ADVANTAGES OF THE ARNO TARIFF.

The above disadvantages do not appear to be serious and have not prevented this system from being adopted by some undertakings, but other more direct methods would appear to meet the case better. One such is the well-known Arno tariff. This is a charge per unit consisting of two parts. The first part covers the works costs and as much of establishment charges and capital charges on the non-electrical part of the undertaking as is to be paid for by power consumers. The second part covers the capital charges on the electrical part of the undertaking. A single meter is used which integrates kilowatt hours plus a fraction of kilovoltampere hours, so that the bill can be based on a single reading. A modification of this tariff has been suggested in which two standard watt-hour meters are used, and a simple computation from their readings gives a very close approximation to the Arno charge, which is the scientifically accurate one.

BONUSES FOR CONSUMERS.

All these methods suffer from one drawback. The consumer is paying for something of which he does not get the benefit: that is, he is paying in one way or another for the idle component of power. No doubt, if supply undertakings start an educational campaign consumers will eventually come to understand that such charges are not only fair, but to the interest of everyone concerned. They will find it much easier to understand this, however, if the adjustment takes the form of a bonus for a good power-factor

rather than a penalty for a bad one. It is suggested that tariffs should be based on the assumption that the average power-factor will be 0.8. It is reasonable to expect consumers to have a power-factor of this value without any special appliances, so very heavy penalties may be exacted for values below 0.8. If the consumer improves his power-factor above 0.8 the supply undertaking should allow a bonus of so many pence per 1 000 units for every 1 per cent., by which the average power-factor as shown by the readings of two standard integrating watt-hour-meters is improved.

DISCUSSION

The CHAIRMAN remarked that the question of power factor was becoming a serious matter now that the era of large stations and wide distribution had begun. The devices for rectifying lagging current to which Mr. Kapp had referred could be grouped under a number of headings. But all these systems involved additional apparatus which did not necessarily automatically adjust themselves to the amount of current that was being provided. Sufficient attention had not been paid in this country to the possibility of employing asynchronous motors which ran with unity power factor on practically all loads. This type of motor had been developed to a considerable extent in the United States, and should have attracted interest over here in view of Mr. Kapp's suggestion to give a bonus to those who improved their power factor.

THE CONSUMER PAYS.

Dr. S. P. SMITH said that the problem of power factor improvement was well understood from the technical point of view, but had been rendered more acute by high costs. It had not been seriously attacked, perhaps, because it had not yet sufficient economic importance. It was important to note that low power factor was eventually paid for by the consumer either in the form of rectifying apparatus or in tariffs. The more just arrangement seemed to be to make the consumer himself put down apparatus, because it got at the man who was causing the trouble. In the case of a level tariff rate a consumer with a high power factor was penalised to help the consumer with the low power factor. The installation of rectifying apparatus might mean the employment of additional skilled attendants, and that must be taken into account. Mr. Kapp had referred to the use of reactances but Dr. Smith thought that reactances were really a feature of the transitory stage through which we were now passing, and that, in time, every part of the circuit would be so safe that nothing would be damaged under any short-circuit conditions. Though the alternating current commutator motor was theoretically infinitely superior, in practice it was very much inferior to the simple induction motor. This must be emphasised because the feeling against the alternating current commutator motor was getting a little milder, and with the necessity for speed control it was certainly an economic solution to use such an apparatus and, if it were possible, at the same time to keep a high power factor.

Mr. W. R. COOPER thought the psychological side of the subject was important. The consumer did not want to spend money on plant, and certainly not on rotary plant, which required attention. That was a strong argument for the condenser.

THE ELECTRIC FURNACE AS AN IMPROVER.

Mr. S. E. FEDDEN said that he had been up against the power factor question for years, and though he had tried many methods for improving it, the problem became more important as his undertaking grew. Originally, he had a tariff which penalised consumers with motors whose power factor was less than 0.8, but this was unpopular with the manufacturers. He then specified that the alternators should do their full load at 0.65 power factor, but this was increased to 0.8 by the introduction of the electric furnace, which was a wonderful rectifier of power factor up to a certain point. Rolling mills were the greatest sinners in this respect, and he proposed making them pay for their low power factor. The difficulties of low power factor would be much increased with super station schemes where they generated at a fairly low voltage, and then transformed up for transmission and down again for distribution. Individuals who were the cause of low power factor were the people who ought to be made to pay and some tariff should be designed which would be sufficient incentive to put in a rectifier. A power factor of 0.8 was satisfactory and to raise it to unity was not worth while.

THE COST FACTOR.

Mr. W. M. SELVEY said that there was no real scientific problem in connection with power factor which could not be solved at a cost. If, as the author said, capital and running costs were generally much less than a bad power factor that placed the onus entirely upon the supply authority. It was very encouraging to find that E.D.A. had memorialised the Electricity Commissioners on the question of standardising tariffs on a kilovoltampere basis. He believed the question would have to be faced by using tariffs on the lines suggested by the author. But it was the magnetising current of the motors which caused the low power factor and the tariff might have to be based, not on the kilovoltampere demand but on the kilowatts installed.

LET WORK WHOLE?

Mr. C. P. SPARKS wondered whether the improvement of power factor on the lines suggested was worth while. He gave instances of two cases where power factor correction was obviously commercially advantageous and argued from these, that power factor correction was a commercial proposition which should be employed on a larger scale than it was at

present. It was unfair that the consumers as a whole should pay for this correction as only a certain percentage were responsible for the low power factor, and he was entirely in agreement with the suggestion that power factor should be taken into account in fixing the tariff. A figure of 0.8 could be taken as a basis as working to unity power factor was uncommercial. If the undertakers could not tempt people by such tariffs they must provide special apparatus to obtain the necessary improvement.

Mr. A. H. DYKES said a system he had found effective was to charge on the kilovoltampere basis, using a simple maximum current indicator to measure the maximum kilovoltampere together with a running charge per unit. He assumed a standard power factor of 0.8. He had had very good results from condensers installed at stations where the power factor had to be improved but there was no doubt that the proper place for such apparatus was on the consumers premises. Some modification of the Arno system seemed to offer the greatest advantages.

In reply to the CHAIRMAN, Mr. FEDDEN said that the effect of the steel furnaces was that they gave a large load at a good power factor so improving the whole.

LOW POWER FACTOR AND DIVERSITY.

Mr. J. R. BLAQUIE said that if an intermittently running power load was charged for on a low power factor basis it simply meant that the plant at the station was hired by the quarter or the year. Low power factor consumers got no advantage from diversity to which they contributed very largely, and they also paid the penalty for their low power factor. As regards charging it was quite easy to apply a power factor basis with a different scale of fixed charges, i.e., consumers could be classified according to power factor and a fixed charge arranged for each class. The apparatus required would simply be a maximum demand current meter. It had been said that commutator motors were neglected in England, but there was one designed by Mr. Creedy and manufactured by Parkinsons, which operated marvellously well, due, he thought, largely to improvements in carbon brushes, which got rid of excessive sparking at the commutators. If commutator motors were employed there was a chance for single-phase. Another aspect of the problem was how far the central station contributed to bad power factor. The number of transformers in circuit might have a great deal to do with it; this should be taken into account in framing a tariff with large consumers.

Mr. R. O. KAPP, in reply, said a 0.8 power factor could be obtained with reasonably good meters, but to obtain a better power factor he thought that something in the nature of condensers or other plant would have to be installed at a cost of between 30s. and 50s. per kilowatt in order to improve the power factor from about 0.8 to 0.95. Improving the power factor from 0.95 to unity would cost a great deal more, but as had been shown in the Paper the cost of bad power factor was very much more per kilowatt than the cost per kilowatt of power factor of improving apparatus, and it seemed probable therefore that it would pay to install devices which improved the power factor beyond 0.8.

EXHAUST STEAM.

In Section III., which deals with machinery, a Paper on "Exhaust Steam" was read by Mr. E. R. DOLBY. We give an abstract of the Paper and an account of the discussion below.

Exhaust Steam: Its Employment for Power Heating, etc.

By E. R. DOLBY.

The expression "exhaust steam" may be defined as "steam which has passed through a prime mover." No limitation of pressure is suggested, as it may vary from that of the atmosphere to 60 lb. per square inch or even higher. The deciding factor will naturally be the specific purpose for which it is to be employed.

Exhaust steam may be employed for the generation of power, or electrical energy, or for heating, drying, cooking. The problem before us is the better utilisation of the heat in the steam. This subject comes before the engineer not as a theoretical problem, but as a practical question relating to a given factory, mine, public institution or business premises. If in a given case there is a constant demand for power, and at the same time a demand for heat which may be exactly supplied by the utilisation of the heat ejected by the prime mover, then the solution of the problem is simple. In practice this ideal condition is rarely met, and probably never subsists for the entire year.

THE DISTRIBUTION OF STEAM.

In the opinion of the Author, the most efficient utilisation of the thermal value in coal cannot be obtained until there are sets of public mains provided by the community for public utility. One set of mains might receive electrical energy in the form of alternating current at a standard pressure and frequency; another set might receive steam at a pressure of 5 lb. to 10 lb. per square inch; while a third set would deliver water at a temperature of 180°F. to 200°F. The electrical energy, steam and hot water would be by-products from scattered installations comprising prime movers driven by steam.

The subsidiary electric mains would be coupled to the existing public supply mains, as is now the case on the North-east coast of

England, the consumer being paid for what he delivers and charged for what he consumes. The steam mains would furnish direct heating in radiators, drying-chambers and calorifiers for the supply of domestic hot water, and wherever practicable the condensate would be drawn back by an air-pump to the starting point. Such mains are common in the United States, although rare in Great Britain, where, however, several large blocks of buildings in Manchester are supplied with exhaust steam from an electric generating station. The hot-water mains would convey water heated in exhaust steam calorifiers and circulated by pumps. In some instances, owing to the configuration of the ground, and the height of the buildings, steam mains would be preferable, while in other cases hot-water mains would be better.

WHERE POWER ONLY IS REQUIRED.

If steam be employed solely for power purposes with a fairly steady load, and condensing engines are used, then the saving of the thermal loss in the condensing water may be obviated by eliminating the condenser, providing steam at a somewhat higher pressure and discharging the exhaust at, say, 5 lb. back pressure into a public steam main. Electrical power from the public mains might in some cases be substituted with advantage.

If the load is intermittent, such as that of colliery winding, hauling, &c., then the engines are usually of the simple type and exhaust to the atmosphere direct. If more power be required, then the exhaust may be passed first into an accumulator, of one of the well-known types, and thence into an exhaust steam turbine. If extra power is not required, then this turbine can be used to drive an alternator, and the current delivered to the public electricity mains. The heat loss in the condensing water would still continue, but this could be obviated by omitting the turbine and discharging from the accumulator to the public steam mains.

POWER AND OTHER USES.

If the other uses require steam at about atmospheric pressure only, then steam engines or steam turbines may be used for power only, or for electrical energy also; they would be non-condensing, and the exhaust at a back pressure not exceeding 1 lb. would be taken into the private heating mains, and an air pump used on the return. Steam at this temperature would not boil water, but it could be used for drying, air heating, water heating and in radiators.

If rapid boiling or high-temperature heating be necessary, as is quite general in paper-mills, chemical works, &c., then the stop-valve pressure would be selected so that the necessary power could be obtained from the prime mover within the assumed fall of pressure. With steam turbines several different "pass-out" pressures may be selected, say 60 lb. for cooking the raw product, and 15 lb. to 30 lb. for heating the drying cylinders. If reciprocating engines were used, they would be of the simple type exhausting at the highest back pressure desired.

The methods of allocating charges to the various purposes for which the heat is employed are often fallacious. The Author is of opinion that the thermal units employed for each service should be charged to that service, and that all costs of labour, fuel, stores, taxation, interest and sinking fund should be charged *pro rata* on the thermal units consumed by each service.

THE ECONOMICS OF THE QUESTION.

Data supplied to the author prove that enormous savings can be effected by using back pressure on reciprocating engines employing "pass-out" steam turbines, and utilising apparatus to employ the heat in the exhaust steam. The cost of electrical energy can in many cases be reduced well below the rates charged by public authorities. It must, however, be borne in mind that many private electrical generating plants in works, and also in public institutions, have been removed, even although the whole of the exhaust steam was usefully employed. This has occurred particularly in London, but the Author believes that in most of these cases the high cost of labour, the necessity for three shifts of stokers, and the high costs of secondary battery maintenance have been the deciding factors in the removal.

DISCUSSION.

Mr. FRANK BIGGIN (President of the Institution of Heating and Ventilating Engineers) said the Institution of Heating and Ventilating Engineers had had this matter of the utilisation of waste steam under discussion and had appointed a committee to consider to what extent exhaust steam and waste gases could be utilised. They were also collaborating with the Institution of Electrical Engineers to see if it were possible to arrive at some common basis on which to make use of these waste products.

Mr. R. W. WEEKES referred to a works which had highly efficient condensing engines working with Schmidt superheaters. The steam

consumption per kW hour was 15 lbs. By making use of the exhaust heat the total coal consumption was reduced from 12 800 tons to 8 000 tons per annum and electricity was produced for just under 0.5 lb. of coal per unit.

EXHAUST STEAM AND PRIVATE PLANTS.

MR. PAYNE advocated the utilisation of exhaust steam in all private steam plants for the generation of electricity which should in turn be made available to the public. That apparently was contemplated by the Coal Conservation Committee.

MR. WATSON said the Paper seemed to foreshadow a kind of public drainage system which would take away exhaust steam from all kinds of power plants and utilise it for heating purposes. It seemed to him that it was impossible to contemplate anything of the kind, where towns already existed. In a garden city or a housing scheme where there was no electricity supply, all the economies suggested in the Paper could be effected.

MR. EDWARDS said the efficiency of many electric power stations could be doubled by utilising the exhaust steam, but they continued to throw heat away.

ELECTRICAL ENGINEERING ECONOMIES.

MR. HAYDON said in the Manchester installation (referred to the Paper) the effect of that was only to put a back pressure of $1\frac{1}{2}$ to 2 lbs. on engine in the power station. In that case the building was 600 ft. away. He had been told on one occasion that it was intended to scrap some of the boilers at the station, but he had suggested that they should be kept solely for the heating supply, and that the generation of electrical energy should be regarded as a by-product. Electrical engineers as a rule thought of nothing else than the low cost of the unit of electricity, and it did not matter what they threw away to obtain it. It was for that reason that the heating engineers desired to collaborate with the electrical engineers in order that they might secure both electricity and the value of the heat.

MR. W. H. PATCHELL said that to distribute exhaust steam and heat for district heating would not pay in this country as it did in America, at any rate for domestic or office work.

MR. DOLBY, in reply, said the whole object of the Paper was to try and find means for stopping the tremendous waste of exhaust steam in the form of condensed water, and the particular works might not have any use for it, and the only thing was to put down mains and run it to where it was required. In Manchester the exhaust heat for the electricity generating station was passed on to the Calico Printers' Building, in Berlin it was sent to the public baths, and there was a number of instances in which the same thing could be done. In Great Smith Street, Westminster, there was a public baths with its boiler plant, whilst not far away was an electricity generating station wasting a great deal of heat.

WATER POWER.

SIR ROBERT HADFIELD presided over a meeting of Section IV., which dealt with Mining and Metallurgical Processes. The first Paper read was on "The Employment of Water Power in the Development of the Mineral Industry," by Mr. J. W. Evans, F.R.S., of which we give an abstract below.

The Employment of Water Power in the Development of the Mineral Industry.

By J. W. EVANS, F.R.S.

Electrical energy generated by water-power has been widely utilised, not only as a motive power in mining operations but in electrolysis for the production of almost chemically pure copper, zinc and nickel, and, above all, in the production of metallic aluminium. The electrical reduction of iron is also making way. During the war there was a remarkable advance in Sweden, where the number of electric furnaces employed in this industry increased from eight in 1914 to 25 in 1917 and 28 in 1918, and the output of pig-iron obtained from them increased from 5 786 tons in 1911 to 75 684 in 1918. The day is at hand when electrolytic methods will enable metals to be extracted with commercial success from ores which are too poor to be dealt with by smelting operations. On the other hand, the manufacture of substitutes for mineral substances such as synthetic nitrates, artificial graphite and carborundum by electrical energy will tend to some extent to oppose the development of the mineral industry. There is, however, reason to believe that the increase in the use of electricity obtained from water-power will have far greater effects in facilitating both mining and metallurgical operations.

WATER POWER AND MINERAL RESOURCES.

There are few mountainous districts that do not contain vast reserves of water-power, but some of the greatest, including the Alps and the Himalayas, are not correspondingly wealthy in mineral resources. The water-power of the Alps is, however, now being employed in the extraction of aluminium from bauxite; this was formerly largely imported from France, but is now obtained

mainly from the Carpathians and Dalmatia. In the long line of Sierras that rise from the eastern shores of the Pacific from Alaska to Tierra del Fuego, the water-power and mineral deposits are frequently associated, and the resulting economic advantages will increase rapidly as metallurgical science advances.

Water-power is, however, also largely developed where the drainage of the great plateaux descends to the plains. The Victoria and Sivasamudra Falls are examples, but there are many other powerful streams both in East and West Africa and in India that may be exploited. In addition to Niagara there are in Canada numerous falls in the great drainage basins of the St. Lawrence and of James Bay which provide a total of some eight millions of horse-power, and in the development of the mineral wealth of the wide pre-Cambrian shield—of which Sudbury, Cobalt and Porcupine represent in all probability only a fraction and which bids fair to rival that of the Rockies—water-power should play a conspicuous part. Already its use in the mining and metallurgy of Canada has had a marked effect in stimulating production.

THE RESOURCES OF BRITISH GUIANA.

Turning to South America, we find in British Guiana valuable sources of energy in the rivers that descend from the southern highlands. A preliminary estimate has been made that the falls of the Cuyuni, the Essequibo and the Demerara alone develop a minimum of nearly 800 000 H.P. in the dry season. After making liberal deductions for loss of power in conversion and transmission there is at least 440 000 H.P. available for commercial purposes—and this does not include the immense amount of water-power available in the falls of the Courantyne, that forms the boundary with Dutch Guiana, and in those of other streams, which have not been included in these calculations. These reserves of water-power in our tropical Colonies and Protectorates are of special interest in connection with the occurrence of bauxite, hydrate of aluminium, the most readily available source of aluminium. This is most characteristically developed in the tropics, where it appears to be formed under certain conditions by the action of a warm, moist climate on alumina-bearing rocks. Where, on the other hand, it is found in temperate regions, it probably dates from former periods when tropical conditions prevailed. Extensive deposits have been recognised in British Guiana, the Gold Coast, and India, in each case within a reasonable distance of water power, while it is only in the last-mentioned that coal is available, and then only in the neighbourhood of some of the deposits. One of the most important results of the economic production of aluminium will be the facilitation of the transmission of power by the substitution of aluminium for copper in long distance conductors. For the former must ultimately be available at lower prices, having in view the comparatively restricted occurrence of the latter.

DEVELOPING BAUXITE DEPOSITS.

There are, generally speaking, three different courses that may be taken in developing deposits of bauxite. In the first place the material may be exported after only a preliminary mechanical dressing, where that is possible. The chief obstacle in the way is the high cost of freights at present prevailing, but the 20 per cent. *ad valorem* tax now placed on exports from France, hitherto the chief source of the ore, to some extent diminishes these drawbacks. The second course would be to refine the bauxite on the spot, removing impurities and water so as to obtain pure aluminium oxide. This would effect a considerable saving of freight, but up to the present it has not been carried out locally on account of the absence of coal. By the help of electrical energy, however, it can probably be made a commercial success, if the power can be provided sufficiently cheaply and the costs of plant and labour are not too high. The possibility of obtaining a market for by-products of the operation might also be an important consideration. Finally, the matter might be carried a step farther and the water-power employed also for the extraction of metallic aluminium. This will undoubtedly be done in India, which has an almost unlimited market for the metal in its own territories and neighbouring countries.

WATER POWER AND RAINFALL.

The problem of the utilisation of water-power in the tropics is complicated by the irregularity of the rainfall. In the absence of some form of storage in natural and artificial reservoirs this causes a similar irregularity of the river flow and of the horse-power available. Figures have been given above for British Guiana showing the horse-power available in the dry season. When the river is in flood it may be three or four times as much. It would be difficult to reap the full benefit of this increase because the problem of utilising the power of such a stream becomes entirely transformed when its waters have risen to a much higher level. It is also most important for the economic development of metallurgical

work, and the power available should be more or less uniform throughout the year. The position of the storage of mechanical power on a large scale is probably not insoluble from the engineering standpoint. One can envisage the construction of the dam, from which the water is stored in the reservoir of rock masses, yielding masses of water by hydraulic pressure and the consequent pressure of the potential energy thus accumulated, and then releasing the energy by the means of a turbine, and that turbine adapted to the stream as it is, or, in the case of the excess of precipitation in the rainy season, by additional turbines. In the dry season, however, the water is not so very scarce, and the turbine is not so much used, but the expense would be considerable, and it is not to be known how far this would be a profitable investment.

There is, moreover, another difficulty, the excessive evaporation in the tropics. On the Nile, for instance, only a small fraction of the rainfall in the drainage areas of the Victoria and Albert Nyanza reaches the lower Nile, and all who, like the writer, are familiar with the numerous storage reservoirs of the Peninsula of India know that the loss of water in heat by evaporation from a 600 ft. x 4 ft. reservoir, if it is heated, over the whole surface. The prevention of this loss is a matter of urgent importance, and it could, I think, be best effected by the construction of some form of cover floating on the surface of the water. A thin film of oil, or a layer of paper, or something temporarily, as it would itself evaporate.

DISCUSSION.

Mr. J. H. B. BROWN (the Electrical Engineer, London) said that the problem of storage of power was a very important one, and that it was not only a matter of engineering, but also a matter of economics. He pointed out that the cost of storage was a very important factor in the cost of power, and that it was not only a matter of engineering, but also a matter of economics. He pointed out that the cost of storage was a very important factor in the cost of power, and that it was not only a matter of engineering, but also a matter of economics.

Mr. W. M. BROWN (British Electrical Research Association) speaking on the subject of storage of power, said that the problem of storage was a very important one, and that it was not only a matter of engineering, but also a matter of economics. He pointed out that the cost of storage was a very important factor in the cost of power, and that it was not only a matter of engineering, but also a matter of economics. He pointed out that the cost of storage was a very important factor in the cost of power, and that it was not only a matter of engineering, but also a matter of economics.

PROCESSES OF COAL-CLEANING.

Mr. B. W. WHITLEY (British Electrical Research Association) said that the problem of storage was a very important one, and that it was not only a matter of engineering, but also a matter of economics. He pointed out that the cost of storage was a very important factor in the cost of power, and that it was not only a matter of engineering, but also a matter of economics. He pointed out that the cost of storage was a very important factor in the cost of power, and that it was not only a matter of engineering, but also a matter of economics.

Mr. A. E. KIRSON said that the problem of storage was a very important one, and that it was not only a matter of engineering, but also a matter of economics. He pointed out that the cost of storage was a very important factor in the cost of power, and that it was not only a matter of engineering, but also a matter of economics. He pointed out that the cost of storage was a very important factor in the cost of power, and that it was not only a matter of engineering, but also a matter of economics.

Mr. A. E. KIRSON said that the problem of storage was a very important one, and that it was not only a matter of engineering, but also a matter of economics. He pointed out that the cost of storage was a very important factor in the cost of power, and that it was not only a matter of engineering, but also a matter of economics. He pointed out that the cost of storage was a very important factor in the cost of power, and that it was not only a matter of engineering, but also a matter of economics.

in the transmission of power over long distances aluminum was both lighter and cheaper than copper, but it had the drawback of that, owing to leaving in the wind, the molecules of metal were inclined to rearrange themselves, and there was a consequent tendency to brittleness. Sufficient attention had not been given to the extraction of aluminum from bauxite. To do so would require much less power than to extract it from alumina. In West Africa there were large areas covered with auriferous gravels which were too poor to work in the ordinary way, but which would prove a rich proposition if cheap water power could be obtained.

Dr. EVANS, in reply, agreed that it would be possible to treat bauxite on the spot if cheap electrical energy could be obtained. He was sorry to learn that the project for bringing water power from the Victoria Falls to the Rand had been practically abandoned. It seemed to him that the limitation of transmission was due to cable difficulties and this might be overcome by the use of large-sized aluminum lines.

Recent Developments in Coal Cleaning Processes.

By R. NELSON.

The stress of war and the resulting period of Government control have had a very adverse effect on the quality of coal produced. Small coals, such as are commonly used for industrial purposes, are the worst offenders. For instance, for unscreened small, a class of coal generally used in large electricity works, the average increase in the quantity of ash is nearly 63 per cent. The problem of how to secure cleaner fuel is therefore an urgent one and the discussion of recent developments of coal-cleaning processes may help to shorten the path to a solution.

The difficulty has two aspects, national and individual. Of the 60 million tons of coal used per annum in this country for industrial purposes about three-quarters is slack coal and as much as 89 per cent. of this is unwashed. Considering the high percentage of dirt in this unwashed fuel at least 1½ million tons of material, which is worse than useless, is annually transported up and down the country, absorbing labour to load it, to transport it, to off-load it, to fill it into furnaces, to take it out again as clinker and finally to dispose of it by dumping it on to an ash-dip. If this dirt were got rid of at the pit head about 2,000 trucks and 40 locomotives together with a large quantity of man power would be permanently available for some useful purpose.

The coal-cleaning problem is also of importance to all who use coal for steam raising or manufacturing purposes. Coal washers of varied designs have been in use for many years, but the chief difficulty of the older methods is to deal effectively and efficiently with finest coal. One of the processes described below offers a solution of this problem. The other attains an unusually high degree of efficiency in dealing with coals of all sizes from 2½ inches downwards. A proper combination of the two would seem to offer an adequate solution over the whole range of coal cleaning.

THE CLEANING OF FINES.

Coal washing has hitherto been effected by methods which depend upon differences of specific gravity between the coal and the dirt. If the dirt is of the same or nearly the same specific gravity as the coal, these methods fail when applied to material below a certain size. The new process for washing fines coal is independent of gravity. The coal to be treated, if not already fine enough, is crushed until the particles pass through a screen about one-tenth linear inch aperture. It is then mixed with three or four times its weight of water together with a small quantity of reagent. The reagent may be an oil or coal-tar product, and 1 lb. is, generally speaking, required for each ton of coal treated. The mixture is agitated by a power-driven mechanical mixer and a multitude of minute air-bubbles are produced. To these air-bubbles the coal particles attach themselves and they are floated by them to the surface of the water in the form of a thick coal-laden froth. The ash-forming dirt sinks to the bottom. The coal contained by the froth is removed by a suitable scraper and then dried for use. The dirt which sinks is drawn off and rejected.

Once the proper reagent has been found, the working of the flotation process is extremely simple and very effective. Given a steady flow of feed to the plant and a regular supply of reagent, a flotation machine will, it is claimed, produce clean coal on the one hand and, on the other, a residue which is very nearly coal-free.

CONSTRUCTION OF THE MIXER.

Apart from piping and valves and the mechanically-driven mixers and scrapers, the ordinary flotation machine is constructed entirely of wood. It consists usually of from five to ten "mixing" boxes, each with a "froth box" connected to it. The material under treatment passes from mixing-box No. 1 via froth-box No. 1 to

mixing-box No. 2, thence *via* froth-box No. 2 to mixing-box No. 3, and so on through the plant, the final reject coming from the last froth-box. A flotation machine to deal with 1 000 tons of coal in a 24-hour day measures approximately 37 ft. by 15 ft. 9 in. by 15 ft. 6 in.

In a typical separation Derbyshire top hard slack the process reduced the ash for 29.55 per cent. in the cinder fuel to 9.86 per cent. in the cleaned product, correspondingly increasing the percentages of fixed carbon and volatile matter available.

THE CLEANING OF NUT COALS.

The new process for cleaning coal other than "fines" comes to this country from Belgium. It is called the Rheolaveur process and its main features are:—(1) The means used to carry the material to be washed through the washer, namely, a stream of water confined in a series of narrow troughs. (2) The simple arrangement by which the process is controlled. (3) The arrangements by which part of the material under treatment is automatically reworked so that, in the ultimate result, a high degree of freedom from shale and dirt is attained.

A strong and steady flow of water is the first requirement of the process. The water is turned into a trough into which the coal to be treated is also led. The flow of water carries the coal along with it and the separation of the coal and dirt is effected by stratification, the rate of flow of water being so regulated and the trough of such a length as to allow time for the coal and dirt to stratify. Arrangements are made to draw off the dirt from the bottom of the trough at intervals, allowing the coal to be borne along, until, at the end of the trough, there is no more dirt to draw off and clean coal is delivered to the clean coal hoppers. At each drawing-off point a cast-iron box is inserted and a current of water (controlled by a hand-valve) is made to flow upwards from the bottom of the box into the trough to prevent coal from being drawn off with the dirt.

In washing nuts the strength of the upward current of water in the first box is kept high so as to allow shale only to be drawn off. This shale forms the reject and it finds its way at once to the shale dump. In the second box the strength of the upward current of water is rather less so as to allow the balance of the shale, and it may be a little coal, to pass through the box. This reject is not sent to the shale dump; it is returned by means of an elevator to the original trough to be reworked. In washing nuts two boxes only are necessary, the coal passing the second being dirt-free it is delivered therefrom via a moving drainage plate to the nut coal bunker. In washing small coal, four boxes and two lengths of trough, one above the other, are necessary, but the principle of working is the same.

The Rheolaveur process claims the following advantages:—(1) Low initial cost; (2) low maintenance and running costs; (3) easy control of working; (4) absence of complicated mechanical parts, and (5) economy of space.

DISCUSSION.

Col. A. RHODES was not quite certain whether it was proposed to crush the whole of the coal to below 1/10 in. or only to deal with the very small coal, say, below 3/4 in. It was possible to clean the larger coal by present methods, and in some cases to clean smaller coal by washing it with that of larger size. But to crush the whole of the coal down to a very small size would give rise to very great difficulties, one of the chief of which was redrying.

Mr. C. H. MERZ said that the points to which Mr. Nelson had called attention were very important in their effect upon the economic life of the nation, especially in regard to the baulage of coal and the disposal of the ash. But there was the further factor that the efficiency of coal consumption was materially interfered with by the presence of dirt and an improvement of between 5 and 10 per cent. might be obtained by paying attention to this. He thought that the amount of ash left in the coal after washing, as given by Mr. Nelson, seemed very large, but this might be attributed to the fact that the coal was not ground sufficiently fine. He did not think the consumption of the troublesome war-time fuels could continue, and it was to be hoped that some enterprising collieries would try to increase the demand for their products by supplying both large and small consumers with the fuel they wanted and not just with what came out of the pit.

Mr. R. NELSON in his reply thanked Prof. Edser for demonstrating the separation process. The flotation process was designed to deal with fine coal alone and not with all the coal. The drying difficulty to which Col. Rhodes had referred was actually overcome in the plants he had described by employing a vacuum dryer. He was glad to learn that Mr. Merz did not propose to lie down under the infliction of dirty fuel. In connection with the ash content figures the reject contained 82 per cent. of ash, 2 per cent. fixed carbon and 14.8 per cent. volatile matter, that was, because no process gave 100 per cent. efficiency and probably some coal was left in the reject. Possibly also some of the reject was shale which have a carbon as well as a volatile content. Probably better results could be obtained by employing further wash boxes.

Development of Crane Facilities for Discharging Vessels of the Largest Size.

By H. J. DEANE, B.E.

There is little doubt that before the general introduction of steam-driven vessels the discharge of the old sailing ships was carried out almost exclusively by manual labour. Time was not so important an element, and, moreover, the dimensions of those ships did not enable them to carry so much merchandise per lineal foot of ship as the modern cargo vessel, and the small holds could easily be discharged within a comparatively short time.

The most important landmark in the history of crane facilities was in the year 1846, when Lord Armstrong first applied hydraulic power to quay cranes, and this was rapidly followed by the equipment of docks and harbours with complete hydraulic installations, including pumps, mains and cranes. Since then up to the present day progress has been parallel with the growth in the size of ships, and has been amplified by the introduction of electrical power as applied to cranes.

It is obvious that crane facilities necessarily have to be designed to suit the shipping which is likely to frequent the port, and, in preparing specifications, a large number of considerations must therefore be taken into account which, amongst others, give rise to the following questions:—

Whether cargo vessels, generally speaking, are likely to increase much beyond the present maximum dimensions, and, if so, is it probable that such vessels will be equipped with their own cargo-handling appliances (as is already done in numerous cases). Whether the largest modern liners of the trans-Atlantic passenger type can be considered seriously (for the purpose of port-crane facilities) as cargo-carrying vessels, and, if so, should such facilities be provided on the quayside, or should the owners of such vessels be expected or required to furnish the necessary equipment on the vessels. If the future requirements of shipping remain generally as they are to-day, to what leading dimensions should such equipment be designed; and is the present general type of luffing and sluing jib crane, with or without horizontal luffing contrivances, the most economical, efficient and satisfactory type to follow, or should some more simple design be aimed at in which the weight of the structure and more particularly its moving parts are brought down materially, the number of motions (namely, three or more) reduced, and the handling of cargo materially speeded up.

SOME DISTRIBUTION QUESTIONS.

When the proceedings in Section VII, opened on Thursday it was announced that the Papers on "Economic Limits of Distribution from Coal-fired Stations," by Mr. W. B. Woodhouse, and on "Low-voltage Overhead Distribution," by Mr. B. Welbourn, would be discussed that day instead of on Friday, as stated in the official programme. We give abstracts of these Papers and an account of the joint discussion below:—

The Economic Limits of Distribution from Coal-Fired Stations.

By W. B. WOODHOUSE.

The economic limit of distribution from a central power station is reached when, as an alternative to further extensions of mains, the establishment of one or more additional stations enables energy to be delivered to the consumers at a lower cost.

The problem is therefore a consideration of the steps to be taken to supply an area which extends beyond the economical limits of the distribution pressure in use. This is a problem which presents itself for solution as the supply of electricity has developed over wider areas. The solutions have been three in number: To supply from one generating station by increasing the output to meet the demands and adding to the original distribution mains a higher pressure system or systems feeding into the general distribution system at a number of points. The general distribution system may or may not be subdivided into independent sections. To supply from two or more generating stations each feeding a part of the area independently of the others. To supply from two or more generating stations inter-connected by a system of high pressure mains with or without intermediate feeding points.

Within certain limits the first solution is without question the most economical. The economies may be summarised under three headings.

ECONOMY OF CAPITAL.

The total cost of a generating station increases less rapidly than the rated output of the plant installed, but the earning capacity of a station depends on the use which can be made of the plant

after providing the spares necessary for security of supply. Inter-connection of stations also affects the question. An advantage of a large station is due to the diversity of demand arising from supply over a wide area which may have the effect, as between a station of 100 000 kW and one of 500 000 kW, of reducing the station demand by some 10 per cent., and the capital expenditure accordingly.

ECONOMY OF COAL.

The increase of efficiency as between turbines of 1000 kW and 25 000 kW under similar steam conditions represents a saving of some 25 per cent. of the coal consumption. The diversity of demand has its effect in improving load factor and still further reducing the coal consumption. The economies made possible in a large station represent a further saving, but as between a 150 000-kW station and a 500 000-kW station the amount is not great. Economies of wages and other expenses, though marked, represent a saving on only a small part of the total costs, and are relatively less important.

TOTAL SAVINGS.

It is with hesitation that one submits a general figure of the savings to be made on these accounts, but it may be taken that the relative cost per kilowatt-year varies somewhat as follows:—500 000 kW, 100 per cent.; 250 000 kW, 114 per cent.; 150 000 kW, 122 per cent.; 50 000 kW, 173 per cent.

COST OF DISTRIBUTION.

Against these economies the extra costs of distribution over the wider area must be set. It should be noted that the addition of the higher pressure system, by permitting the subdivision of the general distribution system, will allow a greater load to be carried on this latter system without further capital expenditure, or alternatively will effect a reduction of energy losses with the same load. In either case this saving must be taken into account.

The total cost of distribution is made up of the charges on capital, the establishment charges and the cost of energy losses. With the exception of the copper losses, these annual charges are practically constant, in other words, the economical area of distribution is a function of the load factor of the system. The economical area is also dependent on the density of load, the uniformity or otherwise of load distribution, the number of consumers, and other conditions which make a comparison between different areas a matter of great difficulty.

If it be assumed that such an area has a density of load of from 500 kW to 2 000 kW per square mile, it may be said at once that a pressure of 10 000 V has been fully demonstrated by practical experience as suitable for general distribution. The economical area for such a pressure of distribution is approximately 150 square miles from which a station demand of, say, 137 500 kW may be expected to arise.

Low-Voltage Overhead Distribution.

By B. WELBOURN.

Overhead lines are required to comply with "Regulations prescribed by the Board of Trade under Section IV. of the Electric Lighting Act, 1888." These Regulations prescribe factors of safety as follows:—Line wires, 5 at least; wooden poles, 10 at least; iron or steel structures, 6 at least; taking the maximum possible wind pressure at 25 lb. per square foot, while no addition need be made for a possible accumulation of snow. No temperature is mentioned, but it is presumed that 22°F. is intended. These factors of safety are highly controversial—they are seldom observed, and it is generally hoped that they will be replaced by some more logical rules which will obtain ready acceptance.

VOLTAGE REGULATION.

It would be interesting to know whether, in the interests of standardisation of lamps, motors, &c., as well as of voltage regulation, it is possible to arrange for new work to be carried out at a declared voltage of, say, 240 V to the neutral. Regard should be paid to the question of transforming down to some lower voltage at each house and, if so, is a higher voltage to the neutral than 240 V permissible on the street wires, whether conductors should be stranded only or whether solid wires are permissible under any circumstances having regard to the fact that the conductors may be of (a) copper or (b) aluminium, or even of (c) steel or iron, whether services should be of bare wire or of insulated cable, whether the present minimum of 22 ft. for height of wires, the ground might be reduced for certain classes of roads, are also debatable questions.

Experiences with different types of poles would be useful. With this question is wrapped up the large question of the possibility of making use of houses to carry brackets for the supporting of conductors without danger to the public or to the residents or to workmen employed on the houses, as well as whether the present methods of guarding required by the Electricity Commissioners

and the General Post Office are sufficient or too onerous, and in what directions they might be simplified or made less costly, and whether anyone has discovered any entirely effectual way of preventing lightning getting on to the internal house-wiring.

COST QUESTIONS.

The question of distribution by overhead wires *versus* underground cables is a controversial one, and cases may sometimes be settled by first-cost considerations, but, fortunately, aesthetic and maintenance conditions are sometimes given their full value,—especially in garden city schemes. In one such scheme the total first cost of the overhead distribution, including 108 public lighting fittings, was £6 800, whereas the estimate for a high-class scheme using cables throughout was only some 20 per cent. higher. Allowing for the longer life and lower maintenance charges on cables, it is very doubtful whether there was any real saving by using overhead wires in this case. Exact costs obtained from other schemes would be very useful.

The author has always held the view that overhead distribution has a special field of its own in the development stage of the electric supply industry in the United Kingdom—particularly in rural areas and in works and colliery distribution. The standard of work and appearance, as well as of continuity of supply, are much higher here than in many other countries, and the author believes that ultimately the distribution in all our towns, garden cities, and large villages will be done by underground cables. The basis for this belief partly lies in the growing practice of the General Post Office in replacing overhead wires by cables even in country villages.

DISCUSSION.

The CHAIRMAN (Mr. Roger T. Smith) said that, according to Mr. Woodhouse, it was more economical for a railway company to generate current itself than to purchase it from a capital power station if the latter was more than 30 miles away. Parliament seemed to consider in the Electricity Act that railways should have the opportunity of buying in the cheapest market and they could, therefore, obtain approval from Commissioners to build their own stations unless the Joint Electricity Authority could prove that it could supply as cheaply as the railway company itself. On the other hand, by purchasing current the railway saved a very large capital expenditure and the troubles incidental to the employment of workmen who were connected with the Railway Union. With regard to Mr. Welbourn's Paper, the use of overhead distribution was not entirely a matter of economics, as there were sometimes considerable difficulties in using cables for railways. On the other hand, in railway yards there were advantages in using overhead lines.

FACTORS OF SAFETY AND POPULARITY.

Mr. A. PAIGNTON said that the new proposals regarding factor of safety on overhead lines should make overhead distribution very popular in England in future. He was glad to see that the principle of allowing for ice loading had been introduced. Where it was necessary to use smaller conductors, consideration should be given to a form which had not yet been used to any great extent in this country, namely, a cable with outer wires of aluminium and a centre of high-grade steel. The proposal to use lighter poles was also a step in the right direction.

SOME POINTS FOR DISCUSSION.

Mr. B. WELBOURN, speaking on his Paper, felt that overhead low-voltage distribution had a very definite place in the development of electricity supply in this country. For this reason it would be best if the discussion dealt with the points upon which engineers desired guidance, such as the question of permissible voltage in crowded thoroughfares of overhead wires. Pressures as high as 3 000 V had been used on such lines in Canada and the United States, and he did not see how we were to develop such loads in this country unless we used higher pressures. The best method to employ in taking services into individual houses from overhead wires was also a difficult matter. By using a short length of lead-covered rubber cable any effects due to lightning could be eliminated. Earthing was another important question and satisfactory results could be obtained by using Trotter volt guard on the Elder guard. The latter on a four-wire three-phase distribution system consisted of an earth wire placed above the four distribution wires with, about 3 ft. on either side of each pole, a very light rectangular frame the top bar of which was of metal and was connected to the earth wire. At the lower end of the frame there was a metal bridge which was connected to the neutral and these two metal parts were supported by uprights of hard wood. This was an exceedingly cheap arrangement and, in the event of a breakage of any wire, the bottom metal bridge was fouled and a short was produced on the system.

A HALF-WAY SYSTEM RECOMMENDED.

Mr. G. V. TWISS said that lines erected to Post Office conditions were likely to be adversely affected by snow and ice if the conductors were small and it was, therefore, necessary to have a limit to the minimum size of conductor used. Such a limit would greatly add to the expense, and, looking at the matter generally, a half-way line between the Post Office practice and the Board of Trade regulations seemed desirable. Cordeaux screws, recommended in the B.E.A.M.A. specifications, were not good mechanically and were bad electrically. There should be two types of insulators for small wires and large wires respectively, and the use of Cordeaux screws should be eliminated on power lines altogether.

Mr. S. G. LEACH said that whether conductors should be stranded or solid was entirely a question of construction and appearance. When tape was used for weatherproofing this came away from the wire in course of time. The result was untidiness, while it was doubtful if it added much to the life of the cable. With an uninsulated distribution system all house services should be insulated. Poles 17 ft. or 18 ft. high would clear any possible obstruction from traffic, and he had never been able to find any reason why the Board of Trade fixed 22 ft. On a pre-war basis a saving of 40 to 50 per cent. would be obtained by using overhead distributors, as against a loss of 20 per cent. compared with underground cables given by the author, though probably this comparison did not hold good now. The author considered that eventually everything would go underground, but the speaker was of opinion that the only possible means of giving an efficient supply of electricity to rural areas would be by overhead mains. Post Office practice was not a safe guide, as they used much smaller wires, while they were not so much hampered by finance as a commercial concern.

Mr. B. BATHOLOMEW said the reason for choosing 22 ft. was that tramway wires were usually placed at this height. He thought Mr. Welbourn was a bit of an alarmist in regard to the effect of lightning on overhead conductors, the Post Office experience being that the ordinary protector was sufficient to make houses safe from this danger.

SOME COMMERCIAL LOAD FACTORS.

Mr. A. H. PREECE thought the question of overhead and underground cables was purely a question of economics. In the colonies at the present time it was almost hopeless to carry out much overhead work owing to the enormous cost of the poles. Referring to Mr. Woodhouse's Paper he said that people were apt to talk in a casual way about 500 000 kW stations, but in this country such power stations would be very difficult to arrange, and it would be usually more justifiable to put up three smaller stations of the same aggregate output than one large one. This was due to water and coal difficulties. He rather doubted whether Mr. Woodhouse's load factor of 60 per cent. could be obtained in an industrial area. In Manchester, where the load was fairly concentrated, the figure was only 32 per cent. In one case abroad it was 46 per cent. for a station turning out 150 million units where there were no eight-hour shifts, no Saturday afternoon, no mid-week football and no Sunday closing.

OVERHEAD WIRES NOT ALWAYS ECONOMICAL.

Mr. LLEWELYN ATKINSON said that Mr. Woodhouse's Paper was based on an arithmetical assumption, but the moment we began to consider such assumptions we found there was no experience with which to check them. His experience in the Trafford Park industrial area with overhead wires had been that, though given plenty of scope by the Board of Trade, the whole of the distribution had gone underground for economical reasons. He thought, however, that, in a rural area, overhead construction would find its application, as at present at any rate it was quite unthinkable that we should use miles and miles of underground cable in country districts. The use of higher pressures with transformers on the consumers' premises was indicated. In Holland, voltages up to 10 000 V had been taken into farms and connection to a high pressure line of this kind was made with a sort of hook attachment. To prevent prohibitive cost, lines in this country must be put up to withstand ordinary and not exceptional conditions.

Mr. W. A. TURNBULL said he thought 500 V for overhead distribution would be about the limit. Using overhead wires on a housing scheme he proposed to run the wires overhead from the chimneys into the ends of the houses, protecting them from contact by a barbed wire ring. He had, however, given up the idea of using overhead wires owing to cost of maintenance, as, in housing schemes, excavation costs were reduced because the roads were all "up" during construction work.

Mr. A. S. BARNARD said that overhead lines were very liable to attack by the King's enemies, and this would be an important matter when we were wholly dependent on electric power for vital necessities.

MACHINERY AND LABOUR.

The two following Papers on subjects of interest to electrical engineers were read before Section III. on Thursday, June 30th:—

The Influence of the Automatic and Semi-automatic Machine on the Skill and Resourcefulness of the Mechanic.

By A. H. HALL, C.B.E., B.A.

Both automatic and semi-automatic machines have been a gradual development from the ordinary turning lathe, with the object of enabling increased output to be obtained on repetition work. Probably the two main features considered by the designer were production and flexibility. The two are not always compatible, and it will generally be found that the more completely automatic the machine the larger its potential output on work suited to its capacity, but the greater the difficulty in changing over from the manufacture of one article to another.

THE ELIMINATION OF INITIATIVE.

These developments in design have practically eliminated the need for initiative on the part of the operator. In the extreme case

a full automatic machine requires only feeding with the material, while the capstan and turret lathe require the employment of labour merely to make them function in their predetermined cycle of operations. Except in the case of machines designed for a single purpose, the variety of work now possible on a well-designed automatic or capstan lathe is such that ample scope is provided for the display of resource on the part of the mechanic. This quality is more a question of inherent ability than of training, and though long experience may increase aptitude up to a point, it is doubtful if this is not skill rather than resource.

It is well known that only a small percentage of good mechanics can set up and tool an automatic machine to the best advantage—the remainder in varying degrees lack the ingenuity necessary. The inference is a strong one, that the quality of the resource required differs to some extent from that shown on less specialised work. It is not, however, possible to consider this question fully without reference to the character of the works in which the machines are installed. Probably the highest degree of initiative is displayed by the mechanic in small engineering works, where facilities such as are provided in larger works are absent, even allowing for the fact that the machines may not be run at the high efficiency expected in a shop where a staff of specialists is employed.

SMALL VERSUS LARGE WORKS.

The mechanic in such circumstances will probably have a variety of work to consider, the quantities in most instances being strictly limited, and he will not only have to decide on the type of tools, the speeds, feeds and methods of setting up, but he will learn to think in terms of time per cycle of operations. He may also have to determine whether the quantities to be made will justify the provision of special tools and cams, or whether a lower rate of production, with standard appliances and lower initial cost, will not be more economical.

In larger works the tendency is for the preliminaries to be done in the office, and the shop will begin the times, or even the actual operations will be detailed. The resource of the mechanic will be limited by such arrangements, just as the necessity for ingenious methods of adapting a tool to work for which it is not designed does not arise in a well-equipped tool room.

INTEREST AND OUTPUT.

The skill displayed by the operator varies with the class of tool, and on the semi-automatic machine in particular the aptitude shown is probably acquired unconsciously. The workman who obtains average results learns that he must not press his tools, or stoppages will reduce output, and he performs the cycle of operations in a manner that does not unduly exhaust his physical energy. The operator who gets the maximum output usually exhibits more than usual interest in the work, and his aptitude results in the expenditure of less energy, the latter probably by reason of a subconscious process which enables him to achieve a result approximating to that obtained by a close motion study of the work. In a woman operator, for some reason, the interest factor is more often sustained, and the tools wear longer because of her keener sense of touch. On light work, therefore, where physical exhaustion is not a potent factor, her output is often better than that of a man. That the combination of interest and aptitude defines skill is clearly shown in the variety of defects which can be produced by an inexperienced workman. It is also noticeable that where the makers of a machine wish to demonstrate what can be produced, it is usual for the workman to be a mechanic, or an operator of exceptional intelligence.

SETTING UP.

The mechanic's function of putting the machine into the condition for successful operation may be considered under two heads—the setting up, and the provision of tools. The first is specialists' work—the variation in the time taken by different mechanics in getting similar machines to run being an indication that a high degree of skill is necessary. The provision of extremely accurate yet robust tools calls for skill analogous to that of other tool-room work.

The conclusions of the writer are, therefore, that the designer has precluded the operator from the display of resource, but that a reasonable amount of skill is required. The mechanic must display great resource, the amount varying with the degree of responsibility allotted to him by the management in the matter of design and lay-out of the tools. His skill in making these is of the kind usually expected of a highly trained workman, but in setting them up he may exhibit qualities not readily capable of comparison with those required in other work. It is suggested that amongst the points, which might be advantageously amplified by discussion, are the following: (1) The degree of skill exhibited by the operator in dealing with different qualities of material, especially the very

hard alloy steels used in motor-car and aeroplane construction; (2) the skill displayed by women in similar conditions and generally; (3) the effect on the initiative of the mechanic: (a) of highly specialised machines with definite limitations in their scope; (b) of the practice in large works of detailing the operations in the office.

Mechanical Appliances and Labour in Loading and Unloading Ships' Cargoes.

By A. MUSKER.

This Note is intended to promote discussion upon how much more mechanical appliances could be used, and to show how many docks lack up-to-date methods in this respect.

One point of considerable importance is the bunkering of steamers from barges in the London docks. It is no exaggeration to say that over 3 000 000 tons of coal per annum are raised from barges by means of crude steam winches and boilers; the coal being shovelled by hand into wickerwork baskets. There are some large appliances used for this purpose, but being unwieldy and difficult to move from dock to dock they only do a small portion of the work required. A full gang of 15 men and one boilerman put the coal into the bunker hatches at the rate of 45 tons per hour, and taking the present cost of labour into consideration, it should surely be possible to improve this system. If the handling of the goods is followed from the time they are put into the ship to the time they are put on a barge, cart, or railway truck after being discharged, a visit to any ordinary dock shows a fearful lack of mechanical appliances which could take the place of manual labour. The goods appear to be stowed in the steamer in the first instance with an utter want of thought as to how they are to be discharged and distributed to save labour. One sees in the same sling packages or bales addressed to different consignees, which have to be trucked separately to the various positions set out in the warehouse; and it does not appear impossible that a little forethought and arrangement when loading would prevent this. When discharged, they are handled in small units by a man with an ordinary truck, sometimes being run over rough concrete roads and rough wooden floors in the warehouse. Warehouses are built low, and the goods are only stowed in tiers four or five bales high; all being done by hand. The loss of time one sees owing to the men having to wait on one another is appalling. To keep up-to-date and handle warehouse goods economically, warehouses, if not suitable, should, like old machinery, be scrapped.

WHAT COULD BE DONE.

A striking instance of what could be done is given in an article in "Engineering" (May 6 and 13), which describes the appliances used in handling goods at the Port of Manchester warehouses, where they have overhead cranes, electric trucks, conveyors and stacking machines; and other docks would do well to follow the example.

Why should not electrical trucks be used in place of hand trucks and why should not careful attention be paid to the floors over which they have to run? On the other hand, why should not ordinary wheel trucks, to carry about 10 or 15 cwt., be fitted with ball bearings, so that each load lowered by the crane could be moved to its destination by one man, instead of its being split up into hand truckloads of say 2 cwt., one man to each? With a reasonably smooth floor and a well designed truck, 20 cwt. can be easily moved by one man. Even in the slings used for lifting the goods there is a want of attention to detail; one sees almost every lift a sling used about 8 or 10 ft. too long, which means that the crane, as a rule, lifts 8 or 10 ft. higher than is necessary, probably wasting 25 per cent. of the power required.

CONTINUOUS CONVEYORS.

The continuous conveyor, as against the intermittent crane system, might be extended with considerable advantage as regards economy in time and labour, as against the prevailing system of slinging, lifting and lowering by means of cranes, then being put on a hand truck and wheeled over rough roads to the cart or railway wagon. I have seen at Victoria Docks two quarters of beef wheeled for about 100 yds. to a stage where each quarter was lifted by four men from the truck on to the shoulders of one man and carried out to the van to additional men to be placed in position. More attention might be paid to the hatches of steamers and the doing away with the stanchions in the holds, in order to facilitate getting in and out and stowing the cargo.

APPORTIONING THE BLAME.

Whether the want of appliances is due to the shipowners, shippers, stevedores, dock companies, or difficulties with labour is an open question. Whether it is due to (as is often the case) the loading and discharging of the cargoes being paid for by a percentage on the

cost of carrying out the work is also an open question, but undoubtedly it is a system that does not tend to either rapid or economical working. Should not dock warehouses in all cases be built high enough to store goods a height of 15 to 20 ft., the goods being raised or lowered by mechanical appliances?

If the engineers of the various interests have not the time to study the questions together, it would pay them and the country generally to employ expert engineers to obtain the views of the various interests, combine them, and prepare schemes for economically handling cargoes in the various docks, of the various character of goods.

ELECTRIC TRACTION.

On Friday, July 1st, the proceedings in Section VII., under the chairmanship of Mr. C. P. SPARKS, opened with a short Paper on "Battery Locomotives," by Mr. J. Dalziel. This we give in abstract below:—

Battery Locomotives.

By J. DALZIEL.

Electric shunting locomotives may be either operated from overhead wires or from a self-contained battery. Certain limitations imposed by the battery roughly define the respective spheres. Generally speaking, battery operation is most suitable for yards where the work is moderate and fairly uniform, especially where fairly long lengths of infrequently worked siding are involved. In such cases battery locomotives will economically replace horse or capstan shunting. A probable field for battery traction on electrified main lines is that of working way-side sidings with a battery tender to supply the main line locomotive. Some branch lines may be worked economically with battery locomotives. Shunting in large goods yards will probably be best effected by locomotives combining overhead conductor with battery supply, the battery dealing with the lightly worked sidings. Where the obstruction of an overhead wire is objectionable, as on quay sides, battery operation is the only form of electric traction possible.

DISADVANTAGES OF BATTERY TRACTION.

Supply by battery alters for the worse the operating characteristics of an electric locomotive, especially as regards overload capacity. Straight battery working is not suitable for heavily worked sidings, or those out of which an occasional heavy lift has to be made, and the same applies to lines having heavy gradients, or that at certain hours require specially heavy trains to be handled. In such cases overhead conductors should be used; undue increase in battery capacity and weight, or the provision of special types, prohibitively enhances costs. Mid-day boosting charges are adverse to the life of all batteries of whatever type. Many existing sidings where locomotive operation may be contemplated are equipped with turntables. If it is, as it may be, impossible to substitute points for these, a capstan may be fitted to the locomotive, so as to enable it to pass over such turntables and into the sidings they serve.

TYPICAL BATTERY LOCOMOTIVE.

A typical battery locomotive is that built by the Midland Railway in 1913 to supersede horse shunting in a London coal yard. Its dimensions, &c., are as follows:—

Weight	17 tons 7 cwt.
Draw-bar pull	6 400 lb., max.
Normal load	8 loaded wagons (90 tons).
Maximum load	12 wagons.
Speed	7 miles per hour.
Unloaded speed	About 12 miles per hour.
Yard capacity	About 100 wagons.
Average weight per haul	About 30 tons.
Average length of haul	About 50 yards.
Annual ton miles	About 45 000 (excluding locomotive weight).

DESIGN AND CONSTRUCTION.

Standard wagon parts can in general be used. Hand brakes are sufficient. Special attention is required to battery box ventilation and insulation. The Midland locomotive is mainly built up of 10-ton wagon parts. The brakes are screw operated, working on a special brake drum to avoid undue wear on tire brakes owing to grit. A rheostatic brake is also regularly used.

Motors should be wound specially for low speed and single reduction gear. The Midland locomotive motors are of 22 h.p. at 220 revs. per min., nose-suspended and spur geared 15-68. A single controller is fitted in the driver's cab, it being of ordinary tramway type with rheostatic brake. Special batteries of the road vehicle type are unnecessary for rail traction. Where the use of battery in preference to conductor supply is justified, a flat plate type battery is sufficiently good for the service, and it is anticipated that battery contractors will guarantee such batteries for up to 10 years at an annual charge of about 10 per cent. to 15 per cent. of first cost. On

the Midland engine the battery is by the D.P. Battery Company, consisting of 108 train lighting type cells in wooden boxes lead lined, the capacity being 300 Ah at the 10-hour rate.

CHARGING.

Charging arrangements should be sufficiently automatic to enable technically unskilled labour to be normally employed. In the Midland case charging is done from the Corporation mains through a motor generator; the generator is wound with shunt and reverse series coils, so that the maximum voltage that can be impressed on the battery is about 2.6 per cell with 10 A only passing, while with 70 A passing the voltage becomes only 2.1 V per cell. The shunt coil can be adjusted by field regulation, so as to bring up the voltage to 2.7 per cell for gassing charges, which are given periodically under skilled technical supervision.

In a self-contained yard such engines can be driven by yard staff, who can also perform other duties. If the engine has to work on or to cross the main line a qualified driver would have to be employed.

OPERATION AND COSTS.

The energy consumption of battery locomotives is necessarily high, the actual consumption varying according to the nature of the service. In addition to the normal losses by frequent stops and braking, there are the special losses in the battery and charging plant. In the Midland case the energy consumption measured at the Corporation meter averages about 100 Wh per ton mile. The over-all efficiency is about 50 per cent., i.e., a battery locomotive consumes about double the energy of a conductor-supplied locomotive on the same work. On the other hand, rail bonding in yards presents some difficulties; moreover, in most cases an earthed return is not permissible; motor generator losses are thus inevitable unless double overhead wires are used.

A locomotive of the type and capacity shown would cost, pre-war, approximately, £900, with, say, about £200 additional for charging plant. This locomotive replaced five horses and four men pre-war, the annual value of which, at to-day's prices, is about £1 600. The working cost of the locomotive for the year 1920 was about £400; adding provision for battery renewal, interest and depreciation at to-day's prices and rates, the total cost amounts to about £800, so that in similar conditions such an engine could be installed to-day to save £800 per annum over horse shunting.

DISCUSSION.

In opening the discussion Sir HENRY FOWLER said that battery locomotives would be very useful on the small branches of which, in this country, there were very many with short mileage and with a very light traffic. Then from a financial point of view it would be inadvisable to equip electrically in the usual way. The type of battery vehicle used on the Continent would not be suitable in this country, where separate locomotives would be necessary in order that shunting might be carried out.

Mr. C. H. MERZ said that the battery locomotive offered a means of doing a great deal by electrical methods at a small expenditure. More trials of the kind mentioned in the Paper might be made with advantage as it was only by such trials that the exact capacity of the battery and similar data on charging conditions and plate improvements could be discovered.

AN IMPORTANT LABOUR QUESTION.

Mr. ROGER T. SMITH asked whether the author had experienced any difficulty through acid spilling in shunting operations when using the open type battery, or whether any steps had been taken to prevent this as was done in train lighting cells. The author claimed that the battery locomotive could often usefully replace the horse and the capstan for shunting. His experience showed him that this depended entirely on whether the locomotive could be worked by the ordinary yard staff. He congratulated the author on his ingenuity in using ordinary wagon parts at a capital cost of at least half of what would have been necessary had a special design been employed.

Mr. F. LYDALL said that the locomotive mentioned in the Paper was too small to be of much use for shunting in main line goods yards. An average of 103 tests in 66 yards in the States showed an average length of run of 628 ft., an average time of run of 79½ secs., an average time of stop of 53 secs., an average speed in motion of 5.4 miles per hour, and an average speed including stops of 3.24 miles per hour with an average load of 306 short tons. This would be a very fair service for a battery locomotive, but was probably considerably above what would be required in small yards in this country. Unless the battery was available for recharging at very short intervals it must be of considerable size if the locomotive were to handle full size trains. It would be interesting to know whether it would be practicable to charge the battery intermittently from overhead or third rail.

LONG-LIVED BATTERIES.

Mr. ELLIOTT said that batteries on some locomotives running in Switzerland had been in use for 13 years. These batteries were of the heavy type of cell similar to those employed on the Midland Railway. No light type of cell would have lasted that time, its average life being between one and two years.

Mr. P. EDWARDS said that if any electrification scheme were developed for England, battery locomotives would have to be very much larger and heavier than they had been up to the present. Regeneration might be resorted to so that the energy absorbed in braking could be utilised for charging.

THE EQUIPMENT OF BATTERY LOCOMOTIVES.

Col. F. A. CORTÉZ LEIGH was not at all in agreement with the author about using battery locomotives on branches and sidings. The equipment of these lines was not very expensive and locomotives of the ordinary way was therefore efficient. Exide and Edison batteries would be more suitable than the Plante battery, as locomotives were often very roughly handled in shunting yards. The type of battery now being used on small trolleys for platform work should be suitable for locomotives.

Mr. A. C. AGNEW said that disappointing results as regard speed were often obtained with battery locomotives. He had found the Edison battery extremely satisfactory.

Mr. F. W. CARTER suggested that the motors on battery locomotives might with advantage be compound wound instead of series wound in order to enable them to be used for regeneration and to make the radius of the vehicle greater.

Mr. A. S. BARNARD asked how many motors there were on the locomotive and also whether the control was series, parallel or rheostatic. The success or failure of battery locomotives depended very largely on the system of control.

Mr. BROUFFELL thought that the efficiency of the battery locomotive could be improved by altering the control and getting rid of some of the rheostatic losses and also by improving the cells.

The CHAIRMAN said his experience in mining work led him to think that a special type of battery was required for such service.

ELECTRIC v. STEAM LOCOMOTIVES.

A joint meeting of Sections VII. and III. was held on Friday, when a discussion took place upon the "Mechanical Advantages of Electric Locomotives Compared with Steam." Capt. H. Riall Sankey was in the Chair. Sir VINCENT RAVEN introduced the subject with a Paper, of which we give an abstract below.

Mechanical Advantages of Electric Locomotives compared with Steam.

By SIR VINCENT L. RAVEN, K.B.E.

In a comparison between steam and electric locomotives there are a number of prominent features in both types that are perhaps best expressed by the terms "for and against" or "advantages and disadvantages."

The mechanical disadvantages of the steam locomotive may be briefly summarised as follows:—The locomotive being a complete independent unit, its power cannot be greater than the capacity of its boiler. To increase the boiler capacity obviously implies increased dimensions and weight, both of which offer grave difficulties in regard to clearances and strengthening of bridge structures. It is known that on many railways in Britain the limit of weight has been reached, and further development of power is only possible at enormous expense. The boiler, cylinders, valve-gear, crankshafts and all reciprocating parts are costly to maintain. Turntables, fuelling plant and water supply appliances must be provided. The cab is small and open to the weather, involving discomfort to the locomotive crew. The locomotive radiates heat and uses coal all the time steam is up, that is, during many hours when it is doing no work, and either standing by or coasting. The wear and tear of the locomotive on the track is considerably increased by the impossibility of accurately balancing the reciprocating parts.

THE CASE FOR THE ELECTRIC LOCOMOTIVE.

The case for the electric locomotive may be set out by the brief statement that it is not hampered by any of the above-mentioned objections. In addition, one might point out that it possesses other important qualifications, such as: Simplicity of mechanical construction and operation. Increased power of acceleration. Higher scheduled speed due to the possibility of heavy short period overloads resulting in more frequent service and increased use of existing tracks. Uniform turning effort resulting in better factor of adhesion at starting and on gradients. Absence of all reciprocating movement and accurate balance of all rotating parts. Facilities for driving from either end of a locomotive. Accessibility of mechanical and electrical parts. Better accommodation for locomotive crew by reason of increased cab area and by closing in and heating the cab. Possibility of coupling two or more locomotives together under the control of a single driver.

FUEL ECONOMY.

The production of energy in a power station rather than on the locomotive leads to a substantial economy of fuel. On a steam locomotive fitted with all modern improvements, it is not practicable to work at less than about 2½ lb. of best quality coal per B.H.P. hour, and few engines are capable of doing this for any length of time.

Taking into account the additional fuel required for lighting up, standby losses, periods of uneconomical working and other factors continually met with in practical working, the average consumption is more like $3\frac{1}{2}$ lb. per B.H.P. hour for passenger engines, and 5 lb. for goods engines. On the other hand, with electric locomotives, whether passenger or goods, and with up-to-date power station and sub-station plant, it is possible to reduce the consumption of fuel to $1\frac{1}{2}$ lb. per hour, or even less, of low quality coal per B.H.P. produced on the locomotives. In other words, electrification enables the fuel consumption to be reduced to one-half or one-third, the fuel employed being of a quality unsuitable for steam locomotives.

COST OF MAINTENANCE.

Experience on the North Eastern Railway with regard to the cost of repairs of electric locomotives working between Shildon and Newport, shows that the cost of maintenance is approximately one-third that of maintaining the steam locomotives which worked this traffic previous to 1915. The difference in America, however, is much greater, as Mr. Armstrong, Chairman of the Electrification Committee of the General Electric Company, gives figures showing the cost of repairs per mile of three American railways varying from 6.3 cents to 14.6 cents, as compared with a cost of 60 cents per mile for a 2.8-8.2 Mallet steam engine, which is the class of engine that would have to be used to haul a similar train to that taken by the electric locomotive, the cost of repairs of which is 14.6 cents, or one-fourth that of the steam engine.

CLASS OF DRIVE.

The method by which power is transmitted from the motors to the driving axles is generally spoken of as the "drive." There are two general classes:—(1) In which the motors are built direct on the driving axles, or are connected to them by reduction gearing. (2) In which the power of the motors is transmitted to the driving axles through connecting and coupling rods. In each of these two classes there are numerous distinct types depending upon details.

MOTOR WITH REDUCTION GEAR DRIVE.

The motor with reduction gear is the most widely used method of transmitting the torque to the driving wheels. The motors are totally enclosed, each driving an axle through single reduction gearing, a pinion being mounted on the end or on each end of the armature shaft, and meshed into a corresponding gear wheel, mounted on the running wheel axle. The motors are suspended by a cross suspension bar with bearings and reaction springs. These, with the motor suspension bearings on the axle, provide the motors with four points of suspension. This particular design, which is the ordinary double bogie articulated type, is widely used for freight traffic, and is the same as that used on the Shildon-Newport Electrification, North Eastern Railway, and others in the States and on the Continent.

QUILL DRIVE.

In the quill drive the motors are mounted rigidly between the frames. Each motor is geared to a quill centred in bearings in the motor frame and surrounding the driving axle. The axle and quill are concentric. The quill is connected to the driving wheels by long helical springs which are clamped rigidly at the ends in castings which are bolted, one to the quill flange, and the other to the driving wheel. All springs with clamps are interchangeable, and any spring may be removed without disturbing any part of the running gear. The arrangement is such that the axle, quill, pair of wheels and motor can be removed from the locomotive without disturbing the running gear. This drive secures all the advantages of a flexible gear in cushioning the transmission of torque, and lessens the vibration more effectively than the usual flexible gear construction and mounting. This drive is employed on the geared locomotives of the New York, New Haven and Hartford Railway, also the Chicago, Milwaukee and St. Paul. The advantages of quill drive are (1) The driving wheels are large. (2) The centre of gravity of the locomotive is high. (3) The dead weight on the track is reduced to a minimum, consisting only of the wheels and axles, without the addition of any portion of the motors.

GEARLESS DRIVE.

In the gearless drive the motors are of the bi-polar type, the armature being built directly upon the driving axles, and the other parts of the motor being built into the framework of the locomotive structure. This arrangement is such that any armature with its axle and pair of wheels can be removed from the locomotive without disturbing the rest of the motor. This design is in use on the Chicago, Milwaukee and St. Paul and the New York Central Railways, and is giving every satisfaction. The advantages claimed for this design are:—Simplicity of electric motor

owing to the absence of motor bearings and gear, &c.; facility for examination of motor and removal of armature for repairs if required. The mechanical arrangement of the complete locomotive is said to possess the required flexibility and balance to enable it to run at any speed equally well in either direction without tendency to oscillate or spread the track.

CONNECTING AND COUPLING ROD DRIVES.

In this class the rotary motion of the motor armatures is transmitted to the axles by cranks on the motor shafts, or on jack-shafts driven by the motors and by connecting rods coupling these cranks with crank-pins on the driving wheels. The principal advantage of this method of drive is that the exact position of the motor in relation to the driving wheels is at the disposal of the designer, and he is therefore free from the restrictions imposed upon him by the necessity for getting the motors into the space between the flanges of a pair of wheels as in all locomotives in gear drive, and is therefore enabled to use large motors and place them in the most convenient position in the locomotive. This method of drive has not been employed at all in this country, except for experimental purposes. In the United States there are a few examples, namely, the locomotives on the New York section of the Pennsylvania Railroad, others of a different design on the Norfolk and Western Railroad, and an experimental locomotive designed by the Pennsylvania Railroad for the electrification of the Altoona grade. The general opinion in the United States seems to be more in favour of designs which come under the other division.

On the Continent, notably in France, Switzerland, Italy, Germany, Austria and Sweden, the connecting-rod drive in one form or other is almost universal. Up to the present electrification in these countries has been carried out mainly on the single phase or 3-phase system, and Continental engineers consider that the additional complications caused by the introduction of cranks and coupling rods are more than compensated for by the advantage of having a free hand with the motor design.

A large number of designs have been worked out. Some have proved quite satisfactory, others have given rise to a good deal of trouble. In most cases the trouble has been eliminated by strengthening up special parts, such as crank-pins, Scotch yokes, &c., and by introducing a certain amount of flexibility into the connections between the motors and the crank-shafts.

DISCUSSION.

SIR JOHN ASPINALL said although electrical operation had proved a commercial success, a great deal had yet to be learned with regard to the electrical working of main lines. It was not for instance known what was the best form of electric locomotive, and he could not view with satisfaction the prospect of utilising the Continental form of engine, in which rotary motion was converted to reciprocating motion, and reciprocating motion converted back again into rotary motion. What was wanted was some form of direct drive through gear wheels. He looked forward to the day when electric locomotives could be used on all the main lines of the country and would be able to run from Aberdeen to Dover without change. The machinery of electrical locomotives should be kept well up in the cab and away from the bogies. Uncertainty as to the system which would be adopted for electrification had held up development, but the electric Railway Advisory Committee had recommended, and the Minister of Transport had approved, that there should be a uniform system of direct current at 1 500 V with a third rail throughout the country.

WHOLESALE ELECTRIFICATION NOT DESIRABLE.

SIR PHILIP NASH said that although the economies instanced by Sir Vincent Raven were very striking, he did not think that the wholesale electrification of railways was either desirable or practicable. The enthusiasm of electrical engineers in developing electric traction up to the point that it had now reached had been very valuable, but the time had come when it was necessary to apply the greatest deliberation before conversion from steam to electric working on main line operation was undertaken. The electric locomotive had considerable advantages over the steam locomotive in regard to hauling heavy loads, and it should also find a particular field of usefulness in shunting yards, by reason of its low standby charges.

THE ECONOMIES OF ELECTRIC TRACTION.

MR. C. H. MERZ said he was strongly of the opinion that the heavy capital expenditure involved in the conversion of our main line railways to electric traction would be more than compensated for by the resulting economies. The great advantage of the electric locomotive was its continuous availability for service. It could run long distances and for long periods without being sent to the running sheds for overhaul. It was surprising that the electric locomotive had not made more progress than it had, but that was due to hesitation arising from indecision as to the system to be adopted. He hoped that railway engineers would not wait until they obtained the perfect locomotive before starting, because it was only through experience with a variety of types over long distances that any great degree of perfection could be reached. At present the electric locomotive was a perfectly practicable machine, but more attention should be given to the control equipment which was not

credible to the electrical engineer, and it compared badly with the control of the steam locomotive.

Sir PHILIP DAWSON thought that Sir John Aspinall's vision of electric locomotive running without change from Aberdeen to Dover was a little optimistic. At the present time electric locomotive work was by no means standardised, and we were really in the position with regard to it that we were in thirty years ago with the ordinary double current motor, when every designer had a totally different type of motor to offer to the prospective user. There was undoubtedly a great opening for electric locomotives in shunting yards, where at present there was an enormous waste of time and money.

RAILWAY COMPANIES AND INDUSTRY.

Mr. ROGER T. SMITH said that the industry of this country had been hampered by the railway companies building their own locomotives. The result was that there was no incentive for British manufacturers to take up either steam or electric locomotives. Had the policy of the railway companies been different, he believed that this country would have taken an equal position in the world in locomotive building as it had done in shipping. He hoped the same thing was not going to happen with regard to electric locomotives.

THE ADVANTAGES OF THE ELECTRIC LOCOMOTIVE.

Mr. J. DALZIEL said the adoption of the electric locomotive allowed additional tractive effort to be obtained when hauling heavy loads up steep gradients. Another advantage of the electric locomotive was the possibility of obtaining regeneration, which, although it imposed additional work on the motors, and called for special designs, provided mechanical advantages which were greater than the electrical disadvantages. The Midland Railway was specially interested in the development of electric locomotives, because it had heavier gradients on its lines than any other railway company. The squirrel-cage type of motor was the one which best solved the problems of the high-speed electric locomotive, but a great deal more experience with it was required. He heard with very great regret that there was a possibility of the third rail system being standardised in this country, because he believed that the overhead system could be put up at a cost certainly not greater than the third-rail system, and there seemed, therefore, no reason why we should not be satisfied to accept the overhead system once and for all. It was specially suitable for sidings, and was the only means whereby a continuous system could be obtained so far as the equipment was concerned.

THIRD RAIL NOT STANDARDISED.

Sir PHILIP NASH said he would not like it to go forth that the third-rail system had been standardised by the Ministry of Transport. The fact was that the Electric Railways Advisory Committee had standardised direct-current, as it was considered the most suitable in this country, the voltage suggested being 1500. The Committee had not standardised—and did not propose to standardise—the third rail as the standard system for all purposes.

FINANCE AND ELECTRIFICATION.

Sir HENRY FOWLER said he was convinced that there must be considerable electrification of our main lines as soon as the financial position permitted. The reason for that was perfectly clear, a much higher efficiency could be obtained from electric than from steam locomotives. It was true that in depending upon one central station it was possible that a good part of the system might be put out of operation in case of a breakdown at the central station, but generally speaking, it was finance that was the deciding factor, for however ingeniously steam locomotive engineers might go to work, they could never surpass the great economies obtainable from central power stations.

A STEAM-ELECTRIC LOCOMOTIVE.

COL. F. A. CORTEZ LEIGH said that as long as shunting engines were standing for 40 per cent. of the time they were in use it was quite obvious that a large field existed for the use of the electric locomotive. An important advantage of the electric locomotive, however, was the long period which it could remain on the line without repair. They had been known to be running for 10 days with hardly any attention at all, whereas, with steam locomotives, he doubted whether one-third of the 24 hours was occupied in actual running. At the present time there was under construction at the Armstrong, Whitworth works a steam-electric locomotive, which would shortly be on trial, in which the electrical energy was generated on the locomotive.

Sir VINCENT RAVEN, replying to the discussion, said that, having been brought up as a steam locomotive engineer, he had not rushed hurriedly to change his opinions as to the value of the electric compared with the steam locomotive. It was only after very careful consideration that he had come to the conclusion that electric locomotives must replace steam locomotives, and, as so many speakers had stated, it was only finance which was holding back the change. Another direction in which the electric locomotive showed advantages, apart from actual economy in working, was in labour. The railways and all large industrial concerns had to reduce the high cost of labour by reducing the number of skilled hands, and even the low-class labour which was now used. By the adoption of electric locomotives a large percentage of skilled labour would be done away with, for 30 per cent. of the steam engines now being used could be done away with; in other words, they would be able to cover the same mileage with 30 per cent. less locomotives. He fully appreciated the point made by Mr. Roger Smith with regard to locomotive construction, and if private manufacturers would take up the

design of electric locomotives he saw no reason why they should not be built outside the railway companies' premises. His company had built its own electric locomotives so far because it was simply impossible to get them built outside.

The following Papers were dealt with in Section IV. :—

The Utilisation of Exhaust Steam in Turbines.

By M. DEACON.

Twenty years ago the utilisation of exhaust steam in turbines was in its infancy. During this short period an enormous development of the use of exhaust and mixed-pressure steam turbines has taken place, particularly at collieries, where the volume of exhaust steam is necessarily large in relation to the horse-power developed. The national economy in fuel which has been effected by the utilisation of exhaust steam cannot be accurately estimated, but it may safely be stated that hundreds of collieries in the United Kingdom are now performing the bulk, and, in many cases, the whole, of the underground pumping, hauling, and electric lighting, through the medium of mixed-pressure turbines.

As an example of the magnitude of this economy it may be fairly stated that a colliery of average depth (say 500 yards) and raising from 2 000 to 3 000 tons of coal per day, will produce enough exhaust steam to develop at least 1 000 H.P., and that with the assistance of high-pressure steam when the supply of exhaust steam is insufficient, from 1 500 to 2 000 electrical H.P. may be produced through the medium of turbines and electric generators at such a colliery. Assuming as a rough estimate that there are 500 such collieries in the kingdom fully equipped with turbines, the total economy in fuel amounts to 2 000 000 tons or more per annum.

The cost of generating electrical power by exhaust steam is naturally very low, having regard to the fact that the steam would otherwise be wasted. Disregarding the exhaust steam as of any value, the cost of running is confined to labour, repairs, stores, and interest on capital and depreciation of plant. Taking the two latter at 20 per cent. on the capital outlay the cost of production per British Thermal Unit with exhaust steam only is approximately 0.20d., and with mixed-pressure consisting of 20 per cent. of high-pressure steam 0.40d. These costs are based upon the present-day values of plant, wages and stores, and with small coal at 20s. per ton with the plant running 10 hours per day. On 20 hours per day instead of 10, on approximately full load, the cost per unit would have been 0.10d. for exhaust steam, and 0.20d. for mixed-pressure steam. Prior to the war the cost was rather less than half the present-day cost.

DISCUSSION.

The CHAIRMAN (Sir Richard Redmayne) said that if the colliery load, apart from the winding load were heavy and not fully co-incidental with the latter it would often be attractive to put down high-pressure turbines and adopt electricity for all purposes in the colliery, including winding. It would be interesting to know how many units Mr. Deacon generated from exhaust steam per day, and how many he generated from live steam, so that the proportion of total power obtained by the two methods might be ascertained. Naturally it would be supposed that where the power demand in the colliery was large enough it would pay to generate power electrically by high-pressure turbines and to wind electrically, but unless the load factor was very large it would be more profitable under such conditions to obtain the necessary electrical energy from the public supply. It was profitable to drive continuously running machinery such as fans and pumps electrically, but with a variable load like a winding engine it was a very different matter.

Mr. J. A. McLAY said there was no plant in which the efficiency so much depended on the lay-out as exhaust steam plant. It was often impossible to use the whole of the exhaust steam available in the turbines and the surplus was blown into the atmosphere, with the result that the colliery was worse off after the plant was installed than before. A colliery was often badly off for water and therefore there was much to be said for installing condensers of the surface rather than of the jet type.

Mr. SEYMOUR WOOD described the installation at a colliery where power was purchased from the power company, and practically all the plant except the winding engines was worked electrically. Surplus steam from these winding engines was used in an exhaust steam turbine to provide compressed air for hauling engines underground, coal cutters, &c. Mr. Deacon's Paper was a warning to all mining engineers that they must do everything they possibly could to economise.

Mr. MAURICE DEAKIN, in reply, said that as regards complete electrification his experience had been that where the winding element was a very large one it was more economical to employ steam for driving the winding engines, and to utilise the exhaust steam for the electrification of the remainder of the plant. He had once seriously considered the electrification of the whole of a new colliery on the basis of providing power by gas producers and eliminating steam boilers altogether. This would have been a great advantage but to electrify a colliery by using steam turbines still necessitated boiler plant.

Steam versus Electric Winding.

By W. C. MOUNTAIN.

Whether it is economical to adopt steam or electric winding depends upon so many circumstances that it is quite impossible to lay down any hard and fast rules, for the following reasons: If the colliery, or collieries, are so isolated that a supply of electricity cannot be obtained from a public power station, and the collieries are of large capacity, there is no doubt that the most economical method to adopt is to put down steam winding engines and to utilise the exhaust steam in mixed pressure turbo-generators.

If the collieries are of moderate size, or are small collieries, and there are several of them under one or more ownerships, then it is possible, and in fact probable, that electric winding can be economically adopted, particularly if power can be obtained from a power company at a reasonable cost, but even under these circumstances the type of winder to be adopted must be carefully considered, because unless the power company has a large capacity it may be necessary to adopt electric winders with lighter balancers, as small direct-driven or geared winders with three-phase motors with rheostatic control may throw a peak load on the power station which would cause serious trouble.

There are also collieries where blast furnace or coke oven gas is available, which could be used either in gas engines or under boilers, and there is no doubt that in simplicity and first cost the use of steam turbines, with water-tube boilers employing gas as fuel and properly arranged for superheaters, have advantages, and that a very high degree of economy can be obtained. On the other hand, circumstances may make it possible to utilise the gas direct in gas engines, but it all comes to a question of cost and efficiency in running, also freedom from stoppages due to breakdowns or repairs that may be necessary in daily working.

EXAMPLES OF HEAVY WINDERS.

As an example of heavy winding in collieries in Derbyshire, which may be taken as typical of the heavy duty in this country, two collieries called "A" and "B," may be mentioned. The depths are respectively 820 and 900 yds., and the total weight of coal wound per wind 9 tons 6 cwt., the further particulars in each case being as follows:—

Time of wind	60 seconds
Time of changing	12 "
Steam pressure at boilers	160 lbs.
Diameter of steam engine cylinders	44 inches
Length of stroke	84 "
Dimensions of conical drum	17-32 feet
Estimated H.P. on 2nd revolution	3 960
" " 4th "	3 680
" " 6th "	4 380
" " 7th "	1 780
Steam consumption per wind exclusive of condensation in pipes, &c.	600 lbs.
Steam consumption per shaft-horse-power	30
Consumption of coal assuming 60 winds per hour per winding day of 13 hrs. 20 mins.	22 tons 5 cwt.
Cost of winding engines to-day, approximately	£20 000.

The exhaust steam from these winding engines is used in mixed pressure turbo-generators, and in 1918 the costs per unit delivered to the bus bars in the power station were as follows:—

	Labour, steam and stores.	15 percent. Interest and depreciation on capital.	Total cost.
	Per kW. d.	Per kW. d.	Per kW. d.
Exhaust steam only...	0.0189	0.06	0.0789
Mixed pressure steam...	0.0302	0.06	0.1502
High-pressure steam...	0.227	0.06	0.287

In the case of the high-pressure steam the coal to the boilers was taken at 7s. per ton.

This example shows that up-to-date modern steam winders are economical as regards the consumption of steam per shaft horse-power, and it must be remembered that in utilising exhaust steam in exhaust steam turbines a kilowatt can be obtained for about 35 lbs. of exhaust steam at 16 lbs. pressure delivered from the winding engines into the turbines.

ELECTRIC WINDERS IN SOUTH AFRICA.

Electric winding has made very substantial progress, and a great deal of heavy work of this description has been done by The British Westinghouse Company, now Messrs. Metropolitan-Vickers Electrical Company, in South Africa. The winders are fitted with semi-conical or parallel drums in accordance with the requirements, and

from information supplied to me the motors are rated to give from 1 450 to 1 600 H.P. normally, but are capable of carrying a peak load of from 3 000 to 4 000 H.P.

To reduce the whole matter to a simple basis I cannot do better than repeat my views put forward in 1906: For small collieries there is a future for electric winding if the coal used under the boiler is of any considerable value. In large collieries there is a future for electric winding if the coal used under the boilers exceeds 8s. to 10s. per ton, but this, of course, depends entirely upon the relative costs of steam winders with their boilers compared with the electrical equipment. Electric winding cannot be economically applied to collieries for very large outputs where it is necessary to install a generating plant to produce the necessary output for operating the winder, because the horse-power required for winding is so greatly in excess of the horse-power required for driving other machinery, and as it would be necessary to provide a stand-by plant, the costs would be prohibitive. In collieries generally, particularly those in which electric winding is adopted, colliery owners would be well advised to take their current from the supply companies, assuming they can purchase it at a reasonable price, even if this price is slightly in excess of the cost at which they can produce the current themselves, due to the amount of capital required for the generating plant being so heavy. The same capital expenditure could be applied to much greater advantage in increasing the electrical plant on the surface and underground.

The Relative Values of Protective Metallic Coatings for Iron and Steel.

By S. O. COWPER-COLES.

The protection of iron and steel from corrosion by means of protective metallic coatings can be divided under two headings: (1) Electro-positive metallic coatings; (2) electro-negative metallic coatings.

A large number of engineers do not appreciate the difference between the two coatings, with the result that much money is wasted and in many cases great risks run. Electro-positive metallic coatings are those which are electro-positive to the underlying iron and steel, such as zinc, aluminium and brass. Electro-negative metallic coatings are those which are electro-negative to the iron or steel, such as lead, tin, copper and nickel. The latter are only protective as long as the coatings remain intact; once penetrated, corrosion takes place more rapidly than if there was no coating, hence the danger of coating iron and steel with a negative protective coating, for instance, steel wire with lead as the coating remains intact, whilst corrosion goes on beneath the covering metal. It is proposed, therefore, to limit these notes to the discussion of the relative value of electro-positive coatings, which are the only protective metallic coatings of commercial value. The reason why zinc is the metal most extensively used, is that it is electro-positive to iron and steel. It is, therefore, proposed to discuss its relative advantages and disadvantages first.

Zinc coatings can be applied by four methods: (1) Dipping in molten zinc; (2) sherardizing; (3) electro-zincing; (4) spraying.

DIPPING IN MOLTEN ZINC.

This process is used for a variety of work, and is the only process at present successfully employed for tank work and corrugated sheets, in the first instance, for the reason that it is the only process that solders or makes watertight joints, and in the second instance, it is the only process that enables sheets to be rapidly coated by a continuous process. The chief advantages of the hot or dipping process are: Its soldering action or rendering made up articles watertight, its rapidity, and it ensures a considerable thickness of zinc, except in the case of sheets or wire, which can have most of the coating wiped off, leaving a mere film.

The chief drawbacks to the hot galvanizing process are: The coating is not alloyed or amalgamated with the surface; it can only be worked economically on a large scale, and continuously; the waste of zinc is considerable; the flux employed, sal ammoniac is expensive and helps to start corrosion; and paint does not adhere well. The spangled effect given to hot galvanized sheets, instead of being an advantage from a protective point of view, is a drawback, and some engineers who have studied the subject now specify that galvanized iron sheets should not be spangled. The spangles are sometimes obtained by the addition of a small quantity of tin, which is not advantageous. If a section is made through a spangle, it will be found that the zinc is very much thinner in some parts than others.

SHERARDIZING OR VAPOUR GALVANIZING.

This process consists of placing the iron or steel in zinc dust or powder, a by-product from zinc smelting works, in a closed drum or receptacle, and heating for several hours at a temperature of

several hundred degrees below that employed for the molten zinc process.

The chief advantages are : The zinc coating is quite evenly distributed, so that screwed or machined parts can be zinc coated ; the zinc amalgamates with the surface ; the temperature employed is lower than that required for the molten process ; the surface forms an excellent surface for painting on ; and the working costs are less and it can be worked intermittently.

The chief drawbacks are : There is no soldering action, and it cannot be used for making vessels watertight ; and a thin and inefficient coating can be supplied if too low a temperature is employed.

ELECTRO-ZINCING.

This process consists of placing the iron and steel to be coated with zinc in tanks, containing zinc solution such as zinc sulphate, connecting the iron or steel to be zincd to the negative pole of a dynamo and zinc sheet or slab with the positive.

The chief advantages of the process are : It can be carried out in the cold, and large objects can be coated.

The chief drawbacks are : The zinc coating is uneven, building up on protruding parts, hollow parts receiving very little zinc, and if not carried out under very careful supervision, the thickness of the zinc may be a mere film.

SPRAYING PROCESS.

This process consists of spraying molten zinc on to the surface by means of air, or a reducing or inert gas, and has the advantage that it can be applied to iron and steel structure when erected, but the process is very costly and the coating porous. Considering the great importance of the effective protection of iron and steel from corrosion and the vast sums of money spent yearly on the upkeep of iron structures and renewals of all sorts due to corrosion, it is astonishing that more attention has not been given to the matter. It offers a most useful field of investigation and might well be carried on with the researches now being made in connection with the corrosion of condenser tubes. There are no means at present of determining in a practical manner the thickness of zinc or zinc-coated surfaces. The copper sulphate test, dipping in a saturated solution of copper sulphate, although still specified by many engineers and Government departments, is quite useless for zinc coatings applied by electro-zincing or Sherardizing. It therefore appears that the first investigation should be to devise a standard workshop test for determining the thickness of the zinc coatings, and then apply the corrosion and durability tests. So many tests have been made which are of little or no value, for the reason that the thickness of the zinc coatings have not been determined in a manner that could be applied in everyday commercial practice. An electro-zincd surface might have a film of zinc evenly distributed, whilst a hot galvanized surface might have five times the amount and be very unevenly distributed, so a common test without a previous practical test to determine the thickness and even distribution of the zinc coating is of little value.

Work Without Labour.

By ERNEST J. P. BENN.

While we are busy making jobs, sharing out work, inventing new excuses for employment, and trying to make positions for two where there was only one, America is making the most astonishing progress in the science of "work without labour." Everybody over there is keen on production, and willing to put forward any amount of effort to get it, but that effort is generally made by the brain and not by the muscle. The labouring man is fast disappearing, and the worker would be more correctly described as a director of machinery. I visited the most up-to-date of the Steel Trust's works at Gary, and hoped that I might see the American breed of the mighty smith, bare to the waist, struggling with the white-hot metal, and moulding it at his will ; I conjured up pictures of stokers dripping in perspiration and other typical representatives of labour as we still think of it. I was taken into a sort of miniature Crystal Palace, 750 ft. long, and about 200 ft. wide, the floor of which was one solid mass of moving rollers ; I walked along a gallery or bridge, the whole length of this building, the doors at the end opened and a huge crane appeared carrying a 2-ton lump of white-hot steel which almost seemed as if it had been trained to know its business. First it was gripped by a pair of massive rollers which flattened it in one direction, then passed over more of the moving floor to the next pair which flattened it the other way. On it sped through a long succession of rollers and moulds until on reaching the end of the building it had assumed the shape of five long bars. The automatic rollers pitched these to the other side of the building, where they proceeded to chase one another through a further series of processes until they arrived back at the doors out of which the steel had come

and placed themselves as if they were used to it in a railway truck as finished steel rails. Nobody lifted anything ; nobody sweated ; nobody suffered fatigue ; a score of men, dotted about the mills, pressed buttons and moved levers, and each took a dollar and a half for doing it. An even more wonderful sight is to see the making of railway wheels, with no more hard labour than it takes to drive an automobile. Great big machines like motor cars, running on rails with huge arms which gripped the metal, lifted it from one furnace to another, deposited it under each of a series of stamps and handed over to the machine shop for finishing. All run by a man who sits in the seat of a huge motor with rather more pride, and about the same amount of work, as the average chauffeur in a Rolls-Royce.

THE USE OF MACHINERY THE RULE.

Lest it should be thought that the latest plant of the Steel Combine is something exceptional, other examples can be found at every turn to show the determination of the American workers themselves to reduce labour to a minimum. The chamber-maid in the hotel wheels about a wagon which is a mass of appliances for cleaning the room in a hurry ; she connects the flex to the electric light, and sweeps and dusts and clears in a fraction of the time that would be necessary by English methods.

Elevators all over America are something which we hardly know here. They work at a rate which no self-respecting lift-man would tolerate. But the American lift-man does very little work ; he almost invariably sits on a stool and pushes buttons, he presses with the right foot and the gate opens, with the left foot and it closes, and performs two or three journeys up and down the 25 floors in less time than it generally takes the Tube lift to move one way once.

MANUAL LABOUR UNDIGNIFIED.

Even the work of wheeling a barrow or a trolley is considered beneath the dignity of a self-respecting American labourer, and the American factories are almost all equipped with electric motor-trolleys run about in a manner with which we are familiar at a few of our leading railway stations. When we introduced women into engineering during the war, we did a great deal to improve our methods in these respects, but it cannot be claimed that we have done away with lifting and carrying, while in America it would be almost true to make that claim. If the worker wants a motor to carry him home, as most of them do, it is not likely that he is going to degrade himself in working hours by carrying bulky weights about.

THE ADVANTAGES OF CHEAP ELECTRICITY.

Travelling carriers, both overhead and underfoot, and moving bands are to be found not only in every factory, but in many of the offices. Overhead or underfoot, or both, something is moving all the time. The cheapness of electric current has a good deal to do with this development. I saw several tea-shops or lunch-shops, as they are called, with continuous lifts carrying dirty cups and plates to the washing machines in the basement. The waitresses' trays are all of one size, and they push in to moving slots and automatically disappear below. I found a publisher's office with a continuously moving canvas band which carried the books to the packing counter and back again to the postal box. In our dear old country, some union or other would no doubt object that the band was doing their work ; but in America, where industry has a sounder economic foundation, nobody is willing to do any work that can be abolished.

America is very busy road making. The arrears of the war period are heavy, and the demand for new roads insistent. Concrete is the fashionable material, but the American workman will not demean himself to mix concrete. I suppose I must have seen a hundred concrete-making machines in my short stay in various cities. I was particularly struck with a small type of concrete mixer, not much bigger than a large truck, used for mixing concrete for side walks.

SANE DETERMINATION TO SAVE LABOUR.

Wherever one looks one finds evidence of this same determination to save labour and get rid of work. The police force might, perhaps, be regarded as fair game for job making ; nobody can object to a few extra policemen, and apart from occasional excitement, the policeman's is a pleasant-enough life for a man who is not worried with an overdesire to be energetic. The traffic in most American cities is sufficiently dense to warrant the employment, as with us, of two men at the cross-roads to hold up the stream in each direction ; but American policemen are not willing to be wasted in that way, so one constable stands in the middle of the crossing, operating a simple signalling device which tells the driver whether they are to "stop" or "go."

Take the railways. The railwaymen are organised into a brotherhood, and if English ideas had any influence with them, have the power to so arrange matters as to necessitate the employment of ever-increasing quantities of men. Yet one sees no porters on American railway stations. I waited for a quarter of an hour at a

junction on the line from New York to Philadelphia, watched five trains come in and go out, and never saw a porter at all. The baggage-check system makes luggage porters unnecessary, and the efficient American woman does not want a couple of porters to help her in and out of the train.

A DIFFERENT MENTAL ATTITUDE.

These are simple illustrations given with a view to emphasising the totally different attitude of mind in England and America on this question of work and production. Sir Robert Horne told the House of Commons the other day that "a job must be found for everybody." He could not have said anything so impossible in America; they don't understand the word "job" in the sense which it has assumed in recent years with us, and a position in which somebody will pay somebody else some wages, irrespective of what is done, or where the wages come from, is outside the comprehension of the average American. We have been so nurtured in the school of "9d. for 4d.," so steeped in the notion that wealth and work were fixed quantities which must be shared out, that it is difficult to grasp the American point of view; but if we are ever again in a position to buy American goods, if the handicap of the exchange, and the anti-dumping restrictions are cleared out of the way, we shall assuredly feel its effects in a manner that will not be agreeable to us.

The National Physical Laboratory.

The annual visitation to the NATIONAL PHYSICAL LABORATORY took place on June 28. A large number of visitors were present. The various departments were thrown open as usual and a great deal of interesting work was to be seen. Most of this, however, was already familiar to those who visited the Laboratory last year, though there were a certain number of exhibits to which we would like to call attention.

In the ELECTRICITY DEPARTMENT we had an opportunity of seeing some 8 000 c.p. gas-filled lamps, which are now being used in place of the usual electric arc light at the South Foreland Lighthouse. The lamps take 50 A at 80 V. One of the lamps had already been operating for 1 000 hours and still appear to be in good condition. We understand that they are of Dutch manufacture. Although the bulbs are large spheres the filament and leading-in wires look sur-

prisingly small for such a large current. The filament is arranged approximately in the form of a cross, below the centre, and it is evident that bombardment of the top of the bulb takes place, as a cross corresponding with filament is there formed.

In the PHYSICS DEPARTMENT we noticed a very compact little optical pyrometer, fitted complete with variable resistance and with a small ammeter on one side, the latter being calibrated in temperatures. In the same department a good deal of work has been carried out on hygrometry and kindred subjects. Among these may be mentioned the determination of dew-point, without the observer being in the immediate neighbourhood. The usual method consists in cooling a surface until the observer sees the formation of dew, but this simple method necessitates the observer being quite close to the device that is used, which is not always desirable or convenient. In the arrangement which is now being developed this is avoided. Briefly, the method consists in using the surface on which the dew is formed for reflecting a beam of light on to a thermocouple, the latter being connected to a sensitive, pivoted galvanometer, which may be placed at any convenient distance. In the ordinary way the galvanometer shows a steady deflection, but, as soon as the dew forms, there is greater loss of reflection and, consequently, there is an immediate fall in the deflection of the galvanometer. Thus, the moment at which the dew is formed can be noted at a distance, together with the temperature.

Dr. E. GRIFFITHS also showed apparatus for determining the thermal conductivity of materials used for building purposes, or specially used for lagging. Some of these results have already been published. Among the best thermal insulators is granulated cork, which is often better than slag wool, but it has been found that an even better insulator consists of india-rubber through which air has been forced so as to form large numbers of very small cells. The rubber so obtained is exceedingly good for the purpose, and is also very light.

In the METALLURGICAL DEPARTMENT we noticed a large crucible by The Morgan Crucible Company, of their special type in which the crucible acts as the resistor. It is sufficiently large for melting 200 lbs. of brass and is suitably lagged and mounted for pouring. This particular crucible takes 30 kVA, the pressure being about 20 V. The experience at the N.P.L. has so far been quite short, but the crucible is claimed to be quite suitable for the melting of brass, and there does not seem to be any reason why it should not prove successful in this particular class of work.

London Electricity Inquiry.

Engineering Details and the Companies' Scheme.

The Electricity Commissioners have continued their inquiry into the organisation of electricity supply in the London area.

Mr. WORTHINGTON considered it would be advantageous to supply small districts from the railway mains, but if there were a large load there would be no advantage from the combination of the loads, because the main had to be proportionate to the load it had to carry. He agreed generally with the evidence given by Mr. Rider. Autocratic control was desirable, but there were reasons of expediency which should limit it. The Commissioners should give the maximum amount of control which it was in their power to give, from the point of view of operating the concern with the maximum economy.

THE BENEFITS OF DEMOCRATIC CONTROL.

Interrogated by Mr. DONALD: Democratic control was not necessarily the best system, but it was the most agreeable to those working the system. A capital station with a railway load could not afford to sell electricity cheaper than a station devoted entirely to the railway load if the latter station were of sufficient magnitude to be erected as a capital station. The cost of administration in a capital station which also supplied a railway load would include dealing with a number of authorities, and so on, and the railway company would have to pay its share of that cost. There were practically no administration charges in the case of a railway company's generating station. Tramways were beneficial to a general supply station, but that was on a very different scale. The erection of the capital stations would not be postponed indefinitely by putting all this additional plant into existing stations. The capital stations would be erected as the time approached when the existing stations would be unable to deal with the load. If the load were not provided for by increasing the plant in the old stations, capital stations must be put up. If a certain district had sufficient load to take the output of a 100 000 kW station he would say, instead of erecting a new capital station, go ahead and put it in the existing stations. It was proposed to increase the capacity of Willesden, Grove-road and Marylebone stations to 50 000 kW each. If sufficient condensing water could not be obtained, it might be supplemented by well or canal water. The maximum charge one undertaker could make to another under the

Act was £6 15s. 0d. per kW plus 1d. per unit. The engineering committee had shown the price that would just balance the cost. The actual price would be left to the Joint Authority to decide.

Mr. DONALD said the figure for the final stage in the Conference scheme was £7 4s. 3d., plus 0.561d. per unit. That was in excess of the figures allowed by the London Electric Supply Act. The 1919 Act gave the Commissioners power to require certain undertakers to enter into arrangements for mutual assistance.

THE POSITION OF HERTFORDSHIRE.

In reply to questions by Mr. TINDAL ATKINSON in regard to HERTFORDSHIRE: It would not affect the London supply if Hertfordshire were excluded from the scheme, but it would affect the scheme for the whole area. Inclusion would also be beneficial to Hertfordshire consumers. He concurred in Mr. Rider's statement that prices would depend on the distance to which the current had to be transmitted. It would increase the cost considerably to take a supply to Hertford and Watford, as a 33 000-V cable would have to be used, but the larger the area the sooner the load would justify the erection of capital stations.

To Mr. SZLUMPER (for SURREY) Witness said he had no sympathy with the adoption of county boundaries. So long as he got the best supply he did not care to where it came from.

Replying to Mr. WROTESLEY (for MIDDLESEX): The transmission would in most cases be on 6 000 to 10 000-V, but to some places it would be at 33 000 V. Transmission could easily be done up to 10 miles with from 6 000 to 10 000 V. If the country were open, overhead cable would be used, provided the Commissioners permitted it. He recognised that it might be a hardship for certain parts of an area to be excluded. Though their inclusion might not be desirable from an engineering point of view, there should be a certain amount of give and take, but that could not be carried too far. The undertaking must pay its way. The current generated by the railway companies would be suitable for lighting, if it were generated at 50 frequency, but if it were at 25 cycles it would be unsuitable for direct lighting, and transforming it might put the cost 10 per cent.

Replying to Mr. PAGE: The diversity factor in a station supplying the railway and the general load was of the order of 1.8. The difference between the one station and two separate stations could be best worked out on the standing charges and running charges. The load factor in a station for general supply would be about 30 per cent. and in a railway supply station about 40 per cent.

To Mr. LACKIE, Witness said, assuming a joint station for railway and general supply, the reserve plant necessary would be less than in two separate stations, but he looked forward to linking up with the railway companies' generating stations in any case. In adjusting prices he did not see why other consumers should be charged with a full share of the administrative costs and the railway companies be let off. In reference to a representation to the Commissioners by the British Electrical Development Association that as the smaller undertakings found it difficult to continue supplying on a flat rate it was suggested that the best solution would be to amalgamate the small undertakings with the large ones, he approved of that suggestion. The Joint Authority might not be able to enter into a contract for supply over a long period at a definite price. It might be found necessary to increase the price.

To Mr. BORTH The L.B. & S.C., the South Eastern and the Great Eastern and some other railways might in time require capital stations. He thought there was only one railway (the L.B. & S.C. Company) purchasing current from outside. The others that used electrical energy generated it themselves. That rather pointed to the supposition that they would continue to generate it themselves when their load was sufficient to justify the erection of a capital station.

Replying to Sir JOHN SNELL: Although certain places in Hertfordshire might not be affected adversely or otherwise by being included in the area, the mere fact of the connection between the central authority's system and the North Metropolitan system would break down the barriers, and the flexibility of the combined systems would tend to improve the facilities for electricity supply. The transmission system in the first stage would become a real part of the ultimate system, and without renewal.

This concluded the case for the Conference, and Mr. RIDER was recalled to explain certain tables accompanying the L.C.C. scheme and the supplementary particulars.

Asked by Mr. DONALD if he was right in understanding that there would be an increase in wages in the first stage of the scheme compared with the present cost, Mr. Rider said that was so because they had to provide for wages for running the 250 000 kW of new plant that was being put in. The £1 100 000 which it was expected to save would be almost entirely due to saving of fuel, not only by the use of improved plant, but also due to the interconnecting. It was intended to avoid the use of rotary transformers until the load rendered it necessary.

Mr. KENNEDY then opened the floor for the scheme of the London Electricity Joint Committee (1920). Ltd. (comprising nine companies, the London, Charing Cross, Metropolitan, Central, Westminster, Kensington, Brompton, Chelsea, and St. James'), said the companies had a capital of about 104 millions, and in 1919 the units generated were 158 millions. The companies represented 62 per cent. of the subscribed capital and 65 per cent. of the units sold by all the companies in London. The City company was in friendly communication with the nine associated companies, and it was hoped it would eventually co-operate. Taking the whole of the companies and local authorities supplying in the delimited district the committee companies represented 31½ per cent. of the subscribed capital, and 24½ per cent. of the units sold. The area of the committee companies represented a substantial and compact nucleus, round which a satisfactory scheme might be built, even if they stood alone, which it was hoped they would not do. The engineers, in their technical scheme, after consulting the records of the last 4, 6 and 10 years, stated that the average total increase in the demand was 20 500 kW per annum, and they assumed an increase during the next six years of 26 000 kW per annum, and for the five years after that, up to 1931, an increase of 36 000 kW per annum, which last figure was 75 per cent. greater than the maximum yet attained, and practically 100 per cent. greater than the average. Taking a radius of 10 miles from St. Paul's, the local authorities and companies in that area were supplying 93 per cent. of the total load of the delimited area. What they had called "group" stations fell outside that 10-mile radius were Gravesend, Kingston, and N. Metropolitan (Brimdson), the Willesden station being inside. "Other" stations outside were Dartford, Heston, Surbiton, Harrow and Twickenham. The total outside was 32 400 kW, of which the N. Metropolitan accounted for 25 000 kW, while inside the 10-mile radius the total was 432 856 kW. His clients thought it was not practical politics to supply the outer districts from capital stations in the centre, but there would be no difficulty in arranging an agreement for the N. Metropolitan Company to take a supply. In the Committee Company's amended scheme it was suggested that the area to be dealt with by the Joint Authority should be roughly this 10-mile radius. From the administration point of view, the Committee Company did not think it would make for economy that one central body should be wholly responsible for so large an area. The supplies for outlying districts might very well be given in future by the railways. The engineers agreed that the most economical way to carry on for the next few years would be to use the existing plant, plus the plant which was being put into the existing stations, until the maximum load of 470 000 kW was reached, which it was estimated would be about 1925. The alternative method would be to start larger stations much earlier, but it was found

that saving in the cost per unit by the time a maximum of 650 000 kW was reached would only be 0.034d. Mr. Rider believed it best to adopt the first alternative because it appeared that the 0.034d. could also be saved under that scheme ultimately, but Sir Alexander Kennedy and Mr. Partridge thought it advisable to adopt the second course because the small saving effected in the early stages by the other scheme would be more than counterbalanced by the advantage of having started the capital stations earlier, and because they thought some of the figures given in the first proposal would have to be exceeded. Both engineers agreed that the proper body to decide which alternative was to be adopted was the Joint Authority, when it came into existence. He doubted whether it was policy to give any compulsory powers to the Joint Authority. If an undertaker would not agree for his station to be run by the common authority he did not see how the Commissioners could make him, and it was not probable that any scheme worked by unwilling co-operators would have any great chance of success. If no other undertakers in the area would join, the Committee Company would endeavour to obtain the assent of their shareholders to find the 1½ millions necessary for the first stage of the scheme, and they would strive to get something done at once. If the companies were left alone the results would be poorer than they would otherwise be, but the companies were determined to take some definite step to improve the situation.

In their proposals as to the constitution of a Joint Authority no definite number of members was fixed, because membership was to be obtained by entering into agreements with the authority, by advancing money, or by guaranteeing interest on money, but six members were to be appointed by the County Council, and one by the City Corporation, two by the local authorities from whom purchase rights had been transferred and three by railway companies and large consumers.

Mr. TYLOR, for the RAILWAY COMPANIES, said the companies were out to buy in the cheapest market, and were represented at the Inquiry to ascertain whether they would be able to get supplies from other authorities cheaper than they could generate energy for themselves.

Mr. KENNEDY said it was proposed that undertakers who had no generating stations but who lent £100 000 or guaranteed this sum to the Joint Authority they should be entitled to have one member upon it. Members would have one vote for each £100 000 so lent or guaranteed, with a maximum of five votes. He assumed that all the companies and 50 per cent. of the local authorities would be members, and this would make a total of 47, practically equally divided between the local authorities and the companies. It was proposed that companies must enter into agreements for the transfer of their undertakings. The companies would be allowed an extension of their tenure of the distribution business. It was proposed that such tenure should extend over 60 years. The rent, it was suggested, should consist of 7 per cent. of the value of the plant, plus the sinking fund. It would really be a hire-purchase agreement. If the companies were not satisfied with the valuation they would have the right to go to arbitration. The scheme did not provide that the Joint Authority should have control of every supply undertaking in the area if the existing undertakers preferred to remain outside. The price at which the Joint Authority would supply energy to the existing undertakers must not exceed the price at which they could have generated it or purchased it under existing agreements. The Joint Authority would appoint a technical committee of five members, three at least being members of the Authority. The prices to be charged would be fixed by the Joint Authority subject to the approval of the Commissioners. The L.C.C. and Conference schemes were not acceptable to the Committee Company in regard to representation on the Joint Authority. The proportion of company and local authority interests in the proposed 10 miles radius were about the same as in the larger area dealt with in the other schemes. They did not think a new body consisting entirely of local authorities was desirable and the companies would not be willing to lease their undertaking to such a body.

Mr. W. F. FLAGGATE, Chairman of the London Electricity Joint Committee and of the Charing Cross West End and City Electricity Supply Company, said he had the benefit of the advice of the nine chairmen of the companies represented on the Committee in the preparation of a scheme. He thought that any deal dealt with in the other schemes was too large—to state with any accuracy. With regard to the L.C.C.'s purchase rights in 1931, the companies did not look upon these rights with fear. They had still raised money without any great difficulty, but they could not, without some extension of their tenure, go to the expense of putting in new mains between the power stations. All the undertakers would be induced to join in the scheme if possible. If the Joint Authority were to give a supply to railway companies there must be a definite agreement as to demand and the period of supply, but in any case stations should be erected with a view to maintaining friendly relations and mutual assistance between the Joint Authority and the railways. He thought he would have no difficulty in getting the assent of his shareholders to the raising of his company's share of the capital which it was suggested the nine companies should raise (£1 050 000). It was proposed that the local authorities should hand over their generating station to the Joint Authority or give financial assistance. He and his fellow chairmen at first thought outright sale of the generating assets would be the best scheme, but upon reconsideration they thought the present proposal preferable, as it obviated the necessity of raising a very large sum of money. Under the arrangement now proposed he thought the debenture holders would be quite agreeable to lease the generating stations to the Joint Authority. The fact that the Joint

Authority would hold the generating stations on lease would not prevent those stations being the security for the stock issued by the Authority. The rent should be ascertained by taking the cost of the station. There should be no depreciation allowed on land or buildings. A suggestion was made by one of his company's officials that mains should be depreciated at 3 per cent. and plant at 5 per cent. on a diminishing value. That was the basis adopted by the income tax authorities. The rent should be 7 per cent. on the value at the highest, but he would be prepared to accept 6 or 6½ on behalf of the Charing Cross Company. The L.C.C. would be very fortunate if they could raise money at 6½ per cent. at present. The most satisfactory scheme he thought would be obtained by getting all the companies and local authorities, even if they had no generating stations, to come in and lend money to or guarantee money for the Joint Authority. Having borrowed the money for the initial period and having got its mains laid, and the undertaking being actually working, the Joint Authority would have something substantial to put before the public when further capital was required. If distributors had no generating stations their financial assistance should be obtained. A clause which had been put into the scheme since it was deposited required existing undertakers to supply current to the Joint Authority up to the extent of the undertaker's generating plant at a price not exceeding that at which the Joint Authority supplied. With regard to the area, he thought it was the opinion of all members of the engineering committee that an outlying fringe should be left out for the present. All the four proposed capital stations were within the ten-mile radius. He did not stand out for a hard and fast 10-mile radius. Extensions further out should be made as the demand required it, but attention should first be given to ensuring a reliable supply in the restricted area.

THE PAYMENT OF OFFICIALS.

Replying to questions on behalf of the L.C.C., Mr. FLADGATE said in regard to the payment of Chairman and Vice-Chairman of Committees he was quite prepared to advise that this should only apply to the Finance and Technical Committees. The Joint Authority was to have no control over the Finance Committee. Companies who did not come in would still be subject to the present purchase powers. There might be considerable difficulty in regard to the latter, who might contend that the Joint Authority could not purchase their undertakings in 1931 because it was not the purchasing authority. He thought Parliament would have to be asked to deal with that matter. At the beginning of and during the lease the Joint Authority would have the sole use of the generating stations, and at the end of the lease, it would be the absolute owner of them.

To Mr. TURNER, witness said it was intended that the Finance Committee should have absolute control of financial matters and that the Technical Committee should have absolute control of technical matters.

Mr. FLADGATE explained that there would be no representation on the Joint Authority unless there were control, and no control unless there were representation. His object in putting the terms of leasing into the scheme was to enable the shareholders of the companies concerned to understand what was proposed. The depreciation of buildings could only be very small, and as a matter of fact the Joint Authority would be getting at their cost price buildings which would cost three times as much to build to-day. He admitted that fixity of tenure would be an advantage to the companies. He did not think there was any provision in the scheme for passing on to the consumer any reduction in the cost of generation. The Joint Authority would naturally reduce the price as much as possible for the benefit of the constituent companies.

Replying to Mr. DONALD, witness said he thought his scheme would work quite equitably as between consumers in local authority areas and company areas.

Sir HARRY HAWARD said it was hoped that the Joint Authority would, by economy in working, make sufficient profit to pay the difference between the interest local authorities now paid and the seven per cent. which would have to be paid to the companies, and which it was also suggested should be paid to the local authorities, as rental under the leases.

Mr. FLADGATE continued: It was not proposed under the Committee's scheme to proceed with the capital stations earlier than it was intended to do under the L.C.C. scheme.

To Mr. WROTTELEY (for the Middlesex County Council): It was not proposed to ask county councils to supply money for the initial cost of the scheme. In that case Middlesex could not be represented on the Authority. The proposed area included Willesden, Hendon, Hornsey and Finchley, but excluded Ealing. As far as he was concerned, he would be willing to include the whole of Middlesex. The question of taking in Middlesex depended upon whether the undertakers in Middlesex would contract in.

THE RAILWAY LOAD.

Answering Mr. TYLOR, Mr. Fladgate said he would be extremely glad to have the railway companies represented on the Joint Authority. Their load would react favourably on the scheme. The Committee did not propose that the Joint Authority should be under any obligation to supply to railway companies for any purposes other than traction. He could not see what advantage a railway company would have in raising capital.

To Mr. MORSE, witness said he believed the proposed area included the site of the Barking station and the County of London power area, but excluded Romford, part of the West Kent area and the South Metropolitan Electric Supply Company's area. His scheme was precisely that projected by the Engineering Committee's report, subject to the striking out of certain districts. It could be carried out without the local authorities, assuming that the No. 2 Bill was not passed. The capital required

in that case might be 8 or 9 million. He did not think the term of the companies could be extended without further statutory powers. The £50 000 a year estimated for administration expenses would be quite sufficient for the Joint Committee's scheme. He did not expect a grant from the Exchequer towards the administration expenses, but he would get it if he could.

ADMINISTRATION EXPENSES.

Sir JOHN SNELL said it had been explained that from the beginning the provision for the administration expenses would be shared by the nucleus of authorities included in the scheme who would be earning revenue.

Mr. FLADGATE continued: It was hoped that the Joint Authority would be able to comply with the requirement that current must be supplied to authorised undertakers at a price not exceeding that at which such authorised undertakers could have generated the energy themselves. If the Joint Authority could not do that, of course the scheme broke down.

Sir JOHN SNELL said the cost of capital to the present undertakers and its cost to the Joint Authority would have to be considered in fixing maximum prices of current. It would not be fair to compare them as though they were operating under the same conditions.

ENGINEERING EVIDENCE.

Sir ALEXANDER KENNEDY said the Engineering Committee first addressed themselves to the area delimited by the Commissioners, but it was soon found that the real work was confined within narrower limits. Three of the group stations were outside the Committee's proposed area, Gravesend, Kingston and Brimsdown (N. Metropolitan Company). They did not want to bring in the North Metropolitan Company, though its Willesden station was inside the area. It was important that the largest possible number of undertakings should come in under some complete general technical control. Whether the local authorities supplied money or not it was very important that they should come in and operate in conjunction with the companies' stations. When he first considered the reorganisation of the supply for London he was under the impression that a large number of the existing stations should be closed down as quickly as possible, but he soon found that was not so easy and desirable as he had thought. The alteration in wages and other costs brought about by the new plant which was to be substituted for the plant which was to be scrapped would be very large. After the first stage of the engineers' investigations, he and Mr. Partridge, who represented the Joint Committee, were convinced that it would be impossible to carry out under present conditions a scheme involving such a large expenditure of capital as that which would be required for the capital stations, and it was clear that the companies concerned were not disposed to embark upon such a scheme. In the supplemental particulars he had estimated that there would be reductions in cost of materials (cost of plant being reduced by 30 per cent.), which would reduce the £1 050 000 to £948 000, and the £8 450 000 would be reduced to £7 115 000.

CAPITAL STATIONS.

A matter on which he was not sure that the engineers were unanimous—he gathered that Mr. Wordingham did not agree with him on this—was that he thought that when the capital stations were going to become necessary it would not be desirable to spend 5 millions on the existing stations. It made a reduction on the cost per unit at present prices, but it would not make such a reduction on the assumption that he had taken in regard to reduction of cost of materials. It did involve a very large amount of capital expenditure, and he thought that within the time when the capital stations had to be considered, say, three years before they were actually running, they might have to face, even under the existing organisation, a larger expenditure than the £2 500 000 which was shown in the Joint Committee's additional particulars. The present figures, showing existing plant 633 000 kW, and load of 465 000 kW, indicated that the capital stations would not be wanted in less than six or seven years. The engineers only considered the railways as they affected London. They learned that the Brighton and Great Eastern were bringing their own proposals before the Commissioners, and that the Great Western and Midland were not intending to extend their electrification in the neighbourhood of London. He had found that the opinion of the railway men generally was that they preferred to have their own plant, and also reserve plant of their own. The G.W., N.W. and S.W. companies had intimated that they would be quite willing to supply surplus current to the Joint Authority if circumstances permitted. With regard to diversity factor, he had obtained the hourly loads on two winter days from the whole of the local authorities, the majority of the electric supply companies and the N.W., S.W., Metropolitan, G.W., and London Electric Railways and the L.C.C. tramways. Taking the aggregate instantaneous demand at any instant they got 319 000 kW and the sum of the maxima, taking each undertaking separately, was 334 000 kW. The ratio between these was 1.07. His interpretation of that was that if the whole of the electric supply undertakers and the whole of the railways were supplied from one station, the difference between the sum of the maxima and the actual instantaneous maximum would be 7 per cent. He had done the same thing without the railways, and the instantaneous maximum came out at 214 000 kW, and the sum of the maxima at 222 700 kW, the ratio between them being 1.04. So the difference was only 3 per cent. (the difference between 1.04 and 1.07). Anything like 3 to 5 per cent. would be swallowed up by a number of other considerations.

THE QUESTION OF CONTROL.

Cross-examined by Mr. TURNER, he did not think the measure of control that could be obtained by agreement would be sufficient. He

did not say that the control given by clauses 15, 18 and 21 of the Conference scheme was valueless, but he did not think undertakers would in nearly a case that the authority should be able to say that a station should be shut down or should only work at certain hours.

Sir HARRY HAWARD said he understood that in Sir Alex. Kennedy's view the control would be secured by vesting the undertakings in the Joint Authority, whereas it was proposed to secure a similar measure of control under the Conference scheme by arrangements short of actual transfer of the undertakings.

Sir JOHN SNELL said in fixing the prices to be charged by the Joint Authority it should be assumed that an existing undertaker supplied at x and had extensions in hand which would alter and probably reduce the charge to y , and future extensions that might be required would, owing to the present high cost of money, increase the cost to z , and z was the figure with which the Joint Authority's charge would have to be compared, and not the cost at which the existing undertaker had hitherto been able to generate.

Sir HARRY HAWARD said an important point to consider was whether the saving of the difference between the present average cost of 1-58d. and the estimated cost to the Joint Authority of 1-326d. was such as would enable the Joint Authority to reduce the charge for bulk supplies to the proposed maximum.

Sir JOHN SNELL said the plant which was expected to reduce the cost in the existing stations would be in the hands of the Joint Authority, according to the schemes they were considering, and in addition the linking-up and other improvements were expected to still further reduce costs.

Sir ALEXANDER KENNEDY, replying to Sir John Snell, said the reduction in cost per unit which would be effected by the new plant in the existing stations would enable the undertakers to pay the Joint Authority administration costs. He had no doubt a saving was effected by the linking-up of the East End local authorities. In the case of the companies with which he was concerned, it was a case of interchange of bulk supplies, but not what was generally understood as linking-up. It was difficult to generalise as to the benefit of linking-up. There was a proposal to link up the Westminster Company with Marylebone, but the conclusion was arrived at that it would not be profitable.

Mr. DONALD suggested that under the leasing system the companies would be better off to the extent of the rent they received.

Sir ALEXANDER said he was not prepared to deal with purely financial questions.

Sir HARRY HAWARD pointed out to Mr. Donald that the rental would be 7 per cent. The capital charges were 5-76 per cent, for interest on dividends and 2-47 per cent. for depreciation—total 8-23 per cent. Those charges would be included by the Joint Authority in its charges, and the authorised undertaker would benefit by the difference between 7 per cent, and 5-6 per cent.

Sir ALEXANDER thought the saving by linking up alone would be sufficient to enable the administration charges to be paid. He did not agree that the work in the interim period should be done under the superintendence of the Commissioners without appointing a Joint Authority because he wished the first stage to be a part of the whole scheme, and under the same control.

Sir JOHN SNELL said the Commissioners had no power under the 1919 Act to carry out the work themselves.

To Sir HERBERT NIELD witness said he would not agree that the County of London Company's district in Surrey should be left out. He had nothing particular to say with regard to Finchley and Hornsey. He believed the North Metropolitan Company had powers to give them bulk supplies. The scheme as it stood was better than it would be with the whole of Surrey included, or with Wimbledon and Croydon excluded.

To Mr. TYLOR, witness said he put the average load factor of the railways at 40 per cent. It would be greatly increased if freight traffic at night were to be added.

To the Town Clerk of KINGSTON, witness said he was willing that Kingston should come in.

To Mr. BAGLEY (Middlesex County Council) Sir A. KENNEDY said it was proposed to erect a capital station at Chiswick. That would supply at 33 000 V. One could supply up to 30 miles with that pressure, but it was not proposed to supply more than 10 miles at the outset. The whole of Middlesex could be supplied from that station. It was not suggested that the Power Company's area in Middlesex should be covered by the scheme. It would certainly not do the scheme any good to add the western part of Middlesex. There were probabilities of increased demand in Middlesex. The London and S. Western Railway had a 25-cycle system, and the conversion of the current would be expensive. The N.W. Railway had also 25 cycles; the companies that already had 25 cycles were unlikely to change. It would be undesirable to drop Hendon, Finchley, Hornsey, Brentford and Chiswick.

Re-examined by Mr. KENNEDY: There was no compulsion under the scheme for any district to take energy from the Joint Authority, so their inclusion in the area could not do them any harm. He felt sure that if the Commissioners were not certain that a scheme provided a certainty of the Joint Authority being able to supply current at a lower price than the present cost to the present undertakers they would not sanction it.

Mr. G. W. PARTRIDGE followed with evidence on the engineering aspect of the Committee Company's scheme, and Mr. W. H. PEARMAN, Mr. D. Milne Watson and Mr. Arthur Collins were also called and dealt with the question of finance, &c. On the conclusion of Mr. Collins' evidence on Tuesday, Mr. DONALD opened the case for the Poplar Council's scheme and the examination of Mr. J. H. BOWDEN in its support was commenced.

The inquiry had not concluded when we went to press.

Correspondence.

THE "WAGNER" EARTH CONNECTION.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Mr. G. E. Moore's article on "The Wagner 'Earth Connection' in Practice," which appears on p. 744 of the ELECTRICIAN, dated June 17, calls for some comment.

The method shown is given as an application of the Wagner earth to the Carey-Foster bridge. In the accompanying reproduction of the diagram (Fig. 1) the symbols L and p have been introduced to represent the self-inductance and resistance of the primary of the inductometer. Though very simple to attach and operate, the system has serious defects owing to the fact that it is not applied across the source, but across part of the bridge proper. As a result of this, the current taken by R' , C' has to traverse the inductometer, thereby introducing additional terms into the Carey-Foster equations for C and S . These become

$$(1) \text{ For } C, \quad C' = \frac{M}{R(P + p + \frac{p}{R'} \cdot P)} \text{ instead of } C = \frac{M}{R(P + p)}$$

$$(2) \text{ For } S, \quad S_0 = \frac{RL}{M} \left(1 + \frac{P}{R'}\right) - R \text{ instead of } S = \frac{RL}{M} - R,$$

neglecting residuals and the effect of the presence of S causing a balance between points b and e to be impossible. The correction term $\frac{p}{R'} \cdot P$ in equation (1) is not very serious if P is large compared with p and R' is of the same order as P . The error introduced by neglecting the term may, however,

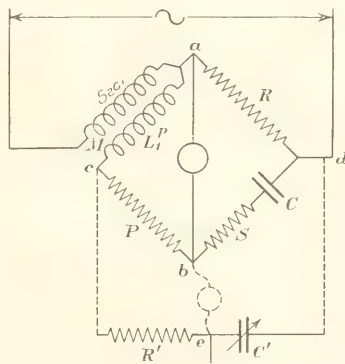


FIG. 1.

easily amount to a few parts in a thousand for the case of a condenser of 0-001 mfd. and would, in general, be greater than the errors due to earth capacities which the method is intended to eliminate.

In regard to the equation (2) from which power factors may be determined, the error is much more serious since the term $\frac{P}{R'}$ may be of the order unity, hence, the quantity $(S_0 - S)$ representing the series resistance of the condenser may be several hundred per cent. wrong.

The system as shown does eliminate capacity effects to earth of the points a , b , c , d on the bridge, but does not eliminate capacity effects of the source lead connected to the secondary of the inductometer.

A system which has been used for a number of years at the National Physical Laboratory by the writer and is believed to be the first application of an earth capacity compensating device to the Carey-Foster bridge is given in Fig. 2. In this arrangement the device consists of a variable self-inductance

N' in series with variable resistance Q and resistance R' approximately equal to R in the bridge.

The point "e" is earthed. The circuit is directly across the source and hence lies outside the bridge proper so that the equations for C and S are unaltered by its presence.

The arrangement is briefly described in the N.P.L. Report Annual for 1920 on p. 63. The cardinal points a, b, c, d are compensated for earth capacity, thus the capacity of lead and secondary at "d" is thrown across ($N'Q$) and hence is outside the bridge, similarly, capacity from "b" to earth is thrown across R' . Capacities from (AC) to earth or the observer are, of course, of no effect since the whole of the telephone and leads or galvanometer is at earth potential. The auxiliary balance can be obtained quite perfectly by adjustment of N' and Q . The corresponding balance in the scheme of Fig. 1 cannot be made perfect unless a variable resistance is inserted in series with C' .

The method shown in Fig. 1 is, however, very simple and easy to work; the errors introduced into the measurement of

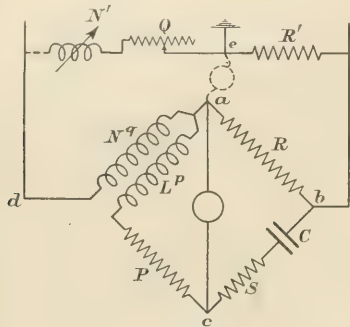


FIG. 2.

C would be negligible in an ordinary case when testing condensers of small value (below 500 μF). The correction also can be easily applied if desired. It does, however, seem to be desirable to point out the defects of the method so as to warn others of possible errors in using it without making the algebraical calculations of the bridge so modified. I am, etc.,

Surbiton,

D. W. DYE.

June 28th.

THE EFFICIENCY OF TELEPHONE INSTRUMENTS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: My attention has been drawn to the Editorial Notes in THE ELECTRICIAN of April 29th, and I trust it is not too late to offer a few comments. The notes refer to an article by MM. Valensi and Palhols in the "Annales des Postes, Télégraphes et Téléphones" on the measurement of the efficiency of telephone apparatus. The impression conveyed by the notes is that the French Administration is taking the lead in introducing a new method of making telephonic measurements. This is not the case, nor is it claimed by MM. Valensi and Palhols, who stated specifically that the method employed is in use in almost all foreign administrations.

Similar methods of testing have been in use in England since 1905 by the Post Office and late National Telephone Company, and earlier in the United States. The French Administration recently sent a commission to England to examine the methods of testing here, and the methods and circuits described in the article are practically identical with the methods and circuits at present in use by the department.

In justice to British engineers it is hoped you will find room to publish this statement.—I am, &c.,

London, June 27.

A. J. ALDRIDGE.

METERS FOR ELECTRIC VEHICLES.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I have read with great interest Mr. R. J. Mitchell's article on "Electric Vehicles" appearing in your issue for June 24th, and would like to refer in particular to his remarks on "Meter Types."

The Sangamo Electric Company, for whom my company are the agents for Great Britain and the Colonies, can claim, I believe, to be by far the largest makers of meters suitable for electric vehicles, and they have developed the apparatus to such a state of perfection that, at the present moment no standard commercial electric vehicle for road use produced in the United States is supplied without the Sangamo meter. In this country, also, since we have taken up the Sangamo meter, practically all our vehicle builders have been interested, so much so that my company supply practically all of them with their meters for use on vehicles.

Mr. Mitchell leads one to believe that the design and manufacture of vehicle meters are not by any means perfect, and, while I agree that no meters for any type of demand are absolutely perfect, I do think that the vehicle meter as developed by the Sangamo Company has now reached a state of perfection which it will be difficult to beat. We are, of course, always ready to consider any improvement that is suggested, and our own laboratories are continually carrying out further research, and, from time to time, improvements are embodied in the meter.

My own opinion is that the difficulties that are encountered are not so much the fault of the meter itself as the installation and care of the meter when it is in use on the vehicle. For instance, I have known cases where the meter has been mounted right at the top of a very loosely fixed dashboard, which was practically unsupported by any stays, with the consequence that the meter was subjected to a tremendous amount of unnecessary vibration, and while the meters are, of course, sufficiently robust to withstand the treatment that they are likely to receive on the chassis of an electric vehicle under normal conditions, they cannot be expected to withstand successfully the additional vibration imposed on them by their being mounted in an unsuitable position. Further than this, while the motors, the battery, the bearings, &c., are all examined periodically, the poor meter is just left to its own devices until it gives up the ghost, which, again, is unfair treatment.

Our experience has been that if meters are installed on the vehicle in a position where they are subject to the least vibration, and are examined and cleaned about once every twelve months, they run perfectly satisfactorily, and I do not think that there is anything else at present on the market that will in any way take the place of a battery-ampere-hour meter.—I am, &c.,

FOR THE EDISON SWAN ELECTRIC COMPANY, LTD.,

Ponders End,

E. H. MILLER,

July 2.

Sales Manager, Inst. & Meter Dept.

DOVER CORPORATION ELECTRICITY WORKS AND ITS STAFF.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I shall be glad of the hospitality of your columns in order to refer to the recent decision of the Dover Corporation to give notice to the whole of the technical staff of the electricity works to terminate their engagement, with the option of reappointment at considerably reduced figures.

I may point out that in December of last year this Association received a definite promise in writing from the Corporation to the effect that they intended to put into operation the schedule of salaries issued by the National Joint Board. The recent decision of the Corporation to throw over the schedule and to effect such drastic reduction in the salaries of the technical staff is a direct violation of that promise, and is calculated to give a staggering blow to our faith in the integrity of public authorities.

One frequently hears criticisms of the lack of faith shown on the part of employees and of their failure honourably to carry out agreements to which they were parties, but surely it would be hard to find a parallel in the decision of the Dover Corporation.

If the Dover Corporation feel that the present payment of the schedule is bearing hardly upon them, there exists in their district area the constitutional machinery in the form of a District Board at which their grievances could be ventilated and, if substantiated, could be corrected. To ignore that machinery is to undo all the good work that has recently been done in the conciliatory machinery and uniform methods of negotiation and to bring about a reversion to the old bad methods of individual bargaining.

This Association proposes to take prompt and firm action in the matter, as it recognises that this is a test case, and that if the action of Dover is allowed to pass unchallenged, there will be no end of the same thing throughout the country. The first stone must be arrested, otherwise there will be an avalanche.

Steps are being taken by the Association to warn all its members against even applying for, still less accepting, the positions at present occupied by our members when they become vacant, and it ventures to hope that other engineers who are outside the ranks of the Association will refrain from applying for the positions, and so impress the Dover Corporation with a sense of the folly of their contemplated action. If all electrical engineers will take a proper view of the matter and refuse to accept positions the Corporation will be forced to reconsider its decision.—I am, &c.,

W. ARTHUR JONES,

London, July 4. General Secretary,
Electrical Power Engineers' Association.

I.E.E. Conversazione.

THE ANNUAL CONVERSAZIONE of the Institution of Electrical Engineers was held on Thursday, June 30, at the Natural History Museum, South Kensington. The guests numbering over 1 600 were received by the President, Mr. Llewelyn B. Atkinson, and Mrs. Atkinson. They included the following delegates of the American Engineering Institutions who are now in this country: Mr. Ambrose Swasey, Col. A. S. Dwight, Mr. Charles F. Rand, Dr. Ira N. Hollis, Mr. John R. Freeman, Mr. Charles T. Main, Mr. Robert A. Cummings, Mr. Jesse M. Smith, Dr. F. B. Jewett and Mr. William Kelly.

As usual music and refreshments were among the principal attractions, the former being provided by the string band of the Royal Engineers in the Central Hall, and by the Misses Carey-Foster and Peters and the Allied String Quartette in the Reptile Gallery. A novelty in the proceedings was the presentation of a message from the American Institute of Electrical Engineers to the Institution of Electrical Engineers. Before this was done by Dr. F. B. Jewett, Mr. AMBROSE SWASEY, Chairman of the Deputation, said a few words expressing the appreciation of the American engineers of the work done by British engineers during the war. The message from the American Institute was signed by the President, Mr. A. W. Berresford, and is reproduced below:—

Dr. Frank B. Jewett, May 24, 1921.
Western Electric Company,
Norfolk House, Victoria Embankment,
London, W.C.2.

DEAR DR. JEWETT: I am advised that on June 30 the deputation of American Engineers visiting Great Britain will be the guests of the Council of the British Institution of Electrical Engineers, and it has seemed to me that advantage should be taken of so notable an occasion to emphasise the relation of mutual trust and understanding which exists and must continue to exist between the great English-speaking nations.

From my knowledge of the membership of the American Institute of Electrical Engineers, I am confident that I am voicing only their conviction when I state that this relation is the foundation upon which the structure of world peace and progress must be built. Departure from it would be a world calamity. There may be differences of opinion, but these are but the surface ripples of a wind blowing against the stream. The main current flows on.

Will you, on the occasion in question, express to our confrères in Great Britain the greetings of the Institute; make clear our recognition of the absolute need of the maintenance and promotion of understanding and co-operation; and convey our firm purpose to do what we may toward their advancement?—Very truly yours,

A. W. BERRESFORD,
President.

H.M. Fuel Research Station, Greenwich.

For the first time since its establishment the FUEL RESEARCH STATION, situated just off Blackwall-lane, Greenwich, has been open to inspection by members of engineering societies and the Press. It is to be presumed that the general Press will record with satisfaction that fuel research is being carried on and that the tax-payer need not question the importance of the work. If this follows, then the invitation to the Press is good tactics at a time when the public is as thoroughly alarmed at the fuel problem and the shortage of coal as over-weighted by the burden of taxation; and there are, no doubt, many other research departments which would be glad to have such an opportunity of gaining public approval.

RESEARCHES ON COAL.

At present, the work carried on at the Greenwich Station is practically confined to coal. The equipment for that purpose is very workmanlike, being on a sufficiently large scale to ensure that the conditions of operation are practical conditions, and likely to be accepted as such by all; and yet sufficiently small to ensure minimum running costs and maximum economy in operation.

The station has been working for two years, though, during that time, a considerable amount of time and effort has been necessarily expended on the completion and development of equipment. The aim has been the production of exact thermal balance sheets for operations conducted on an industrial scale, thus running on parallel lines to the National Physical Laboratory.

It is intended that the station shall supply engineers, metallurgists and chemists in charge of manufactures with reliable information on the production and use of heat, and thus enable them to check the efficiency of their existing methods or, when designing new forms of apparatus, to calculate the units of heat actually required under the best practical conditions.

MEASURING ARRANGEMENTS.

Very complete arrangements have been made for the reception, preparation, weighing and distribution of the coal to the carbonisation or other apparatus in which it is to be treated, and for the accurate weighing of the coke or char which results, and its redistribution in accurately determined quantities to the apparatus in which it is to be further dealt with. Further, the analysis of each coal which passes through the station is added to the register which is kept in the Survey Department, and will thus help to form the nucleus of a general survey of the coal seams of Great Britain.

The heating of the retorts and carbonising apparatus and experimental furnaces is done by water gas, since this is easily produced in regular practice that a standard of about 300 B.Th.U. per cubic foot has a high flame temperature and is free from tarry impurities. The water gas supplied to each piece of apparatus passes through a meter and in the furnaces, constancy of supply is maintained by diaphragms of standard sizes. The calorific value per cubic foot is regularly determined and maintained. At the same time the water gas can be replaced by other fuel gases of either higher or lower calorific value. There are also arrangements for the distribution of air under positive pressure and for its direct measurement and control at the point of combustion of the fuel gas.

Electricity has been adopted as the motive power for the station. There is a 100 H.P. gas engine and dynamo, a stand-by set of a Diesel engine and dynamo and a further stand-by of accumulators which are mainly intended, however, for the supply of large currents at low voltages for use in the laboratories. The distribution system admits of the use of electric motors in any part of the station.

CARBONISATION APPARATUS.

Two pieces of apparatus have been installed for carbonisation, and much work is being done at present on low temperature carbonisation. The apparatus installed for this is such that the Director has no doubt that all the data as to the products to be obtained from any given coal at any given temperature up to 600°C. will be obtained with a certainty which has never yet been reached on a steady working scale. Not only the exact quantities of the products, gas, petrol, oils, ammonia and coke will be obtained, but the qualities of these products will be tested and ascertained and their commercial value can be assessed.

AN OPEN FIRE DEMONSTRATION.

One of the special demonstrations given was the burning of an open fire in which the only fuel used was the coke formed by low temperature carbonisation. The fuel was absolutely smokeless and it burned cheerfully enough to give complete satisfaction to

the most conservative Britisher and the most ardent lover of a cheerful fire. The kindling was done in the old-fashioned way and the coke soon became enveloped in very slightly luminous but smokeless flames. These quickly raised the surface of the coke to incandescence. The commercial side of this apparently ideal domestic fuel has not yet been worked out, but the case appears to be promising.

Time Discipline Apparatus.

The introduction of a mechanism for controlling the pendulums of workman's registers should be of wide interest, as, although many modern firms have adopted an impulse or time circuit in their factories, some have neglected to go a step further and fit their workman's registers with electric control owing to the fact that an interruption of the time circuit disturbed the workman's registers as well as the clocks.

When unification of workman's registers was first attempted, the electric clock maker tried to achieve this end by substituting for the spring-driven clockwork an electrical step-by-step or impulse movement. Such a substitution avoids the necessity of winding, but introduces other troubles, because the comparatively low power of the impulse movement leaves little margin for "stiff" places in the clock mechanism, and any disturbance or stoppage of the time circuit disorganises the checking and costing system.

OVERCOMING INITIAL DIFFICULTIES.

The next step towards overcoming these difficulties was to "scrape" the existing mechanism electrically. By so doing the

per day. The value of this feature cannot be over-estimated, because friction with the workpeople is entirely avoided. We are informed that many firms have already adopted the "Reflex" control on their existing time circuits.

Dinner to Mr. Ernest Benn.

THE INDUSTRIAL LEAGUE AND COUNCIL is entertaining Mr. Ernest J. P. Benn and Mr. F. H. Elliott to dinner on the occasion of their return from a trip to America. Messrs. Benn and Elliott acted as delegates from the Industrial League to the National Civic Federation of America and this function, which will take place at the Holborn Restaurant on July 14th, is for the purpose of receiving a report on industrial conditions in the United States. Employers attending the dinner are invited, as is usual with Industrial League functions, to bring with them representatives of their workers. Tickets can be obtained on application to the General Secretary, Mr. John Ames, 82, Victoria-street, S.W.

Benn Brothers Ltd. Staff Outing.

IN glorious weather the staff of Messrs. BENN BROTHERS, LTD., visited Westerham on Saturday, on the occasion of the first summer outing organised by Benn Brothers' Social Circle. The party which numbered upwards of 80, travelled by train to Oxted, and thence rambled over the common and through the woods to Westerham, where luncheon was served. A different route was followed on returning to Oxted, where tea

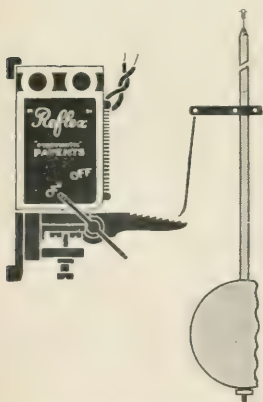


DIAGRAM OF THE "REFLEX" PENDULUM CONTROL.



BENN BROTHERS' STAFF OUTING. THE PARTY PHOTOGRAPHED AT BLUNT HOUSE, OXTED.

pendulum was eliminated, and an electrical scraping mechanism substituted. This, by operating every half minute by means of the time circuit, allowed the clock train to run on in half minute intervals. This principle is sound and practical, but still it does not remove the possibility of a stoppage if the time circuit is interrupted.

The latest development in workman's registers is to be found in the "Reflex" pendulum control, made by Messrs. GENT & COMPANY, LTD., Leicester. By this arrangement, nothing is removed from the register, though an addition is made thereto in the form of the "Reflex" control mechanism. This consists of two main parts, one the "vibrator," which is clipped to the pendulum rod, without drilling or tooling being necessary, while the other part, or "stator," is screwed to the woodwork of the register by wood screws or by nuts and bolts, as may be desirable. The register is "wound up" in the usual way. It operates by the clockwork, but, owing to the "Reflex" movement, the pendulum is compelled to keep time with the transmitter controlling the time circuit of the factory and with the other clocks in the circuit.

PENDULUM REGULATION.

The pendulum should be so rated that the clock does not "gain." It must be given a slightly losing rate, but need not be set to lose more than two minutes per day of 24 hours. So effective is, we understand, the "Reflex" control that, in a pendulum beating 88 per minute, as in the case with some of the best-known makes of recorders, it will effectively deal with a loss as much as ten minutes

was partaken of at Blunt House, on the invitation of Mr. and Mrs. E. J. P. Benn, games following. Sir John Benn, Bart. (Chairman of Directors) and Lady Benn, together with other directors, honoured the company at Blunt House with their presence.

Freer Use of Power Alcohol.

A deputation arranged by the BRITISH EMPIRE PRODUCERS' ORGANISATION recently waited on the Chancellor of the Exchequer to urge the removal of certain restrictions and duties which at present prevent the free supply of power alcohol to consumers in the United Kingdom.

MR. BEN H. MORGAN, in introducing the deputation, pointed out that cheap fuel supplies were of enormous assistance to industry both in the United Kingdom and overseas, as cheap transport was the first condition of prosperous settlement and expansion. The deputation urged that alcohol intended for mechanical power purposes should be admitted free of duty, so as to enable it to compete with petrol and no fuel tax whatever should be imposed so long as the present vehicle tax remained in existence.

MR. SHRAPNEL SMITH, representing the Commercial Motor Users' Association, supported the case, and quoted figures which showed that power alcohol could not compete with petrol unless it were imported, like petrol, free of import duty.

THE CHANCELLOR OF THE EXCHEQUER, in reply, said he saw difficulties in adopting a different scale of preferential duties for power alcohol from that applicable to alcohol intended for other purposes. The subject, however, was very complex, and he would consider it further.

An Electric Sedan Chair.

The accompanying photograph is of an interesting electric vehicle, whose title is enough to make both beauties and sedan chairmen turn in their graves. It has been specially designed for the purpose of town shoppers and for the use of invalids. It is known as the **Levys electric sedan**, and its leading features are claimed to be ease of control, low operating costs and moderate speed. It must be one of the lightest machines on the road, for without passengers it turns the scales at 6½ cwt. It is fitted with



GENERAL VIEW OF THE ELECTRIC SEDAN CHAIR.

Tudor accumulators, and will run about 50 miles on one charge at a constant speed of 10 miles per hour. The operating costs amount to 0.5d. per mile. Control is effected by one lever which acts as both switch and for operating a brake on the rear wheel. A second brake is worked by Bowden control fitted on to the tiller steering arm.

Egyptian Trade in 1920.

In a report on the trade of Egypt in 1920, H.M. Commercial Agent at Cairo (Mr. Mulock) states that the year, with its attendant commercial crisis, proved very unfortunate for many firms both in the United Kingdom and Egypt. Complaints in regard to the high prices demanded for machinery by British exporters and the large orders for railway material and rolling stock, steel work, dynamos, &c., have gone to foreign firms because the British quotations were too high.

FOREIGN COMPETITION AND IMPORTS.

There was an enormous increase of imports from Germany, and, as in pre-war days, the Germans are pinning their faith to advertising efficiency and the excellent quality of their samples. The rate of exchange is so much in their favour that they are in a position to undersell both the United Kingdom and other Allied and Neutral countries in most manufactured articles. Second only to yarns and textiles as a contributory factor in the increase of imports from the United Kingdom are metals and metalware. The largest proportionate increases are in iron or steel bars and billets, sheets and plates, rails and fittings, plant, w.i. or steel pipes or fittings, galvanised sheets, in which for the most part Belgium was the principal competitor, internal combustion engines, in which Switzerland was a keen competitor, as also in electrical machinery and parts, of which the United States also increased her exports to Egypt, motors and chassis, in which the United States, thanks to a ten-fold increase in value, and a more than eight-fold increase in numbers, took first place. The United Kingdom has temporarily lost her foothold in, and command of, the Egyptian coal market, and as the result of the coal crisis in Egypt during 1920, the British share of coal imports into Egypt dropped from nearly 90 to 26 per cent. in quantity, and from 80 to 29 per cent. in value, thereby ceding British supremacy to the United States, whose share amounted to 53 per cent. of the quantity and 59 per cent. of the value of the coal imported.

Commercial Topics.

The Termination of E.P.D.

Representations have been made to the Chancellor of the Exchequer by the Federation of British Industries in regard to the question of Forward Contracts and Bad Debts, and two new clauses will be moved upon the Report Stage of the Finance Bill in order to secure that all firms should be placed as nearly as possible upon an equal footing as regards the burdens to be borne and the relief to be obtained under the provisions for the termination of E.P.D. The Federation seems to have a good case, and we hope that the clauses or some similar provision will be introduced into the Bill.

Trade Marks in Cuba.

Under the Pan-American Convention of Buenos Aires, 1910, an International Bureau for the registration of Trade Marks has been set up in Havana. The owner of a mark registered in the United States Patent Office and still in force may apply for registration at Havana regardless of the residence of the owner. Applications based on registration in the United States must be forwarded to the U.S. Patent Office for certification and transmission. Though a number of countries in South and Central America have ratified the Convention, there is some doubt as to whether the countries who have adhered to the Convention are effectively recognising registration at Havana.

Trade of Syria.

H.M. Consul at Damascus (Mr. C. E. S. Palmer) reports that the local market is still rather overstocked with most commodities, and at present most orders are going to countries where the exchange is low—Germany, Austria and Italy. It is thought, however, that when stocks are exhausted there may again be a limited demand for good quality British goods. It is impossible to compete in the cheaper qualities.

Among the goods which the Consul thinks most likely to find a sale in Damascus are electric light fittings and shades, motor cars and lorries, motor cycles, tools, &c. Catalogues (preferably in French) may be sent to the British Consulate, Damascus.

Glasgow Foreign Samples Exhibition.

By arrangement with the Glasgow Chamber of Commerce an Exhibition of Foreign Samples will be held in the McLellan Galleries, Sauchiehall-street, Glasgow, from July 11 to 14 inclusive. The samples number several thousands and include the following (among other) goods recently received from abroad:—Surgical and scientific instruments, domestic electrical goods, pressed glassware, paints, varnishes and enamels, glassware (scientific and table), electric cables and flex, &c.

In addition to the samples there will be available for inspection recently received foreign catalogues of the following trades:—Wire cables and ropes, cranes, dry and floating docks, coal mining plant, coal handling, screening and washing plant, pumps, crushing machinery, hydraulic machinery, conveyors, marine and stationary engines, turbines, drilling machines and machine tools, chemicals, &c.

Metallurgical Possibilities in Brazil.

The Commercial Secretary to H.M. Embassy at Rio de Janeiro (Mr. Ernest Hambloch) has forwarded to the Department of Overseas Trade some notes on the Brazilian President's recent message to Congress. The President dealt at length with the subject of the utilisation of Brazil's immense resources of coal and iron and said that, in order to establish not only the possibility of the manufacture of metallurgical coke from Brazilian coal, but also to test the cost of producing pig iron and steel in electric furnaces, the Government sent to Belgium several tons of coal from the mines in Santa Catharina and Rio Grande do Sul and appointed a professor of the Ouro Preto School of Mines to control the tests. Metallurgical coke was manufactured from Brazilian coal, and the technical results are claimed to be highly satisfactory. The percentage of coke (60), although not very high, gives ample scope for industrial exploitation, especially if the quantity of the valuable by-products, benzol and sulphate of ammonia, which is double what is generally found in Belgian coal, be taken into consideration.

The manufacture of pig iron and steel from Brazilian ore is to be carried out in electric furnaces in Sweden. Whatever may be the definite course which the metallurgical industry may take in Brazil, the great influence which the employment of electric furnaces may have on it is incontestable, and for this reason the Government is making a survey of its hydro-electric power and a study is being made of the technical conditions of the waterfalls.

The Esperanca (Usina Esperanca) in Minas Geraes, the only source of supply for national foundries and mechanical works, produces only about 15 000 metric tons of pig iron per annum. At present tests are being made of the manufacture of steel in a small Bessemer converter, and the company hopes to erect small works for the manufacture of steel in an electric furnace. One electric furnace is at present in existence in Sao Paulo with a capacity of 1 000 kilograms for the manufacture of steel from pig iron and "sucata," and besides this there is another small electric furnace for smelting pig iron for moulds. It is stated that the Companhia Electro-Metallurgica Brasileira will, by the end of the year, have in operation at Ribeirao Preto a factory for rolled steel, and be able to produce everything including pig iron in electric furnaces. The Anglo-Brazilian Iron & Steel Syndicate also intend to erect not far from the city of Rio de Janeiro iron and steel works which will employ electro-siderurgical methods.

Electricity Supply.

RYUL Urban Council is seeking authority to borrow £2 400 for additional feeder cables.

THE ABLEDGE City Electrical Engineer has been authorised to make arrangements for the electric lighting of the streets of Dyce village.

THE NENAGH Gas & Electricity Company, Ltd., is erecting electric generating plant and hopes to commence supply very shortly.

THE COLCHESTER electricity department's accounts for the year ended March 31 show a net deficit of £281, compared with £5 532 in the previous year.

CHESTERFIELD Corporation has applied for sanction to borrow £1 000 for service cables, £1 000 for distributors, £2 000 for e.h.t. cables and £750 for covering in the river at the electricity works.

THE ACCRINGTON Electricity and Tramways Committee has prepared a statement setting forth the Corporation's objections to the inclusion of the borough and the districts supplied by the Corporation with electricity within the mid-Lancashire electricity district.

DARWEN Council is recommended to increase the salary of Mr. Percy Taylor, assistant electrical engineer, from £250 per annum to the basic salary of £427, rising by three instalments to £471, with the usual bonus from November 20 last in accordance with the schedule of salaries of the National Joint Board.

PRESTON Corporation has applied to the Electricity Commissioners for a Special Order authorising it to generate and sell electrical energy in the Borough and the Rural District of Preston and to purchase the undertaking of the National Electric Supply Company, Ltd., in the area.

Now that the coal strike has been settled the LEEDS Electricity Department are undertaking experiments with a view to settling the question of the relative merits of coal v. oil fuel for steam-raising purposes. The electric supply has been maintained during the dispute by means of oil burning plant, but the authorities have had some anxious periods in consequence of the uncertainty in the arrival of oil supplies.

As the coal strike has caused a considerable reduction of the electricity revenue, STOKES-ON-TRENT Electricity Committee has decided to increase, at the end of the September quarter, the charges for electrical energy by a further 10 per cent., making in all 160 per cent. on power, heating and cooking, and for theatres, cinemas, places of public worship and similar supplies, and 100 per cent. over pre-war rates on those charged on the maximum demand system for lighting.

At the monthly meeting of BELFAST Corporation on the 1st inst., a recommendation of the Electricity Committee to increase the rate for electric light and power by 30 per cent. was referred back. The chairman of the Committee, Sir James Johnston, said that the undertaking was not paying and higher charges would have to be imposed to meet their obligations. Councillor Alexander criticised the contracts with the shipyards and said they had involved a loss of £50 000 per annum.

An inquiry was held last week by Mr. John Gemmill into the use of ELECTRICITY in the coking coal seam of the AUCHENGIECH COLLIERY (LANARKSHIRE) of Messrs. James Nimmo & Company. On June 1, 1920, an explosion occurred caused, it was alleged, by the ignition of gas by a spark from the electric coal-cutting machine which was in use in the seam. The Divisional Inspector of Mines gave the mineowners notice that the use of electricity in the coking seam would, on account of the risk of explosion of gas or coal dirt, be dangerous to life, and required them to desist from using electricity in the seam at or within fifty yards of the face for coal-cutting or for any purpose than that of shot firing or of obtaining light by means of electric safety lamps. The owners refused to comply with the notice, being of opinion that the use of electricity would not involve danger to life. Mr. Gemmill was, therefore, appointed a referee to determine the question, but, after hearing evidence, he took time to consider his decision.

Electric Traction.

COLNE Town Council has applied to the Ministry of Transport for sanction to borrow £6 600 for the purchase of new trams.

THE BRIGHTON Tramways Committee has decided, in view of the unsatisfactory financial position, to raise a short term loan to meet the deficit caused by extensive renewals of the tramway track last year.

Recently the GLASGOW Cleansing Committee has been in communication with the police registrar on the question of the duty payable on the 22 electric vehicles owned by the department. Duty totalling £584 8s. had been paid under the Finance Act, 1920, but a claim for rebate had been made to the Minister of Transport, who has intimated that he was prepared to license the vehicles in terms of paragraph 6 of the Act, and remitted £456 12s. as a rebate on the duty paid.

The accounts of MANCHESTER TRAMWAYS DEPARTMENT for the year ended March 31 show total revenue £1 813 401, compared with £1 586 863 in previous year, gross profit £305 834 (£379 632), or £316 146 (£398 494) after adding interest on investments, &c. After providing for interest on capital, debt redemption, street improvements, rent of tramways, leaseholds, and £1 645 net deficit on motor buses after allowing £1 597 for depreciation, a sum of £124 429 (£227 836) remained, out of which £106 166 (£80 229) has been placed to renewals fund, and £18 263 (£35 716) paid for income tax. Last year a sum of £111 891 remained and was contributed in aid of rates. There is no corresponding allocation this year. Passengers carried were 277 738 710 (285 046 914) and car miles run 18 711 007 (18 906 664). Total revenue per car mile was 23-247d. (20-127d.) and working expenses, including power, were 19-337d. (15-325d.)

Imperial and Foreign Notes.

There is an increasing demand in JOHANNESBURG for electric light and power, and business in electrical accessories and fittings is brisker.

Increased use is being made of EAST AFRICA'S WATER POWER in generating electricity, &c., and a substantial demand exists for pumping plant and similar machinery.

THE MIDDLEBURG (Transvaal) Council has decided, according to the "British & South African Export Gazette," to spend £36 000 on improvements, including an electric supply scheme.

MR. A. E. VAL DAVIES, M.I.E.E., until recently Assistant City Electrical Engineer at Capetown, has been appointed Consulting Electrical Engineer to the Pretoria Portland Cement Company.

THE ELECTROLYTIC ZINC COMPANY discharged about 150 men from their works at Risdon, near Hobart, some weeks ago, and this step was said to have been necessary owing to increased cost of production and decreased value of the product. It is hoped that when the Company's 100-ton plant is installed the margin of profit will justify working at full pressure. It has been agreed to pay the present rates of wages until September 1 and a Zinc Industry Board is to be asked to fix the subsequent rates. The Company has also put forward a scheme to deduct 7½ per cent. from the men's wages to be converted into shares certificates which will be issued to the men.

DR. Wm. Macdonald, of Cape Town, has recently visited Italy to investigate the Italian system of railway electrification and also the possibility of developing TRADE RELATIONS BETWEEN ITALY AND SOUTH AFRICA. At present the exchange difficulty hampers trade, but a campaign has been initiated for abolishing the National Institute of Exchanges. The Institute was established in December, 1917, with a view to the artificial maintenance of the Italian exchange. In May, 1919, its principal functions were transferred to the four chief banks, the Institute retaining only the duty of supervision and verification. As the general conditions of the country have improved and trade is growing, the abolition of the monopoly is urged to be essential to the free flow of imports and exports.

THE Mitsubishi Shipbuilding Company are, according to *The Engineer*, erecting large electrical engineering works at NAGOYA (JAPAN) and a sum of 15 000 000 yen has been allocated for the purpose.

Good progress has been made with the electrification of the SAINT GOTTHARD RAILWAY, and it is expected that the Bellinzona-Lugano-Chiasso section and the double line between Giubasso and Basso will be completed by October, while the Erstfeld-Aarth-Goldau and Aarth-Goldau-Chiasso sections will be ready by the end of the year.

IN ORDER to provide COMMUNICATION BETWEEN GERMANY AND EAST PRUSSIA a submarine telephone cable of about 100 miles has been laid in the Baltic between Leba (Pomerania) and Tenkitten, near Königsberg. Six wires are to be used for telegraph purposes and three for telephone circuits. The cable is 52 mm. in external diameter and weighs 2 tons per kilometre.

Institution Notes.

At the recent annual meeting of the RÖNTGEN SOCIETY Prof. J. W. Nicholson was elected president and Dr. G. H. Rodman, Sir Ernest Rutherford and Sir William Bragg were elected vice-presidents. The Council for the ensuing year consists of Mr. C. Andrews, Dr. H. Black, Mr. A. E. Dean, Major Kenelm Edgcombe, Mr. N. S. Finzi, Dr. F. L. Hopwood, Dr. F. H. Johnson, Dr. R. Morton, Mr. C. E. S. Phillips, Prof. A. W. Porter, Prof. A. O. Rankine, and Sir Archibald D. Reid. Mr. G. Pearce is hon. treasurer, Dr. E. A. Owen and Dr. J. R. Reynolds are hon. secretaries and Dr. G. W. C. Kaye is hon. editor.

At the June meeting of the DIESEL ENGINE USERS' ASSOCIATION, the subject of wear and bursting of cooling coils of air compressors and safety devices in connection therewith was discussed. The president (Mr. C. O. Milton) gave an interesting account of investigations carried out by him to ascertain the cause of the wear of cooling coils. He gave data of the actual wear of cooling coils at different points of their length after various periods of running and at varying loads, and he explained the methods he had used of ascertaining the wear by periodic weighing of the coils and by an electrical method by determining the variation in resistance of a unit length of the coil at different points. He emphasised the importance of draining compressors between the stages of compression and of restricting the use of lubricating oil in the compressors to the strict minimum consistent with proper lubrication. His investigations also showed the importance of taking into account the engine load-factor and atmospheric conditions. In the discussion it was made evident that the question of atmospheric humidity was of material importance in connection with the wear of compressor cooling coils.

Catalogues, Price Lists, &c.

Economy of transport in warehouses, factories, &c., is essential under modern industrial conditions, and those occupied with transport problems will be interested in the MORRIS GRAVITY CONVEYOR, which is the subject of an illustrated leaflet recently sent out by Messrs. Herbert Morris, Ltd., of Loughborough.

Those interested in the question of domestic labour-saving appliances will appreciate a new illustrated list, giving a description of the "CROYDON" PREMIER ELECTRIC SUCTION cleaner, which has been issued by Messrs. Scholey & Company, 56, Victoria-street, S.W.1. The cleaner is manufactured at Croydon and weighs less than 10 lb.; it is easily manipulated and strongly constructed, and it is claimed to be the cheapest on the market. Over half a million Croydon machines are stated to be in use, a striking testimony to its popularity.

Miscellaneous.

An experimental station for receiving WIRELESS MESSAGES from the U.S.A. has been erected on the north Girvaan shore by Marconi's Wireless Telegraph Company. Two 70-ft. masts have been erected, and tests of the apparatus have been made. This site was chosen because there is no land intervening between the point and America with the exception of the Mull of Kintyre.

With reference to the description of the 500 W turbo-generator, manufactured by Messrs. the Westinghouse Electric International Company, Messrs. BROWN BOVERI call our attention to the fact that many years ago they brought out a set of the same size which was specially designed for locomotive work, and that many of these sets are now in use on the Swiss railways. They can, of course, be used for a multitude of other purposes and are designed for a very large range of voltages.

For many months the BRITISH ROAD TRAFFIC ASSOCIATION has been working for the advancement of road traffic, both as regards the transport of goods and passengers. The object of the Association is to supplement the work of the commercial vehicle owner by co-ordinating road transport for goods, by establishing freight exchanges, &c. Recently the Association has still further extended its activities by the publication of a comprehensive but simple guide of motor coach services.

The "Motor Coach A.B.C." is, in fact, the time-table of the road throughout England and Wales, and the information contained in the first edition, which is now on sale, will be revised monthly in accordance with the alterations of the various companies' runnings. Anyone who has watched the great progress of the road transport movement must realise the need for such a guide, the cost of which is only 6d.

MESSRS. BRUCE PEEBLES & COMPANY, LTD., of Edinburgh, have prepared a very complete set of LANTERN SLIDES regarding their works and manufactures, and these are available for illustrating lectures on electrical machinery in this country. There are nearly 80 lantern slides in all, and in addition to those illustrating their Edinburgh works there are slides dealing with self-contained and open-type a.c. and d.c. generators and motors, motor generators, rotary converters, frequency changers and also the firm's well-known speciality, the Peebles-la Cour motor converter.

In reply to a question in the House of Commons on the IMPERIAL WIRELESS CHAIN, Mr. Kellaway (Postmaster-General) announced that the wireless stations at Leafield (near Oxford) and at Abu Zabal (near Cairo), which were to form the first link of the Imperial wireless chain, would be ready for use before the end of the year. The delay in the completion of the stations had been due mainly to labour difficulties. A Commission of experts was considering the design of the other stations recommended by the Imperial Wireless Telegraphy Committee. Pending the construction of these stations arrangements were being made for the further transmission to and from places beyond Egypt of telegrams forwarded by wireless between the Leafield and the Abu Zabal stations. Negotiations were also proceeding between this country and Canada in regard to wireless communication.

It is notified that in accordance with the agreed recommendation of the Conference of the National Federated Electrical Association and the Electrical Trades' Union at York in April, a REDUCTION OF 10 PER CENT. IN RATES OF WAGES current in April, 1921, will be substituted for the present reduction of 5 per cent.; such variation to take effect as on the first pay day following the 9th inst. The reduction applies to all grades of the National Wages Agreement for the Electrical Contracting Industry—to journeymen, mates, assistants and foremen; but in the case of foremen paid by the week under any existing arrangement which provides a minimum difference between foremen's wage and operatives' wage, such difference to be maintained. The reduction will not apply to indentured apprentices unless their rate is stated in the indenture to rise and fall with the journeymen's rate.

The need for inculcating "SAFETY FIRST" METHODS AMONGST INDUSTRIAL WORKERS is emphasised by the recently published statistics compiled under the Workmen's Compensation Act. These figures show during 1919 an accident toll of 3 293 deaths with 365 176 disablement cases in the seven chief industries, viz., mines, quarries, railways, factories, docks, constructional work and shipping. The cost of these accidents in direct claims alone amounted to £4 616 723. Legal, medical and administrative expenses have to be added to this amount and the resultant loss of productivity has also to be taken into account. All this is waste, and when one considers that carelessness causes the great majority of accidents it is evident that every effort should be made to prevent such staggering waste of life, limb and money. In view of these facts employers of labour will appreciate the possibilities of a liberal and general use of the specially designed "Safety First," "Warning" and "Danger" signs supplied by the Pyrene Company, Ltd. The attractive colour and wording of these metal signs, when fixed in prominent and appropriate positions, call the employees' attention to the risk at the right moment. The "Safety First" signs should be used whenever there is a risky and a safe way of working; whilst the "Warning" signs serve to impress a specific risk upon an employee and keep him on the alert. The "Danger" signs should be used only where immediate danger exists. Each of the three designs is issued with 12 different wordings for the panels at the bottom. These embody the most general risks under their respective headings and the Pyrene Company, to whose enterprise the issue of these coloured metal signs is due, will be pleased to send to all interested a fully illustrated folder showing the complete range of signs and wordings in actual colours, upon receipt of requests addressed to 9, Grosvenor-gardens, S.W.1.

Business Items, &c.

MR. DAVID G. BROOKS, representing the Walsall Hardware Mfg. Company, Ltd., has moved from 79, Lincoln's Inn, Corporation-street, to Daimler House, Paradise-street, Birmingham.

Fergus Jas. Adam and Wm. Edwd. Gayler, trading as ADAM & GAYLER, electricians, Dyneto Works, Suffolk-place, Birmingham, have dissolved partnership. Debts by Mr. Adam, who will continue the business on his own account.

MR. W. S. ASKHAM, 17, Regent Park-terrace, Hyde Park, Leeds, asks us to state that he has severed his connection as North country representative with Messrs. J. H. Tucker & Company, Ltd., after 17 years service, and has joined Messrs. J. A. Crabtree & Company, Ltd., of Walsall.

The agency for the United Kingdom and Colonies for the Atlas Company, Ltd., of Copenhagen, makers of impulse steam turbines, steam engines, condensing plant, double helical gears, &c., has been taken over by Mr. E. W. Dorey, Norwich House, Southampton-street, High Holborn, W.C.1.

MESSRS. SIR W. G. ARMSTRONG, Whitworth & Company, Ltd., have secured the services of Mr. R. P. Tod, M.I.Mech.E., M.I.Met., in connection with their hydro-electric work. Since 1907 Mr. Tod has been at the British Aluminium Company's works, Kinlochleven, where originally he was in charge of the erection of the pipe lines and turbines of 30 000 H.P. Until recently he has been Manager-in-Chief of the whole of the British Aluminium Company's undertaking at Kinlochleven.

Personal and Appointments.

SIR JAMES DEWAR has been re-appointed Fullerian Professor of Chemistry at the Royal Institution.

WALLASEY Electricity Committee recommend the appointment of Mr. B. T. Hawkins, of St. Helens, as electrical engineer and manager of the Corporation electricity undertaking.

MR. W. M. MILNES, of Coventry, has been appointed general manager of the Wigan Corporation tramways, at a commencing salary of £700 per annum.

The Institute of France has awarded the Triennial Osiris Prize of 100 000 francs to GENERAL FERRÉ, Director of the French Wireless Service during the war.

The directors of the Metropolitan Railway Co. have appointed Mr. Edward A. Wilson, M.I.C.E., to the position of chief civil engineer to the company in succession to Mr. W. Wilcox who has retired.

MR. GEORGE HALLY, of Birmingham, has been appointed chief works manager of the engineering side of the Edison Swan Electric Company, Ltd., Ponders End, Middlesex. Mr. Hally has had a wide experience with leading firms of engineers in this country and abroad, and served his apprenticeship with Messrs. Alley & McLellan, of Glasgow, of which city he is a native.

In the course of his visit to the Royal Agricultural Show at Derby, H.M. THE KING inspected the joint exhibit of the Derby Chamber of Commerce and the Borough Electricity Department. Among those who were presented to His Majesty on this occasion were Ald. W. J. Wilkins, J.P., Chairman of the Electricity Committee, and Mr. T. P. Wilmshurst, M.B.E., Borough electrical engineer.

Several of Col. Crompton's old pupils (through the instrumentality of Mr. Llewellyn Foster) took the opportunity on the recent occasion of COL. and MRS. CROMPTON'S GOLDEN WEDDING, to present them with a small token of their esteem, affection and goodwill. The gift, which has been suitably acknowledged by Mrs. Crompton, was accompanied by an album containing the signatures of those who contributed.

Bankruptcies, Liquidations, &c.

Meetings of creditors and contributories of PORTABLE ELECTRIC MOTORS (1919), LTD., will be held on July 12 at 33, Carey-street, London, W.C.2.

At a meeting of creditors of the DEVON HYDRO-ELECTRIC & DEVELOPMENT COMPANY, LTD., it was decided to wind up the Company voluntarily.

A first and final dividend of 1s. 4½d. is payable at 3, Manor-place, Sunderland, to creditors of JAS. WM. LAYTON, electrician, 5, Noblesbank, Hendon, Sunderland.

THE ANGLO-NORWEGIAN ELECTRO-CHEMICAL & FINANCE COMPANY, LTD., is being wound up voluntarily, and Mr. E. Dyball, 6, Gt. St. Helens, London, E.C., has been appointed liquidator.

A meeting to receive an account of the winding up of ENGINEERING & ARC LAMPS, LTD. (in vol. liq.), will be held on Aug. 4 at the office of the liquidator, Mr. W. A. Henderson, 29, Gracechurch-street, London, E.C.3.

JOHN HY. TOMS, electrical engineer, 13, Gray's Inn-road, London, W.C., has been adjudicated bankrupt. The first meeting of creditors will take place on July 11, and the public examination on Sept. 27, both at Bankruptcy-buildings, London, W.C.

A receiving order has been made against C. A. CARPENTER, electrical engineer, 4-5, Mason's-avenue, Basinghall-street, London, E.C. The first meeting of creditors will take place on July 11, and the public examination on Sept. 13, both at Bankruptcy-buildings, London, W.C.

A receiving order has been made against G. H. GEE, electrician, 10, Front-street, Annfield Plain, co. Durham. The first meeting of creditors will take place on July 12 at Pearl-buildings, 4, Northumberland-street, Newcastle-on-Tyne, and the public examination on July 28 at the County Court, Westgate-road, Newcastle-on-Tyne.

Companies' Reports, &c.

The NAIROBI ELECTRIC POWER & LIGHTING COMPANY, LTD., has declared the first interim dividend of 5 per cent. for the current year.

The directors of the NATIONAL ELECTRIC SUPPLY COMPANY, LTD., announce an interim dividend of 2s. 6d. per share (less tax) on the ordinary shares.

The directors of PINCHIN, JOHNSON & COMPANY, LTD., have declared a dividend at the rate of $6\frac{1}{2}$ per cent. per annum on the preference shares for the six months ended June 30.

The ANGLO-AMERICAN TELEGRAPH COMPANY, LTD., has declared a dividend for the quarter ended June 30 of 15s. per cent. on the ordinary stock and £1 10s. per cent. on the preferred stock, less tax.

It is announced that the subscription list for the issue of £228 400 7½ per cent. debenture stock at 95 per cent. by the NORTH METROPOLITAN ELECTRIC POWER SUPPLY COMPANY, which opened on Monday morning, was closed at 10.45 a.m. on the same day.

The total receipts of the TAUNTON ELECTRIC TRACTION COMPANY, LTD., for 1920 (including £214 brought forward), amounted to £5 47s. After deducting all expenses and debenture interest, there is a balance of £611 to be carried forward.

The accounts of J. G. WHITE & COMPANY, LTD., for the past year show a profit of only £4 20s. as compared with £28 03s. for the preceding year. No final dividend is at present to be paid on the preference shares. In the previous year 7 per cent. was paid on the preference and ordinary.

A petition for confirming a reduction of the capital of the CAPE TOWN CONSOLIDATED TRAMWAYS & LAND COMPANY, Limited and Reduced, from £300 000 to £15 000, will be heard by Mr. Justice Lawrence in the High Court of Justice on July 12.

The revenue of the CALCUTTA TRAMWAYS COMPANY, LTD., for 1920 amounted to £222 120, and the directors have placed £40 000 to reserve for depreciation, £80 000 to taxation reserve and £2 402 to staff provident fund. It is proposed to pay a final dividend of 3s. 6d. per share, making 7 per cent. for the year, tax free, carrying forward £42 591.

At meetings of the holders of the 5 per cent. first mortgage gold bonds of the MEXICAN LIGHT & POWER COMPANY and the MEXICAN ELECTRIC LIGHT COMPANY, the 5 per cent. 50-year first mortgage bonds of the PACHUCA LIGHT & POWER COMPANY, and the general consolidated first mortgage 50-year 5 per cent. gold bonds of the MEXICO TRAMWAYS COMPANY, last week, resolutions were passed confirming the arrangement provisionally entered into by the committee on behalf of the holders of such bond issues.

The annual report of the ARBOATH ELECTRIC LIGHT & POWER COMPANY, LTD., states that the net profit was £5 71s. after paying interest charges and the 5 per cent. preference dividend. At the meeting last week it was agreed to pay a dividend of 8 per cent. on the ordinary shares, and an additional 1 per cent. on the preference shares for 1920; to place £3 000 to reserve and renewals fund, and to carry forward (subject to payment of directors' and auditors' fees) £1 367. The past year has been the most prosperous in the history of the company. The share capital has been increased to £100 000, and it is proposed to make an issue of new shares for repaying loans and providing capital for extensions of plant and cables.

The report of CROMFORD & COMPANY, LTD., for the year ended 31st March last states that the net profit was £5 71s. after providing for depreciation, interest on debentures, directors' fees, &c., and a reserve sufficient to cover Excess Profits Duty, Corporation and Income Tax for the year, is £66 29s. With £18 17s. brought forward and deducting the interim dividend on the preference shares (£4 86s.) the balance is £79 60s. The directors recommend that £19 500 be placed to general reserve fund, that a dividend of $6\frac{1}{2}$ per cent. be paid on the preference shares (making, with the interim dividend, 10 per cent. for the year), and a dividend of 10 per cent. per annum on the ordinary shares, leaving to be carried forward £18 37s. In order to cover the abnormal fall in prices of material an exceptionally large sum has been written off stocks.

In presenting the accounts for 1920 at the meeting of the KALGOORLIE ELECTRIC POWER & LIGHTING CORPN., LTD., last week the chairman (Mr. G. C. Howard) said that the available balance was £12 63s. and after meeting various charges (including interest on debentures) and placing £9 500 to depreciation, the amount of £107 was carried forward. Only £7 500 debentures are outstanding. The prominent feature of the accounts was the increase in revenue from Western Australia. During the year they had a number of strikes which caused disorganisation of work and heavier wages. The miners' strike, which started in November 1919, did not come to an end until the middle of January. There was trouble with the tramway people and the tramway load was taken off for a fairly long period. Then there was more trouble with the firewood cutters, affecting the work in the mines.

At the meeting of RICHARDSONS, WESTGARTH & COMPANY, LTD., the chairman (Mr. D. B. Morison) said that notwithstanding the exceptional difficulties experienced during the past year the profits were considerably greater than in the previous year. Owing, however, to the excess profits duty being raised to 60 per cent., and to the addition of the corporation profits tax, the retainable profit of £155 63s. was £80 000 less than it would have been had the duty remained at 40 per cent. In the land department numerous turbines were supplied for the generation of electric power, while the number and size of Contraflow high vacuum condensing plants and marine auxiliaries exceeded all previous records. The steel works department was normally busy, noteworthy features being the building of rolling mill engines of 20 000 H.P. for the Cargo

Fleet Iron Company, and of many Nesdram water tube boilers, which continued to give great satisfaction.

Presiding over the annual meeting of EDMUNDSONS' ELECTRICITY CORPORATION, LTD., on Thursday last the chairman, Mr. P. D. Tuckett, said the directors felt confident that the company had definitely turned the corner, but until they enjoyed a return to more normal conditions, and secured the regulation of their selling prices on a more rational basis, they could not be sure of the steadily improving results to which they looked forward. Most of their maximum rates had been granted, and with few exceptions any further adjustment of them could only be made under the powers of the Statutory Undertakings (Temporary Increase of Charges) Act, 1918, which restricted profits to an amount which was sufficient to yield three-quarters of the average pre-war ordinary dividend. A more stupidly unfair and utterly uncommercial restriction to impose on a progressive industry it was difficult to imagine, and he failed to understand how it was supposed that any healthy progress could be made under such conditions.

The net revenue of the BARCELONA TRACTION, LIGHT & POWER COMPANY, LTD., for 1920 (including income from the investment in Les Tramways de Barcelone) was \$2 731 769. Interest payable in cash on bonds of company for 1920 amounted to \$1 963 485. Usual provision was made for amortisation of underlying bonds, and, in addition, reserves for depreciation were made by chief operating companies as follows: Light and power companies, \$655 820; railway company, \$283 364. There was an increase of 6 128 683 pesetas in gross earnings of combined enterprises of companies operating in Spain, and net earnings increased 5 044 321 pesetas. With completion of new hydro-electric installation at Camarasa major construction projects of Ebro company may be regarded as finished. The result of the year's operation of Cataluna Railway Company was highly satisfactory. Work upon extension to Sabadell is well advanced. The operating results of Les Tramways de Barcelone showed an increase in net earnings of about 14 per cent.

The speech of the chairman of the LISBON ELECTRIC TRAMWAYS, LTD. (Mr. L. Breitmeyer), at the annual meeting last week, was mainly a recital of troubles caused by strikes, the fall in the exchange, &c. During 1920 the Company sustained considerable loss by the severe restrictions placed by the Portuguese Government on remittances from the country, and, coal rising to 142s. per ton, traffic receipts were quite insufficient to cover operating expenditure. They had also several strikes of workmen, the principal one lasting from July 30th to September 2nd. Adjustment of tariffs required the approval of the Camara, and that body wasted so much time over the consideration of an application that, by the time a decision was reached, the position had again altered for the worse, past losses were not recovered, and a fresh application had again to be made, which in its turn was subjected to prolonged deliberation. At present the lowest fare in Lisbon was under $\frac{1}{2}$ d., comparable with the $\frac{1}{4}$ d. fare in England. The fares were far too low, especially when the higher price of fuel in Lisbon was considered. For that low tariff the company gave a first-class tramway service, fulfilling its functions to the public more efficiently than other public utility services in Portugal. The number of passengers carried was well maintained, and the traffic receipts were 6 088 286 escudos in 1920, but the expenditure reached the record figure of 8 808 594 escudos. That exceedingly heavy increase in working costs was due to higher labour charges, the collapse in exchange, the advanced prices of all local supplies, and the fact that fuel cost, in escudos, 20 to 30 times as much as before the war. Further, the company had to pay to the Camara approximately 8 per cent. of its entire traffic receipts, amounting in 1920 to 450 contos. In addition, the Government imposed an extremely heavy percentage tax on tickets. Those heavy burdens meant a charge of about 15 per cent. on the gross takings. It was no wonder that the ordinary shareholders had received no dividend since December, 1915, and that the dividend on the preference shares was in arrear from June 30, 1917.

For the year ended Oct. 31 last the gross receipts of the UNITED ELECTRIC TRAMWAYS OF MONTEVIDEO, LTD., were £516 130 (at an exchange of \$47 to the £), an increase of £72 436. Operating expenses also showed a continuing increase, mainly due to higher wages and taxation, and exceeded those of the previous year by £52 483, leaving a net increase of £19 953; but remittances have been affected by the fall in exchange. The passengers carried were 63 220 875, an increase of 8 336 956, and the number of car-miles run were 8 830 112, an increase of 1 073,478. To facilitate handling increased traffic, 15 motor and 14 trailer cars have been ordered, in addition to the construction of four new cars in the company's workshops in Montevideo. After providing for administration expenses and charging £46 539 for debenture interest, the credit balance was £74 907, making, with £7 031 16s. 8d. brought forward, a total of £81 939. After setting aside sums for the redemption of debenture stock and the preference and ordinary share capital, and £3 000 for renewals and contingencies, and also paying an interim dividend on the cumulative preference shares at the rate of 6 per cent. per annum for the half-year to Sept. 30, 1920, the directors now recommend the following dividends: On the preference shares at rate of 6 per cent. per annum for the half-year and on the ordinary shares at 4 per cent. (less tax) for the year to March 31, 1921, leaving £8 477 to be carried forward.

Presiding over the recent annual meeting Sir George A. Touche, Bart., stated that the one comforting fact was that the traffic again showed an increase in a year full of difficulties and worries. So long as receipts continued to grow, the foundation of the business was sound, and the full benefit should be realised when conditions became more normal. Unfortunately expenses also were higher and had absorbed 72-45 per cent. of the gross increase. That was due mainly to higher wages, and there was little prospect of the item being reduced.

New laws were continually being passed which imposed fresh burdens and taxation. The operation of the Eight-Hours, the Old-Age Pension, and the Pension and Superannuation Laws for Public Service employees had added considerably to their expenses, and they were now faced with Minimum Salary and Weekly Rest Laws, not to mention serious paying obligations. All those charges increased the obligations agreed upon in the concession. In spite, however, of those additional burdens, the company had not yet received permission from the Government to increase its tariffs. The ordinary shareholders had had no dividends for years, and had received an average of only 3½ per cent. since the company was formed. He retained his belief that Uruguay would yet come into line with other nations in recognising that the imposition of new burdens involved a revision of the charges out of which they had to be met. Of the increase of £52 483 in expenses the increased wages and the company's contributions under the Pension Law accounted for £42 272, and the balance was practically all accounted for by increased expenditure on fuel.

New Companies.

The following list is compiled from information supplied by Messrs. Jordan & Sons, Ltd., company registration agents, Chancery-lane, London, W.C.2.—

COLLEY & COMPANY, LTD. (175 304).—Reg. June 21, capital £2 500 in £1 shares, to carry on business of electrical and general engineers and contractors. Subscribers, H. A. Woodman and G. McFarlane, 51, Gt. Ormond-street, W.C.1. Private company.

ENGINEERING PLANT CONTRACTORS, LTD. (175 055).—Reg. June 6, 1921, capital £3 000 in £1 shares, to acquire and carry on business of engineers and contractors. Directors, J. Mills and Mary J. Mills, 377, Waterloo-road, Cheetham Hill, Manchester. Private company.

GERHOLD ALARMS, LTD. (175 334).—Reg. June 22, capital £11 000 in £1 shares, to carry on business of mechanical engineers and deal in the Gerhold patent burglar alarm and apparatus. Directors, A. Gerhold, J. B. Maclean and J. A. Attenborough. Reg. office, 37, Walbrook, E.C. Private company.

HARDY & NASH, LTD. (175 284).—Reg. June 20, capital £7 000 in £1 shares, to acquire and carry on business of motor, electrical and general engineers. Directors, W. Hardy, 7, Mount-street, Cromer, G. Nash, P. J. W. Mayow, and F. C. Weights. Private company.

HEATH & SERENA, LTD. (175 217).—Reg. June 15, capital £2 000 in £1 shares, to carry on business of electrical and mechanical engineers. Subscribers: G. E. Heath (8, Oakleigh Gardens, Whetstone, N.20) and R. Serena (29, St. James-street, S.W.).

J. R. HOWARD, LTD. (175 962).—Reg. June 6, capital £2 000 in £1 shares, to carry on business of manufacturers of scientific goods, &c. Subscribers, J. R. Howard and R. J. Howard. Reg. office, 41, Wigmore-street, W.1. Private company.

MINIRISK COMPANY, LTD. (175 135).—Reg. June 9, capital £1 500 in £1 shares, to carry on business of lock makers and manufacturers of electrical and other fittings. Directors, J. B. Boland and W. S. Mockett. Reg. offices, 47, Victoria-st., S.W. Private company.

NAZEING AND DISTRICT ELECTRIC SUPPLY COMPANY, LTD. (175 258).—Reg. June 17, capital £7 000 in £1 shares, to carry on business of electrical engineers and suppliers of electricity. Directors, E. Grace, (366, High-street, Tottenham, N.17), H. Rose, W. B. Tweddill and E. Silver. Private company.

H. G. OSBORN, LTD. (175 127).—Reg. June 9, capital £1 000 in £1 shares, to carry on business of electrical and mechanical engineers. Directors, H. G. M. Osborn and Amy Osborn. Reg. office, 9, Rathbone-place, Oxford-st., W.1. Private company.

PRICE'S ELECTRICAL SUPPLIES, LTD. (175 200).—Reg. June 17, capital £3 000 in £1 shares, to carry on business of manufacturers of and dealers in, goods, instruments and devices used in connection with electricity and gas power, &c. Directors, W. H. Price and W. F. Cox. Reg. office, Caxton House, Great Charles-street, Birmingham. Private company.

W. A. TASKER & SONS (BRISTOL), LTD. (174 904).—Reg. May 26, capital £2 000 in 1 500 preference and 500 ordinary £1 shares, to carry on business of motor, electrical and general engineers. Directors, E. A. Tasker (7, North-road, Bristol) and W. S. Tasker. Private company.

THERMICS LIMITED. (175 200).—Reg. June 14, capital £200 in £1 shares, to carry on business of electrical and general engineers. Directors: W. W. Nobbs, S. Evling, A. B. C. License and P. A. Lothbury. Reg. office: 2, Falcon-square, Aldersgate-street, E.C.

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Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"The Cabinet Maker": "Sale of the Duke of Beaufort's Furniture"; "Work Without Labour," by Ernest J. P. Benn; and "Design and Tradition." "Chemical Age": "British Dyestuff Industry"; "Review of National Policy and Results"; and "Chemistry of Combustion," by E. V. Evans. "Farm and Home": Royal Show Number: Descriptive and Illustrated Account of the Derby Exhibition. "The Fruit-Grower": "Implement Exhibits at the Royal" (illustrated); "Collapse of the Jam Combine"; and "Imperial Fruit Show." "Gardening Illustrated": "Seasonable Notes on Chrysanthemums"; "Edgings" (illustrated); and "Fruit Growing for the Novice." "Hardware Trade Journal": "Hardware at the London Fair and Market"; "Notes on Pumps, IV."; and "Hardware Sample Displays." "The Gas World": "The Age of Amalgamation"; "The Chemistry of Combustion."

Forty Years Ago.

(THE ELECTRICIAN, JULY 9, 1881.)

ELECTRIC LIGHT IN MINES.—The Royal Commissioners on Mines visited Wigan the other day for the purpose of carrying out further experiments with the electric light, with particular reference to its utility in mines as a means of avoiding explosion of gas.

THE PARIS ELECTRICAL CONGRESS.—A decree appointing sixty-five members of the Congress has been signed, and will shortly be published. No reporters or members of the outside public will be admitted to the Congress, an official report of which will be published by the general committee. The jury will not be appointed by exhibitors, who will thus have no influence on the awards.

ELECTRIC LIGHT IN THE HOUSE OF COMMONS.—We understand that the lamps used in the late experiments in the House of Commons are to be removed in spite of the intimation of Mr. Shaw-Lefevre that further experiments were to be undertaken during the recess. It would appear that the opinion of the hon. members of the House was not favourable enough towards the new light to encourage further experiments.

ELECTRIC LIGHT IN LIBRARIES.—A writer in a provincial contemporary testifies to the utility of the electric light in libraries, not only on account of the non-heating of the atmosphere, but owing to its having no bad effects on the covers of the books. Anyone who has had much to do with libraries will have noticed how brittle and rotten the bindings of books become on those shelves which are near the ceiling of the room, and, therefore, exposed to the heat of the gas. This is not likely to arise when the electric light is used.

ELECTRICITY AND STEERING GEAR.—The correspondent of a Sheffield paper is answerable for the following: A ship has just arrived in the Thames from Glasgow, the exponent of a new experiment with electricity. Its steering gear has been fitted up with electricity, and at the slightest touch of the fingers the vessel can be guided through the roughest seas. The apparatus answered admirably, with one not unimportant exception. The electric battery played a merry game all through the voyage with the compasses, which were practically useless. This, of course, disposes of the experiment.

Prices of Metals, Chemicals, &c.

			TUESDAY, July 5.	
			Inc.	Dec.
Copper—				
Best selected.....	per ton	£73 0 0	£1 10 0	—
Electro Wirebars ...	"	£77 10 0	£1 10 0	—
H.C. wire, basis	per lb.	0s. 11½d.	½d.	—
Sheet	"	1s. 0d.	—	—
Phosphor Bronze Wire (Telephone)—				
Phosphor-bronze wire, basis	"	1s. 3½d.	½d.	—
Brass 60/40—				
Rod, basis	"	0s. 8d.	—	½d.
Sheet, basis	"	0s. 11½d.	—	—
Wire, basis	"	0s. 11½d.	—	—
Pig Iron—				
Cleveland Warrants .	per ton	£6 10 0	—	—
Galvanised steel wire, basis 8 SWG ..	"	£27 0 0	—	—
Lead Pig—				
English	"	£24 10 0	—	—
Foreign or Colonial ...	"	£23 0 0	—	2s. 6d.
Tin—				
Ingot	"	£171 0 0	£4 2 6	—
Wire, basis	per lb.	2s. 4½d.	½d.	—

Salammoniac.—Per cwt. 75s.-70s.
Sulphur (Flowers).—Ton £15.
 (Roll-Brimstone).—Per ton £15.
Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.
Rubber.—Para fine, 10½d.; plantation 1st latex, 8½d. lb.
 The metal prices are supplied by British Insulated & Helsby Cables.

THE ELECTRICIAN

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Notes.

The Revived I.M.E.A. Convention.

THE I.M.E.A. Convention, shorn of most of its social items and transplanted from the breezy coasts of Scotland to the hot streets of London, is to be held at the Institution of Electrical Engineers next week. This statement is made with some reserve, for we understand that if the London Enquiry is not finished by Wednesday next it will be necessary to hold the Convention at the Institution of Mechanical Engineers in Storey's Gate. We are glad to see that the meetings are to be more extended than was at first arranged and that our suggestion that the Papers which were to be originally presented at Dundee should be discussed in London has been adopted, while Major RICHARDSON is also to deliver his Presidential Address. We have had such a surfeit of engineering conferences lately that we are afraid, through no fault of their own, the I.M.E.A. will conduct their proceedings in a saturated field. It is therefore opportune once more to suggest that an "all-electric" conference, embracing every branch of the profession, should take the place of these divers sectional conferences, whose number seems to increase as the influence of each gets steadily less.

An "All Electric" Convention.

BUT amalgamation must not stop at organisations connected with electricity supply. It must continue until every section of the electrical industry is embraced by one great convention. Such a combination would not only be of immense technical value, but would allow those social amenities which are of as much importance in engineering as in other spheres of human activity to be developed in a way which is impossible at present. Incidentally it would obtain for the electrical industry greater publicity for its proceedings than is now the case, a point the importance of which is often overlooked. For there is no

reason why the doings of the electrical industry should not be "news" of the very highest value to our great benefit in many ways. At such a conference all electrical associations of every kind should be encouraged to take part. The gathering should be mainly of a social character and the aim should be to secure the presence of as large a number of those engaged in and interested in electrical work as possible. The place and meeting should be a town where ample accommodation is available, and where machinery is installed for dealing with a large number of visitors. The conference should not take the place of existing institutions, but should supplement their activities on the publicity side. At first sight the difficulties that surround the development of such an idea are more obvious than the advantages, but these difficulties can be easily overcome and the accruing advantages will be well worth obtaining. We present the idea to the serious consideration of the electrical industry.

The Wrong Sort of Economy.

THOSE who argue that the franchise should be restricted rather than extended will derive much support for their opinion from a letter signed "London Elector," which was recently published in "The Times." The theme of the letter is old, fashionable and based on a fallacy. The writer is convinced that the Government's sole aim and object should be to cut down every variety of expenditure and in particular that it cannot achieve this end better than by abandoning its ideas for improving the electricity supply of the country. Possession of the franchise does not, however, necessarily mean possession of knowledge and it is, therefore, perhaps hardly to be expected that an ordinary elector (if "London Elector" is an ordinary elector) should be conversant with all the complications which surround the political side of electricity supply at the present time. But lack of knowledge is at least an excellent reason for not rushing into print on a subject. We, nevertheless, forgive "London Elector."

Starting and Catching a Hare.

THE same excuse can hardly be made for our contemporary, who, with the omniscience which is its characteristic, must know the exact position of electricity supply legislation in this country and is therefore assuming a grave responsibility to its readers in supporting "London Elector's" arguments and by calling upon the Government to abandon prodigality for parsimony in electricity supply. But even this deplorable pronouncement has its bright side, for it has enabled two other correspondents, notably Mr. G. H. HUME, of the London County Council, and Mr. W. F. FLADGATE, of the Charing Cross Company, to point out (in the smallest print) that the arguments of "London Elector" will not bear scrutiny and that far from a large capital expenditure being involved the suggestions put forward by the various authorities for improving London's electricity supply will tend to economy rather than to bankruptcy. Unfortunately, a hare of this kind once started is not so easily caught and we therefore expect to see the old criticisms and the old adjectives blossoming forth on many more occasions, to the disgust of those who wish that electrical matters could be fairly presented to the general public. We do not wonder that the Colonial premiers have a small opinion of the Press of this country if this sort of thing goes on in our leading newspaper.

Unnecessary Locquacity.

NEVERTHELESS there is one item of cost connected with the reorganisation of electricity supply which should be reduced without delay. The locquaciousness displayed at the enquiries and the small amount of real progress that has apparently resulted give rise to the very natural query whether anything beneficial is being gained. And while it is necessary that conditions in particular districts should be thoroughly examined, such examination does not require an array of counsel, long strings of witnesses, or the presentation of ill-digested data more designed to block progress than to provide a workable solution. Legislation and self-interest in this case have a common end: the provision of some arrangement which will enable the next few years to be tided over with the maximum of benefit to the electricity supply undertakings of the country. So that while it is perhaps too much to expect that local jealousies shall be dropped in favour of real co-operation it is only in that way that real assistance to the cause of electricity supply can be given. While then "London Elector" and his kind are the more spectacular enemies those who drag out the proceedings at the enquiries are equally obstacles in the road of progress.

Another Lancashire Authority.

THE draft of the scheme for the North Lancashire and South Cumberland District, a somewhat irregularly shaped area, contemplates the formation of a Joint Electricity Authority of 30 members, and mainly municipal representatives. This body would take over the five generating stations of the existing authorised undertakers. The scheme also provides for the construction of 33 000 V main transmission lines between the principal towns so as to link up Barrow, Ulverston, Lindale, Lancaster and Kendal, while 6 000 V lines will be laid from Lancaster to Morecambe, Heysham, and other districts, and between Barrow and Dalton-in-Furness. Apparently the Joint Authority will also establish distributing systems in several of the urban and rural areas. It is estimated that the first portion of the scheme will effect such an economy in coal consumption alone that the interest and sinking fund on the capital required for the transmission lines will be more than covered, while a cheaper supply will be given to existing undertakers and extensions in the more distant parts of the district will also become possible.

Imperial Inter-communication Again.

THE announcement that a committee is to be appointed, under the presidency of Mr. WINSTON CHURCHILL, consisting of representatives of each of the Dominions and the Ministers at the head of the Board of Trade, Air Ministry and Post Office, to consider the "practical means available at the present time for the development of Imperial communications by land, sea, air, cable, radio-telegraphy and telephony," may or may not indicate that the Government are about to change their opinion on the best way to establish a really efficient system of Imperial intercommunication. Of the necessity of the development of this communication there is no doubt, and a short time ago we were told that it would be most efficiently achieved by the erection of numerous high-power wireless stations which would render the existing network of submarine cables a back number. We were not at the time frightened at this prospect, knowing the wide gulf which is fixed in political circles between contemplation and achievement, though we took occasion to point out at the time that the day of the submarine cable was not yet drawing to a close and that increasingly useful as wireless communication was likely to become it would be rather as an auxiliary than as the rival to the older system. The step now taken by the Government seems to point to an agreement with these conclusions. There are many reasons, both technical and commercial, why for the present wireless communication must be limited in its scope. There is the indirect reason that submarine telegraphy is still a rival to be reckoned with, not the less because it works far removed from the bright light of publicity. Nevertheless improvements in working are constantly being made and we have full justification for saying that the leeway caused by wartime conditions has now been made up, and that the operation is continually being improved by the introduction of new methods, the repair of old plant, and the duplication of both cables and equipment.

The Empire Universities Congress.

OF the many national and international congresses which have recently taken place, one of the most useful and significant is the Congress of the Universities of the Empire, which was held at Oxford last week. Though the majority of the delegates appear to have been representatives of the Humanities, there were some advocates of the bread-and-butter sciences, and there was at least one pronounced utilitarian in Sir WM. ASHLEY. In the course of an interesting and opportune address on the functions of the universities in fitting the country to grapple more successfully with commercial problems, Prof. ASHLEY, who believes that in the course of the next twenty years we shall see faculties of commerce in every considerable university in the Empire, stated that, instead of aiming at only mental culture and trusting that somehow utility will emerge as a by-product, we should aim directly at utility and let culture go hang. This is an attractive idea, the more so as there is considerable room for improvement in our existing methods, but extreme utilitarianism would, we fear, only produce an arid materialistic state. We gladly subscribe, however, to the views of Sir J. ALFRED EWING, Vice-Chancellor of the University of Edinburgh, who said it would be disastrous if universities were nationalised. The truth of this dictum is sufficiently evident when the qualities of many of the exponents of this idea are examined. No doubt these institutions serve certain national interests, and they must continue to act as centres within the State of the highest learning and research, but their doors should be flung open to all who are fit to take advantage of the instruction that is given within.

An Exchange of Teachers.

WE are pleased to notice that as a result of the Congress, there is to be an exchange of teachers between the various universities. Thanks to the Rhodes scholarships, a number of students from the British Dominions have received the benefit of an Oxford training and, in addition, an increasing interest is being displayed by the majority of British universities in Colonial history and political institutions. This is useful in assisting the movement for the consolidation of the various parts of the Empire, but a greater and a more co-ordinated effort should be made to encourage colonial students of engineering, chemistry and physical science to come to the newer universities, such as London, Manchester and Sheffield, and to the Higher Technical Colleges of this country for the completion of their education. France and Belgium are making arrangements to encourage Chinese, Japanese and other eastern students to complete their training in Europe, and if they find it advantageous to do this, how much more important is it for us to attract budding young engineers and chemists from the various parts of the Empire to this country?

The Re-formation of the National Council.

JUDGING from a resolution recently passed by the Employers' Side of the National Council, they have overcome their objection to enlarging the Council so as to give direct representation to the thirteen District Councils. Henceforth direct representation is to be the order of the day. The original arrangement was for the four employers' Associations to elect twelve representatives between them. The secession of the I.M.E.A. left the six municipal representatives to be elected by a special *ad hoc* committee. But as this was not found to be satisfactory, the National Council has fallen back on the old proposal to place the nomination of members in the hands of the District Councils, apportioning to each District one company and one municipal vacancy. On the Trade Union side, there is, however, satisfaction with the present arrangement and they will therefore be content with twelve representatives, resisting the temptation to expand to twenty-six, as they are quite entitled to do. This will be no disability as the voting on all motions is taken by each side separately and the only advantage of the larger representation is that the employers will have a heavier battery in controversy. This is a questionable asset, especially when the team gets out of hand. The duties of the Chairman will certainly become more onerous if he is to obtain the same work from a much larger body.

Developing the Selling Organisation.

ONLY a month or two ago the chief anxieties of many electricity supply engineers were how to deal with his load and how to satisfy the various demands of would-be consumers. Events of the past few months have changed all that and put in their place the need for much greater attention to cutting down all expenses which cannot be justified. As this is a general tendency ultimately it will be for the good of electricity supply undertakings, but for the moment it may mean a serious reduction in the demand, and a corresponding necessity for inaugurating campaigns so that fresh and paying business may be obtained to keep the plant in economical operation. In other words there is a need for supply authorities to increase their selling activities. A good way of doing this would be to remove the lack of co-operation which now exists in too many cases between the selling organisations of supply authorities and the electrical manufacturers' local representatives. To increase this co-operation it would be mutually advantageous if the electricity supply authorities

kept a record of prospective consumers for electric power requirements and if this record were available for inspection by manufacturers' representatives, together with full particulars as regards charges for current. At the same time there might also be available complete information on the prospective main-laying policy for the guidance of those engaged in the sale of electrical equipment of all kinds. For it cannot be denied that the sale of current and the sale of motors, fittings, and electrical appliances are dependent one on the other, and that the greater the co-operation between the salesmen of both commodities and with the contractors the better the result is likely to be for all concerned.

The "Let Us Alone" Club.

G. A. SALA, the journalist, describes the formation of a club whose principal object was to resist attempts, whether by legislation or otherwise, to curtail the facilities which its members considered necessary to their enjoyment. It is true that the particular restrictions complained of were mainly those imposed on the consumption of alcoholic liquor, but the basic idea might well be applied to the industry of the country and particularly to that part of it concerned with electrical engineering. Some of the disabilities with which we are at present contending are of our own making, others are designedly placed in our way to stop our progress, others, again, are the result of muddled attempts at assistance, these often being the worst of all. But one and all they prevent the free operation of all that ingenuity and enterprise which the industry has at its command. If therefore we could be let alone, to work out our own salvation, a great advance towards improved conditions would result.

The Use of Vegetable Oil as a Power Agent.

A WEEK or two ago we called attention to some results of tests undertaken by a Belgian engineer, M. MATTHOT, into the possibilities of using palm oil as a fuel in internal combustion engines. Some details of a similar series of tests, also carried out in Belgium, are given in a recent issue of "The Chemical Age." In this particular series a Drott two-cycle semi-Diesel engine with an output of 8 to 10 H.P. and running at 500 revs. per min. was employed. This engine was of the ordinary type except that special heating arrangements were fitted to the feed tank in order to keep the palm oil in a perfectly liquid condition. This was necessary as the melting point of this oil is 37 deg. C. and at ordinary temperatures it is therefore viscous or of a semi-solid consistency. To keep the oil liquid the feed tank was divided into a series of compartments separated from each other by a fine mesh metallic screen and was heated both by the circulating water which reached a temperature of about 70 deg. C. and by the exhaust gases. To ensure complete liquefaction at starting a small petrol vapour lamp was also provided. An important point which these tests brought to light was that the low grade non-refined palm oil can be satisfactorily used in spite of the fact that it contains a high percentage of free fatty acids. It is interesting to note that the best results were obtained when a certain amount of water was injected into the combustion chamber. This ensured a complete vapourising of the oil and an efficient mixing of the oil mist with air. The reason seems to have been that the water or the steam formed absorbed burnt gases and facilitated their exhaustion. In this way premature combustion is avoided and complete combustion with a consequent maximum economy of fuel is obtained. It is found necessary to use petrol to start the engine and the usual precautions have to be taken to ensure that no residual palm oil remains in the engine when stopping. We may not be driven to the use of palm oil at any rate in engines for generating power in this country, but it is as well to be prepared.

Electric Traction Problems.

It is distinctly unfortunate that certain polemical questions are more and more tending in all discussions on electric traction to obscure those fundamental problems of an engineering character which must be solved before any real progress can be made. Both in history and fiction King Charles had only one head which was always intruding itself where it was not wanted, but in electric traction he has several. The most apparent of them is one round and large like a turnip. It is a strident query whether electrification should be undertaken at all. Some would like to see this change made, others object to it with natural conservatism, others again would only agree to the conversion under the stress of economic pressure and that pressure is increasing every day. Financial departments naturally view with anxiety the capital outlay which conversion on anything like a large scale would involve. In the engineering departments the less progressive members throw their weight into the same scale-pan by arguing that the mechanical, economic and operating advantages obtainable from electric traction are largely for the future, and that much more might be done than has been done in improving steam working. Sir PHILIP NASH is a prominent member of this band. And even the traffic departments, which perhaps more than all the others have the most to gain from the change, are not without supporters of the policy of continuing as we are with the help of methods whose ingenuity is more conspicuous than their ultimate usefulness. For this state of things there is no immediate remedy. We must look to education to bring about a change. But that education may well be assisted by enthusiasm and careful attention to each step forward on the part of those who support the electrical idea, and especially by electrical engineers themselves.

THE GREAT SYSTEM QUESTION.

Another prominent head whose nose is often to be seen is the great problem of the system to be employed. As we have already pointed out the argument that the railways of this country should be all electrified on one system can be given too much weight, and great harm may be done by too much insistence on this idea. Nevertheless, Sir JOHN ASPINALL has recently announced, we presume semi-officially, that the direct-current third rail system at 1 500 V is to be made the standard for this country, and has added that standardisation of this kind is necessary in order that one electric locomotive may operate the greatest number of miles possible by working a train through, say, from Aberdeen to Dover. For the moment that must be an ideal; and we should not be surprised if it were never anything else. We have been told there is no intention to convert present electrically operated lines to the new standard system, but until that is done standardisation of the kind Sir JOHN ASPINALL desires can be little more than a name, especially with the Brighton line sticking closely to its original love, under the shade of official approval.

On the other hand, we understand from Sir PHILIP NASH that the Ministry of Transport would view unfavourably any scheme for the wholesale conversion of the railways of this country to electric traction. But until that is done through running of the kind suggested by Sir JOHN ASPINALL will not be a practical proposition, if it is then. Again next month the railways are to pass from Government control to private ownership. This may have a profound effect on their policy toward both the broad outlines and the details of electric traction. We are not, therefore, getting on very fast.

THE BEST SYSTEM FOR A PARTICULAR LINE.

We cannot help thinking that it was a mistake to lay down so definite a standard system as has been done by the Ministry of Transport. While it is evident that no system can be the best for all possible types of lines and traffic conditions, it is equally evident that every effort should be made to secure the best system for any particular line and set of traffic conditions. The report of the commission of French engineers on American conditions which we published recently shows at least that finality has not been reached even in a theoretical consideration of this question, and that it would, therefore, be better to preserve an open mind for the time being rather than to make too soon a decision which may prove to be the wrong one.

THE OBJECTS OF ELECTRIFICATION.

Such considerations increase rather than decrease in importance when we remember that the two main objects of any scheme of electrification, at any rate in this country, are to increase the ratio between receipts and expenditure, by increasing the traffic, and to save coal. To enable these objects to be achieved, whatever system is employed, close attention must be paid to details of design and manufacture of the electrical equipment used so that the greatest efficiency may be obtained and the risk of breakdown reduced to a minimum.

THE RIGHT DESIGN IMPORTANT.

There could and should be much fruitful discussion on these subjects, and it is therefore unfortunate that Sir VINCENT RAVEN's opening remarks on the "Mechanical Advantages of Electric Locomotives compared with Steam" at the Engineering Conference last week which would have served as an admirable basis for such consideration should have received so little support from subsequent speakers. For most of those who took part directed their remarks to the question we have outlined above, and but few of them thought it worth while to deal with questions of design, important though these are. The old arguments are being hashed and rehashed. What we want now is something new, for we have yet to decide whether we shall build our motors directly on to the driving axles, drive those axles by reduction gearing, or use connecting and coupling rods for that transmission. We have yet to decide on the best position of the motor so that, as Sir JOHN ASPINALL said, they may be protected from dust and allow easy examination and repair. We have yet to decide as to best methods of lubrications if locomotives are to be used on very long runs. We have yet to consider points in controller design to secure greater simplicity and compactness. We have also to consider questions of motor rating, as indicated by the limitations imposed by the particular work they have to do. On these and on many other matters there is great difference of opinion. And unfortunately it is opinion not based on exhaustive working results with this or that design, but on partial information and on personal predilection. We want, more than anything, reliable data and unbiassed deduction from them.

Here then is subject matter, not for one but for many discussions, problems the elucidation of which will more really help the progress of electric traction than details of relative coal consumption, maintenance and operation costs, and the suitability of electric traction generally. For, with the exception of a small band of reactionaries, we are all agreed on these points. But on the other class of problem there is much ground to be cleared and much hard work to be done before any real advance can be made.

Power Factor Improvement.

AMONG the various problems with which the electricity supply engineer has to deal at the present time power factor occupies a peculiar place midway between questions of a purely commercial and those of a purely technical character. The importance which it undoubtedly possesses in supply economics is of recent growth. For the lagging, or wattless, current has until recently been treated as having all the inevitability of the taxes and, like the taxes, as long as it remained insignificant in value, has been disregarded except for an occasional grumble.

AN ENGINEERING NUISANCE.

Nowadays we have changed all that. A low power factor is known to be an engineering nuisance whose influence not only increases in harmfulness with the increasing developments of electricity supply, but a nuisance which has a most malevolent effect on the balance sheet. For low power factor prevents easy regulation between station and station and between bus bar sections, and, by causing alternators running in parallel to be unequally loaded, leads to a higher steam consumption than would occur in a more perfect electrical world. All these varying factors increase their power for evil at light loads and therefore give rise to high steam consumption and uneconomical working at the least profitable periods of the day. Like the taxes their influence can no longer be viewed with indifference, but must be dealt with without delay by such methods as seem to offer the greatest chance of reducing the resulting ill effects to a minimum.

POWER FACTOR AND FINANCE.

But obviously the question has not only a technical side. The electrical conditions, which we have just mentioned as being brought about by low power factor, mean directly increased costs, and, for that reason, if for no other, are worthy of attention. But they also mean decreased revenue. Or, rather, they mean that individual consumers whose equipment is a reason of the low power factor of the system are not paying for their energy at a rate which bears a true relation to the capital expenditure which the undertaking has had to incur on their behalf. This is a point which is easily reduced to figures. For, as Mr. KAPP pointed out in the recent discussion on this subject at the Engineering Conference, if the cost of the electrical part of a supply system is £15 per kVA a power factor of only 0.8 increases this figure to £18.8. Some arrangement whereby the consumer pays according to his load factor would therefore at first sight seem to be a legitimate, if not a necessary, part of every electricity supply tariff.

PAYMENT BY POWER FACTOR.

Now suggestions have recently been made, and widely approved, that consumers should be made to pay according to their load factor, with a view to bringing tariffs more into line with actual conditions than they often are at present. And since the load factor is not under the consumer's control and the power factor is, at least to a considerable extent, this approval should be extended to methods designed to make the consumer pay according to his power factor. But although there is something to be said for such a policy a better way would be to give the closest attention to ways of making the consumer improve his power factor so that the working of the system may be made more efficient, and complicated and not easily explained tariffs avoided. It must not be forgotten in this connection that the undertaking is itself a consumer and that a great deal can be done to improve low power factors by attention to the design, layout and opera-

tion of the apparatus used in generating stations and substations. The elimination or reduction in the number of induction motors used would be a long step down this path.

A TIMELY DISCUSSION.

The discussion on "Low Power Factor," which took place at the recent Engineering Conference was, therefore, timely, and the remarks of the various speakers form a sound basis for future consideration of this important subject. The discussion may be divided into two parts: A consideration of how the power factor is to be improved, and of how consumers with low power factor who take no steps to improve it can best be penalised for their delinquencies. We regret for many reasons, after Mr. FEDDEN's testimonial to this equipment as an improver of power factor, that the electric furnace is not being more widely used, but even so more might be done in employing synchronous motors for driving all continuously running plant and so at least checking that tendency to a decreasing load factor which is becoming more and more evident. In many cases consumers might well be encouraged to use this equipment instead of induction motors and so assist in improving the load factor of the system without being put to the expense of installing special apparatus. Such a policy however, would not take us very far and it was evident that the general sense of the meeting favoured the introduction of special apparatus on the consumers premises for the definite purpose of improving the power factor.

COMPLICATED EXPLANATIONS.

Both these solutions deal with the problem in a direct way, but attractive as such methods are their ultimate utility in maintaining the power factor at a satisfactory commercial level is a little open to doubt. There is the initial difficulty of deciding who is to install the apparatus. If the undertaking is to do this the cost will be considerable and, important as power factor improvement is, might not be economically justified. To insist on the consumer installing the apparatus would mean a discussion before which the complications of that on the maximum demand would pale into nothingness, while the extra capital expenditure, of whose necessity the consumer would be with difficulty persuaded, would also be a real obstacle to that electrical development of which we are all anxious to reap the full benefits.

REVENUE V. CAPITAL.

On the other hand revenue is much more easy to command than capital. And for this reason the tariff method of improving the power factor seems to offer the greater advantages. The consumer who prefers to install corrective devices and so to reduce his quarterly account in that way is still able to do so, while the undertaking can take full financial advantage of those who do not feel disposed to adopt this course. For the purpose of arranging tariffs on this basis it seems reasonable to adopt 0.8 as a standard power factor and to penalise any consumer who fell below that figure, while improvement above that level could be correspondingly rewarded. Such a policy avoids any technically involved explanations and, with the reservation made above, places the responsibility for the low power factor where it properly belongs, i.e., on the consumer.

REQUIRED, A CURE.

We cannot help feeling, however, that all these methods are palliatives rather than cures, and that, as Mr. ATKINSON truly said, our attention might better be turned to discovering the true cause of the trouble rather than accepting that trouble as inevitable. In our opening sentences we compared power factor with taxes. It seems impossible that we shall ever get rid of the latter, but we hope they will soon be reduced. The same applies to power factor.

Power Supply in Dundee.

Some Landmarks in Progress.

The history of the development of public electricity supply in Dundee, as instituted and carried on under the administration of the Dundee Corporation, for over a quarter of a century has now, as might be expected, registered the usual outstanding points of progress, which are common to most of the early-

creasing demand of private consumers, as well as the extra load caused by the conversion of the tramways, large extensions were made to the plant at Dudhope Crescent-road totalling nearly 1 200-kW capacity. This sufficed for all purposes right up to 1906, when it was realised that serious attention would have to be given to a further extension of the plant, notwithstanding that the generating station had been practically remodelled and the pressure doubled across the outers of the distribution system. This therefore completes the second period in our history and also marks the commencement of the third and most important stage in the development of the Dundee power supply, a highly intensive period of progress which has continued up to the present day.

About the year 1906, in fact, the disadvantages of the site of the generating station in Dudhope Crescent-road became increasingly evident and it was realised that drastic changes would have to be undertaken if any real progress were to be made in the generation and distribution of electricity on a large scale for industrial power purposes. That this was necessary is evident from the statement that Dundee (the third city in Scotland) is the centre of the jute industry in Great Britain, importing roughly about 250 000 tons of jute annually under normal conditions and likewise giving employment to about 40 000 people in about 100 mills and factories with an aggregate horse-power approximating 60 000.

The present population is 189 000 and the area of the city is 6 548 acres. The ship-building yards are amongst the biggest and finest on the east coast of Scotland and give employment to a large portion of the inhabitants.

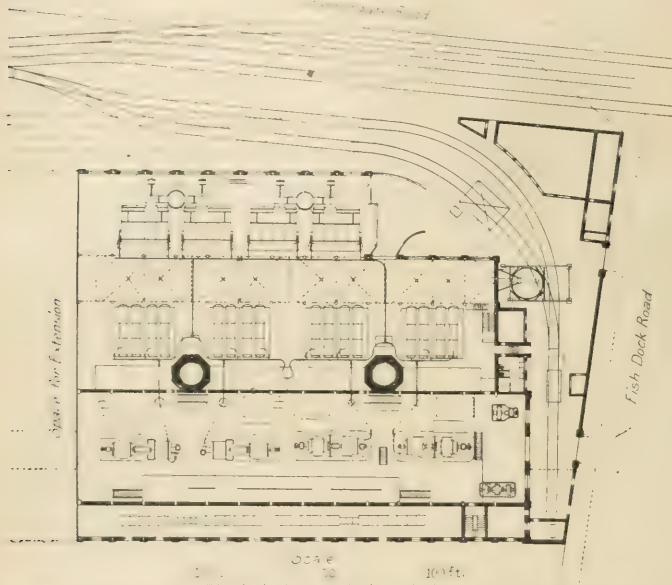


FIG. 1.—PLAN SHOWING GENERAL ARRANGEMENT OF PLANT, ETC., AT CAROLINA PORT GENERATING STATION.

established electricity supply agencies. During the period mentioned the history of electricity supply might, so far as Dundee is concerned, be conveniently split up into three stages, each of which furnishes an important landmark. These three stages can be most simply recorded by a short description of the development and progress of electricity supply in Dundee since its inception in March, 1893, but, naturally, it is principally with the third period that this article deals.

EARLY HISTORY.

Dundee was one of the first cities to take up the generation and distribution of electricity for public purposes, supply being commenced in 1893 from a generating station built in Dudhope Crescent-road, near the centre of the city. The area of distribution was restricted to the central portion of about 320 acres, the population of the town at that time being roughly 155 000 inhabitants. The supply was on the three-wire direct-current system, with 200 V across the outers, the feeders being bare copper strip laid in conduits. The area of supply finally included the whole of the city by the passing of an Act in 1897, and slow and steady progress was made right up to the year 1900 (the end of the first period), at which time electric traction was beginning to develop throughout the country. The Dundee Corporation in that year took over the horse and steam tramways and almost immediately started and gradually completed the electrification of the whole of their system. To meet the in-

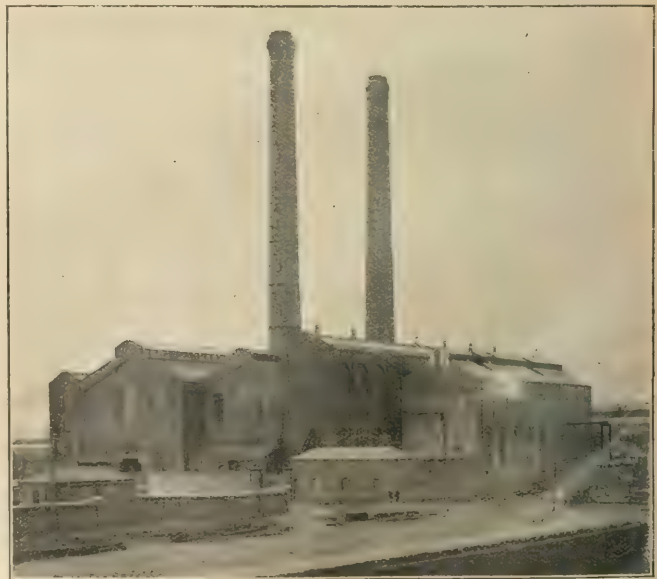


FIG. 2.—EXTERIOR VIEW OF CAROLINA PORT STATION, DUNDEE.

CAROLINA PORT.

After careful consideration of reports, designs and estimates the Dundee Corporation decided to proceed with the erection of an up-

to-date generating station adjacent to the River Tay, supplying e.h.t. three-phase alternating current at 6 600 V, 50 cycles. This was converted in rotary sub-stations to the direct-current system,

but was supplied to large power consumers direct. The whole work was placed so far as the responsibility for the design and execution was concerned in the hands of Mr. H. Richardson, general manager and engineer to the Dundee Corporation, and in December, 1907, the building of the station was started the first portion being completed and running by July, 1909. The main generating plant consisted of two turbo-alternators, each having a nominal capacity of 2 500 kW. This was considered at that time to be ample for many years to come, but, as events turned out, it proved to be totally inadequate within the short period of five years, when a further extension in plant, including boilers and buildings, was completed by the addition of a third turbo-alternator having a nominal capacity of 5 000 kW, to be followed shortly afterwards by a similar extension of another 5 000 kW. Two years ago it was again found necessary to let contracts for the replacement of the first two small sets of 2 500 kW, by one of 5 000 kW, and to arrange for a further extension of the boiler plant. This work is at present in hand.

General progress since 1908 can be judged simply by stating that the output for that year was about 5 000 000 units, with a maximum demand of 3 000 kW, and if conditions had been normal throughout the financial year just ended (1921), the output would easily have been 30 000 000 units, the maximum demand on the system actually being 12 500 kW.

SUPPLY CONDITIONS IN DUNDEE.

Coming now to a detailed description of power supply in Dundee, the main generating station is situated at Carolina Port, about $1\frac{1}{2}$ miles from the centre of the city and 560 ft. from the River Tay. The site occupies an area of about 3 acres and the principal main buildings average 210 ft. in length by 170 ft. wide, the recent addition on the north side for extra boiler plant being alone 135 ft. long and 36 ft. wide. A site plan is given in Fig. 1. An exterior view of the station is given in Fig. 2.

The buildings generally consist of a steel framework filled in with brickwork and a temporary corrugated-iron screen wall forms the principal west elevation to allow of extension. The roof is of wood and slates on steel principals and has large roof lights running the whole length of the buildings, the general arrangement being as shown in Fig. 3.

COAL HANDLING.

A railway branch line is brought on to the site at the average level of the ground. This line passes over a 20-ton weighbridge, where the wagons are weighed and then led through a large ring tippler situated over a receiving hopper. In the tippler the wagons, after being clamped down, are completely turned over, coming back to the

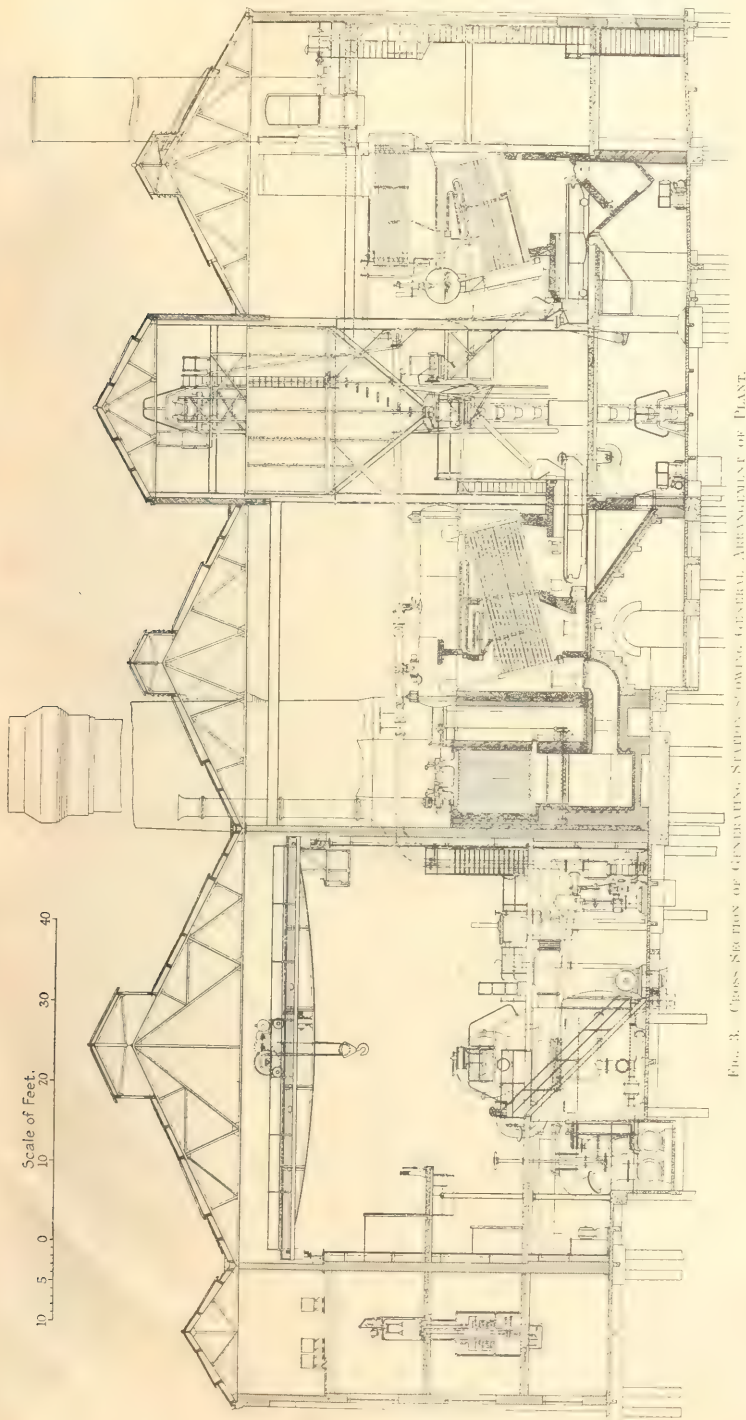


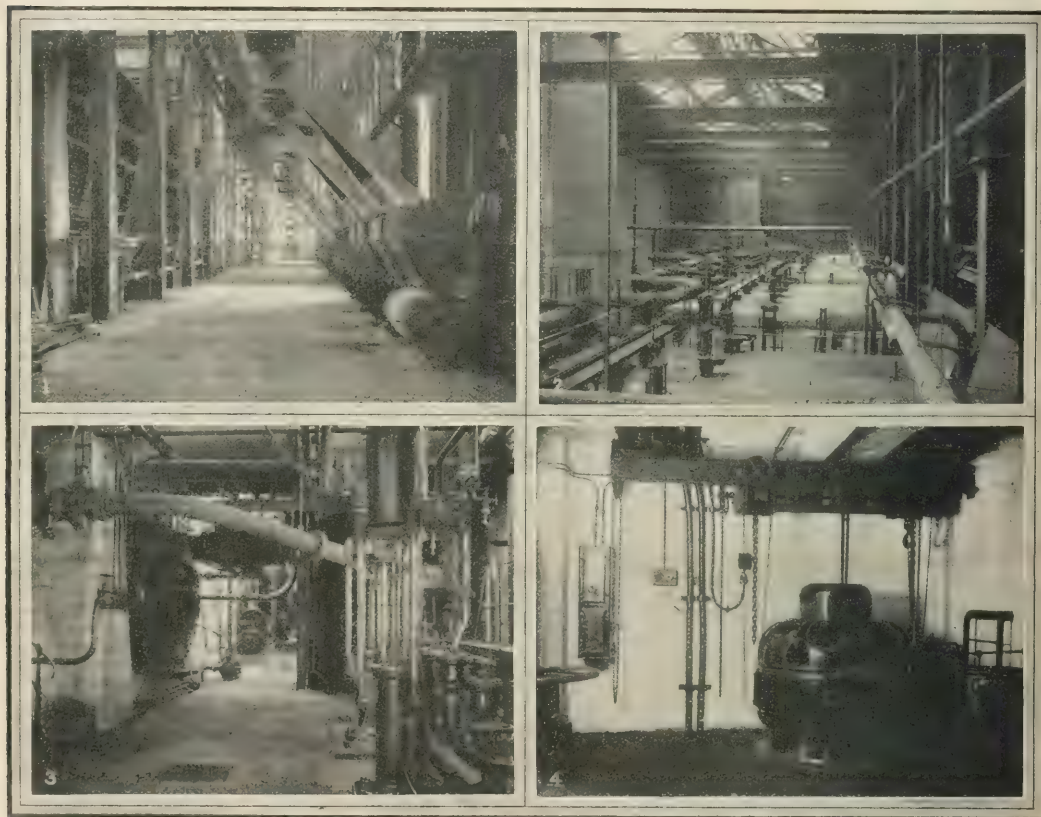
FIG. 3. CROSS SECTION OF GENERATING STATION SHOWING GENERAL ARRANGEMENT OF PLANT.

original position. The tippler is driven by an electric motor of 4 H.P. The wagons are handled by an electric locomotive taking its current from overhead wires by two trolley arms. It is fitted with two motors and is capable of pulling a load of 20 tons up an incline of 1 in 60 at $6\frac{1}{2}$ miles per hour. The receiving hopper into which the coal is dumped has a capacity of 18 tons. A tray conveyor carries the coal a distance of 45 ft. from this hopper to the main gravity bucket conveyor, which lifts it to the overhead bunkers. The tray conveyor discharges the coal into a rotary filler which feeds the buckets of the main conveyor while they are in motion. The gravity bucket conveyor is about 500 ft. long and has a vertical lift of 62 ft. This conveyor is driven by a 6-H.P. motor. The coal is deposited in the bunkers by means of tipplers, for which there are two to each bunker. The overhead bunkers have a capacity of about 1000 tons and are situated above the firing floor. The

ashes from both the old and new boilers. The ash breakers (two in number) run on light railway tracks, one serving each line of boilers, each being driven by a 7 H.P. motor, and will be used to crush the ashes before entering the suction pipes, which are 10½ in. in diameter. These pipes are of cast iron 1½ in. thick, and the joints are so arranged that individual pipes can be turned round in case the wear takes place faster in one side than another. The ashes are drawn into the top of the ash receiving hopper, in which are fitted sprays to prevent as far as possible the dust being drawn into the exhaustor. The exhaustor is a Sturtevant high-pressure blower, situated in the basement, and is driven by a 70 H.P. motor. The ashes may be either delivered into railway wagons or carts.

BOILER HOUSE.

At present there are eight Babcock & Wilcox water-tube boilers of the land type, each having a heating surface of 6 182 sq. ft., and



1. OLD AND NEW BOILER HOUSE.

3. LOWER FLOOR OF ENGINE ROOM, SHOWING FEED PUMPS.

FIG. 4.

2. TOPS OF BOILERS SHOWING STEAM PIPING.

4. NO. 2 CIRCULATING PUMP ROOM.

coal passes through valves at the bottoms of the bunkers into movable boxes run on rails suspended from the bunkers, but the shoots for the stokers are fixed. Coal may be taken from different bunkers to different stokers by this means. Extra mouthpieces will be fitted to the existing bunkers to feed a separate runway of boxes for the new boilers.

ASH HANDLING PLANT.

With the first eight boilers installed the process of handling the ashes was as follows: The ashes were discharged through dumping doors at the back of the chain grate to the ash pits underneath, from which they were allowed to fall to the ash basement floor. After this they were cooled and shovelled into main conveyor, to be taken to the ash bunker. The ashes could be discharged through shoots either into railway wagons or carts.

With the new north extension to the boiler house, pneumatic ash handling plant is being constructed, which will deal with the

rated to evaporate 20 000 lb. of water per hour with a working pressure of 180 lb. per sq. in. The boilers are each fitted with a Babcock & Wilcox superheater of 1 389 sq. ft. heating surface, which gives a superheat of about 150°F. There are two chain grate stokers to each boiler, having a total grate area of 120 sq. ft., and driven by means of chains from a shaft in the ash basement. The stokers of the last four boilers installed were fitted with drop links. The driving motors for the chain grate stokers are situated in the ash basement.

Four other Babcock & Wilcox water-tube [marine type boilers are at present under erection, each having a heating surface of 6 121 sq. ft., and rated to evaporate 38 000 lb. of water per hour with a working pressure of 180 lb. per sq. in. gauge, though designed for 200 lb. per sq. in. These boilers are each fitted with superheaters of 1 510 sq. ft. heating surface, which gives a superheat of about 150°F. at normal load. There are two chain grate stokers

to each boiler of 224 sq. ft. total area for balanced draught. The stokers are driven by means of chains from a shaft in the ash basement. The driving motors of the stokers on the north portion are hung from the ash basement ceiling, and drive through reduction gear. Each pair of boilers forms a complete and independent unit, with its own fans, stoker motors, steam piping, &c. Views in the boiler house and of the overhead piping are given in Fig. 4.

FLUES AND ECONOMISERS.

So far as the first eight land-type boilers are concerned, special attention has been given to making the flues as short as practicable, with easy curves and rounded corners. To facilitate the cleaning of the flues, sliding doors have been provided in the bottom of the

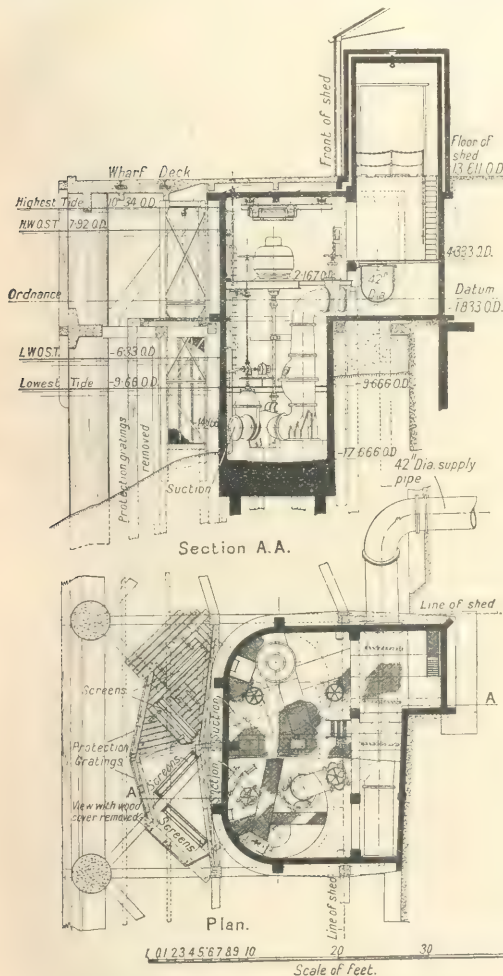


FIG. 5.—PLAN AND SECTION OF NO. 2 PUMP ROOM.

main flues, so that the soot may be dropped into barrows at the ash basement level and taken to the main conveyor. The economisers consist of 360 tubes each, one for each battery of two boilers, and erected above the main flues, so that the gases travel upwards from the flues through the economisers to the chimney. For the four new boilers at present nearing completion, superposed economisers of the latest "Tri" tube type, with cast-iron tubes, are being installed. There are 189 tubes in each economiser, having a total surface of 3 175 sq. ft.

There are two brick chimneys, 9 ft. internal diameter and 200 ft. high above firing floor level. The chimneys for the north extension, two in number, will be of steel, 76 ft. above firing floor level, there being one chimney for each battery of two boilers.

FEED PUMPS.

There are four Weir reciprocating type (see Fig. 4) feed pumps, situated on the engine room lower floor in front of the brick chimneys. The first two pumps installed are capable of delivering 50 000 lb. of water per hour against the boiler pressure of 180 lb. per square inch. The other two have a capacity of 120 000 lb. of water per hour. Besides the ordinary stop valve at the pump, there is a valve with an extended spindle passing through the chimney to the boiler house, with which the fireman can regulate the speed of the pump. Above the wheel on this spindle in the boiler house is a gauge showing the pressure of the feed water, and on this gauge the strokes of the pump can be plainly observed.

Two other Weir steam-driven turbine feed pumps, with a capacity of 200 000 lb. of water per hour, are being placed on the engine room lower floor between the existing pairs of reciprocating feed pumps for the north extension of the boiler house. The feed to these boilers will be regulated by Crosby automatic regulators.

GENERATING PLANT.

The main steam plant consists of two Willans disc and drum steam turbines (see Fig. 6), each having a nominal capacity of 5 000 kW, at 1 500 revs. per min., but each capable of dealing with an overload of 7 500 kW for half-an-hour and two Zoelly pure impulse turbines, made by the English Electric Company, Ltd., each having a normal capacity of 5 000 kW, in accordance with E.S.C. rating. The two original 2 000 kW Willans-Parsons turbines have been removed to make room for the above sets, the first of which has been completed. The speed of the new sets is 3 000 revs. per min., and it has been possible to utilise the bulk of the original foundations.

Immediately underneath each turbine is a surface condenser, which, in the case of the Willans disc and drum turbines, is of 9 200 sq. ft. cooling surface in the main condenser, and 255 sq. ft. in the auxiliary condenser, both sets being fitted with vacuum augmentors. Each of these condensers is provided with a three-throw Edwards air pump, driven by an electric motor, having on the end of the air pump crank shaft a force pump, which lifts the discharge to the Lea recorder on the upper engine-room floor, where the steam used per hour is continuously measured before being allowed to gravitate to the hot well. The cooling surface of the two condensers fitted with the Zoelly turbines is 9 500 sq. ft., and they are provided with air extraction plant consisting of Mirless-Watson steam jet multi ejectors, fitted with rotary water extraction pumps, driven by 6½ B.H.P. motors. Lea recorders for the discharge are also fitted, as in the case of the other two.

CIRCULATING WATER ARRANGEMENTS.

The circulating water for the condensers is taken from the River Tay, and two pump rooms for this purpose have been sunk at the waterside, constructed of reinforced concrete. The first pump room laid down is 14 ft. internal diameter and 27 ft. deep from the ground level to the bottom floor. On the river side of the pump room are two settling tanks, the change in the velocity of the water precipitating the mud which may have been carried through the gratings on the inlets. The settling tanks have removable covers for cleaning. The pump room is equipped with two 16 in. diameter vertical spindle centrifugal pumps, situated on the bottom floor below the lowest water level, and driven direct by two vertical direct-current motors of 63 B.H.P., installed at ground level. The motors are started and stopped from the engine room, and have a wide range of speed regulation. The main circulating water pipes from this pump room to the engine room, and the discharge pipe into the river, are 30 in. in diameter, and rest on a reinforced concrete raft supported by reinforced concrete piles.

The other pump room (see Figs. 4 and 5) consists essentially of two reinforced concrete cylinders extending 31 ft. deep below wharf level, and 11 ft. 2 in. in diameter, which are united into one chamber at the top, on the floor of which the driving motors are placed. Many difficult problems had to be faced in the design and construction of this pump room, owing to the available space being limited by the existing concrete piles and braces of the river wharf, in many cases the clearances being only a few inches. One of the great advantages of the situation of this pump room, however, was the fact that it lay adjacent to the deep water channel of the river, immediately in front of the wharf, which has to be kept constantly dredged by the Harbour Authorities to allow of the large jute cargo boats from Calcutta discharging their cargoes. One 27 in. pump is installed in each cylinder. This is also of the vertical spindle centrifugal type, and is rated to deliver 12 000 gallons per minute against a total head of 35 ft. The pumps are driven by three-phase slip-ring motors of 240 h.p. each. The pumps are below water at all tides, the maximum rise and fall of the tide in the river being nearly 20 ft. In order that the pumps could be started and stopped from the engine room, it was decided to install contactor starting gear, and this was housed in a special apartment on the ground level, owing to the limited

space available and the prevalence of damp in the pump room itself. The contactor gear has been arranged so that full-load speed and a reduced speed at light loads can be obtained at will by means of

42 in. discharge pipe has not yet been constructed, the existing 30 in. discharge pipe being still used. Owing to the extensive rise and fall of the tide, and the situation being exposed to storms, the

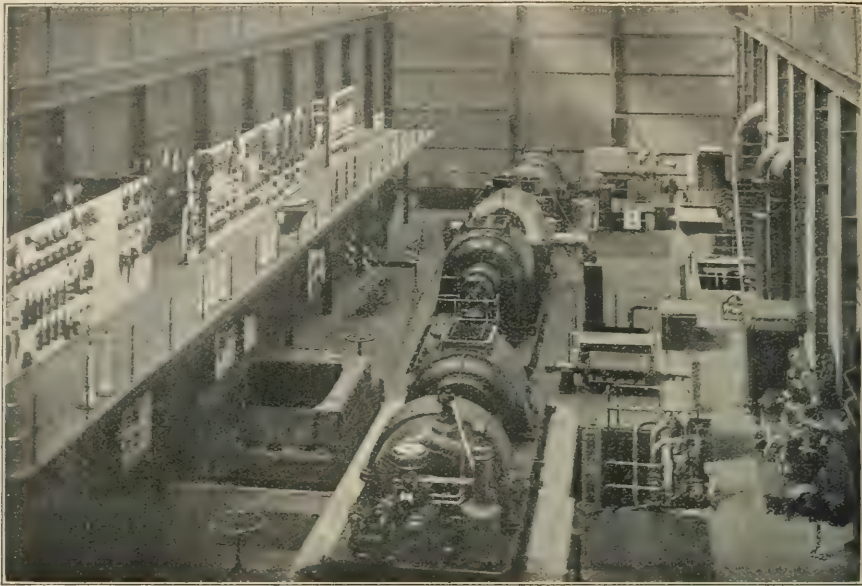


FIG. 6.—GENERAL VIEW OF ENGINE ROOM.

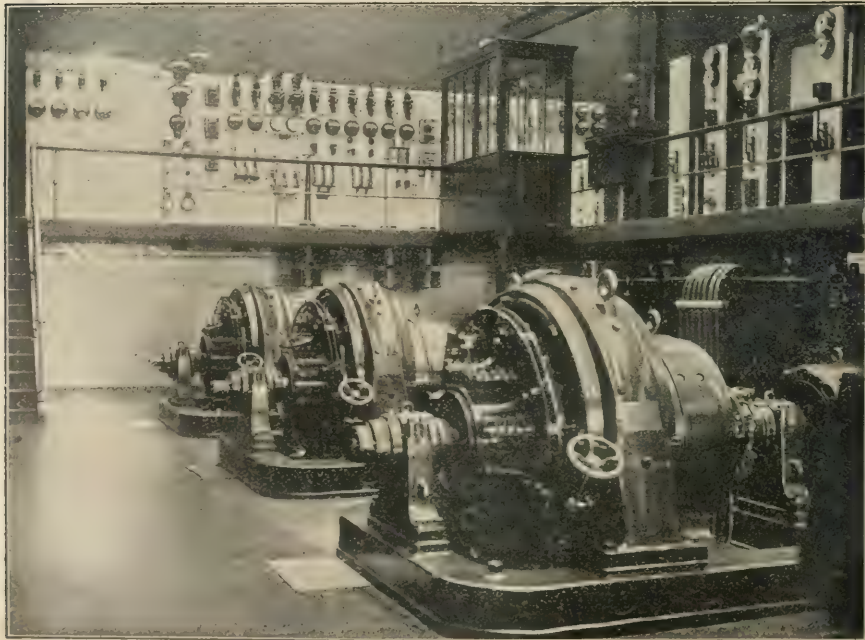


FIG. 7.—INTERIOR OF CLEPINGTON SUB-STATION.

rotor resistance. The main circulating pipe from this pump room is 42 in. in diameter, and is of cast iron, resting on a reinforced concrete raft supported by reinforced concrete piles. The corresponding

screening plant was made simple and of heavy construction, with plain screens of perforated metal, arranged to be drawn up by hand when necessary.

GENERATORS.

There are four main generators, each giving 5 000 kW at 0.8 power-factor, three-phase at 50 p.e.r.i-ods and 6 600 V, two running at 1 500 revs. per min., and the other two at 3 000 revs. per min., all by the English Electric Company. Ventilation in the case of two of the machines is obtained by external fans driven by 30 B.H.P. motors, while with the other two, recently installed ventilating fans are fitted on the rotors of the machines. There are two auxiliary direct-current generators, coupled to two Willans central valve type engines, used as a stand-by for driving the works power direct-current system. A small booster situated on the upper engine room floor consists of a 23 B.H.P. motor and a 15 kW generator used for charging the battery. There are two motor-generators situated on the lower engine-room floor. One is a single-ended machine, consisting of a three-phase 6 600 V motor, coupled direct to a 300 kW direct-current generator, generating at 400 to 460 V. The other is a double-ended machine, consisting of a three-phase motor in the centre, driving two direct-current generators of 150 kW, generating at 200 to 230 V. These motor-generators are used for feeding the district round the station and for supplying the works motors.

A battery situated on the fourth floor of the switch house, consists of 102 Tudor cells in lead-lined wood boxes, supported on glass oil insulators. Its purpose is to operate the oil switches, and to act as a stand-by for works lighting and auxiliary plant.

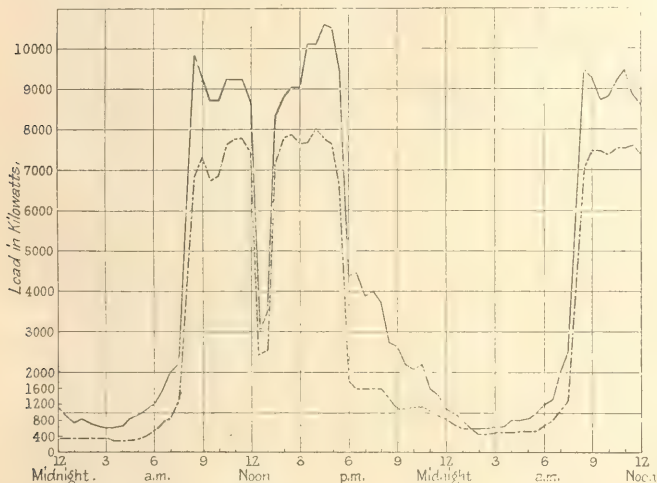


FIG. 8.—MAXIMUM DAILY LOAD CURVE AND MINIMUM DAILY LOAD CURVE AT CAROLINA PORT B.H.T. GENERATING STATION, FOLLOWING ON WITH SUCCEEDING 12-HOURS LOAD CURVE FOR AN ORDINARY DAY IN EACH CASE.

SWITCHGEAR.

The extra-high-tension switchgear is contained in a separate chamber, and occupies three floors. The ground floor is occupied by the cable-dividing boxes and isolating switches. The 'bus bars are on the first floor, and the oil switches on the second, so as to be free and easily accessible. The whole of the extra high-tension switchgear is contained in moulded concrete cells, no brickwork of any kind being used. The 'bus bars are in duplicate, and the two sets can be paralleled through an oil switch. The oil switches have two breaks per pole, and each of the three phases is contained in a separate cell. The opening and closing of the switch is effected by the release of powerful springs. The mechanism is so arranged that, after the switch is either opened or closed, the motor compresses the spring ready for the next operation.

The whole of the switchgear was supplied by the British Thomson-Houston Company. The alternating-current control boards and the direct-current main boards are situated on a gallery 11 ft. above engine room upper floor level. The boards are of white marble. On the alternating-current control board, indicating lamps show whether the oil switches are in or out. Synchroscopes with indicating lamps and frequency indicators are mounted on swing panels at each end of the board in full view of the operator. Triple pole time limit overload relays are used on the feeder and motor generator panels. A T.ril regulator is fitted on each generator panel, and the generators are also fitted with balanced protective gear of

the British Thomson-Houston type. Field suppression switches have been fitted to the last two machines. Special attention has been given to the earthing of the framework throughout in a very substantial manner.

All extensions to the switchgear have been made on the lines of the original scheme, with small improvements which have been suggested by experience.

SUB-STATIONS.

There are seven sub-stations besides the part of the main generating station allotted to the sub-station machinery. These are situated at Clepington, Lochee, Dudhope, Walton, Docks, Broughty Ferry and Downfield. The Dudhope sub-station is part of the old generating station, altered to suit circumstances. The buildings are plain, and lighted from the roof. In the case of Clepington (Fig. 7) and Lochee, the transformers and rotary converters are on the ground floor, while the high and low-tension switchgear is situated on a gallery 7 ft. 8 in. above the floor level. The extra-high-tension switchgear is in similar moulded concrete cells to the switchgear of the main station, but the oil switches are mechanically operated. This latter also applies to the Dudhope sub-station. The bus bars are so arranged that various sections may be separated if desired. In the Clepington sub-station there are four rotary converters, supplied by the British Westinghouse, now the Metropolitan-Vickers Electric Company, Ltd., each of 550 kW capacity. All these machines are booster controlled, one being arranged for self-synchronising. The machines are capable of giving any voltage from 400 to 550 V on the direct-current side and are each fitted with double throw-over switches so that they can be either shunt-wound machines for lighting or compound-wound machines for traction.

At Lochee there are two 250 kW machines, booster controlled, 400 to 550 V on the direct-current side, and at the Docks two 750 kW reactance controlled, self-synchronising machines, 400 to 440 V on the direct-current side, also at Walton two 500 kW booster-controlled machines, with tapings on the transformer to give 400 to 440 V, and 500 to 550 V on the direct-current side. All the machines at these sub-stations were supplied by the British Westinghouse Company, now the Metropolitan-Vickers Electric Company, Ltd.

The extra-high-tension switchgear for Lochee is similar to that described for Clepington, while the switchgear at Walton and Docks sub-stations is of the truck, draw-out, ironclad type, supplied by Messrs. The British Thomson-Houston Company, Ltd. At Dudhope there are three 750 kW rotary converters, reactance controlled, 400 to 550 V on the direct-current side, supplied by Messrs. The British Thomson-Houston Company, Ltd., while at Broughty Ferry sub-station there is one rotary converter, 300 kW capacity, 400 to 440 V on the direct-current side by the British Westinghouse Company, and one 300 kW "La Cour" motor converter, by Messrs. Bruce, Peebles & Company, with a boosting transformer to give 400 to 440 V, or 500 to 550 V on the direct-current side.

DISTRIBUTION.

The extra-high-tension cables are three-core, paper-insulated, lead-covered, double steel armoured, and jute protected cables, with a Board of Trade earthing strip below the lead, and insulated from it by a strip of paper. At present from the generating station there are 20 extra-high-tension feeders to the various converting sub-stations and consumers' sub-stations of from 0.15 to 0.1 sq. in. sectional area, with a total mileage of 44 miles. Special precautions were taken where extra-high-tension cables cross the local railway lines. The cables are laid direct in the ground at an average depth of 3 ft. 6 in. The joints are of the usual extra-high-tension type, each phase being stepped. The Board of Trade strip, lead and armour are electrically continuous throughout. The joints when completed were trenched and run solid in bitumen.

There are at present 24 static sub-stations on consumers' premises which are supplied at about 6 300-V, 50-periods, three-phase alternating current, which is transformed down to the voltage required on the consumers' side, generally 440 V. The aggregate in horsepower connected through these sub-stations is approximately 9 000 h.p. in alternating-current motors.

Referring to Fig. 8 the output shown for the year is only about half of what it is expected to be as soon as the trade in Dundee

(which has recently been in a very depressed condition) resumes its normal state, as many new consumers have been added during the lull.

As soon as the contemplated extensions are underway, whether the supply be from the proposed Hydro-Electric Scheme in the adjacent Highlands, or from new steam plant, the demand is expected, in a few years, to reach the figure of between 30 000 and 40 000 kW.

In conclusion, we should like to thank Major H. Richardson, O.B.E., M.C., general manager of the Dundee Corporation electricity department, for giving us this opportunity of describing the development of an interesting supply system. In the ordinary course of events members of the Incorporated Municipal Electrical Association would have been able to visit the Carolina Port station during the Dundee Convention, but we hope that this article will, in some measure, take the place of a personal inspection.

Zig-Zag Leakage.

By LAURENCE H. A. GARR, M.Sc.Tech., M.I.E.E.

In order to calculate the zigzag leakage in an induction motor it is necessary to determine the magnetomotive force acting at any instant on each element of the path from stator to rotor and *vice versa*, as well as the permeance of that path. The magnetomotive force can quite easily be calculated if the stator and rotor conductors be replaced by an equivalent solenoid (Fig. 1). For convenience in fixing ideas the rotor will, for the moment, be imagined to have more slots than the stator. A rotor tooth such as *A* in Fig. 1, exactly opposite a stator tooth, will have no magnetomotive force acting between it and the stator. As the tooth travels along, however, the position of the turns of the imaginary equivalent solenoid will change, and in effect turns will move from slot to slot so as to link the tooth and thus produce a magnetomotive force between the rotor tooth and the stator tooth or teeth which happen to be opposite.

When a rotor tooth is exactly opposite a stator slot, as *B* in Fig. 1, some turns will be linking the tooth one way and some the reverse way, so that there will be flux both entering and leaving that particular tooth. The cycle will not be completed until the rotor tooth has moved a full stator slot pitch and is again carrying no flux.

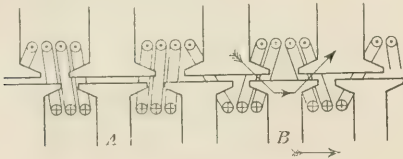


FIG. 1.

Considering the turns linking the left-hand side of the tooth, if x be the movement of the rotor tooth from zero position, that is, opposite a stator tooth, then as the tooth moves to p_2 , that is, a rotor slot pitch, the ampere-turns M will increase from zero in the ratio x/p_1 where p_1 is the stator slot pitch. After the tooth has arrived at p_2 , and to the close of the cycle, the ampere-turns remain constant at the value p_2 in terms of the stator ampere-wires per slot. If λ_x be the instantaneous permeance between the rotor tooth and stator tooth considered, then the instantaneous flux in some units is $M\lambda_x$.

It is unnecessary to trace where this flux crosses back again between stator and rotor, since even if the flux does not recross or zigzag back across the air-gap at once, yet under the next or further pole of opposite sign teeth are passing through the same changes which, with the number of slots in use, average up to about the same total permeance at any instant. This flux, however, does not link with all the turns of the equivalent solenoid, the proportion of total turns per rotor tooth cut clearly being x/p_2 up to $x=p_2$, and unity beyond that value. This ratio may be denoted by γ .

EFFECTIVE LINKAGES.

The value of the effective linkages is then given by the average value of $\gamma M\lambda_x$.

An exactly similar cycle is taking place (though in the reverse sequence) with respect to the turns crossing to the right-hand side of the tooth.

Hence the total effective linkages per stator ampere-wire

per slot, which is, owing to the units chosen for flux, equal to the permeance λ , is equal to twice the average value of $\gamma M\lambda_x$ taken between the limits $x=0$ and $x=p_1$.

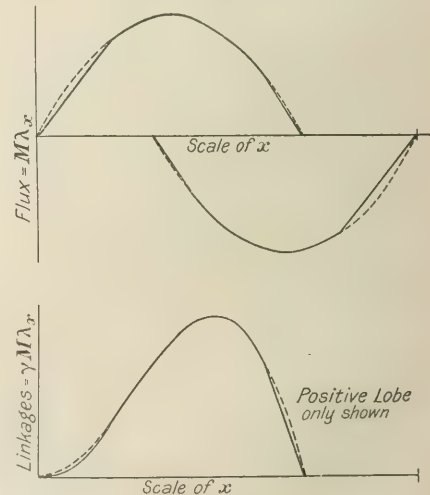
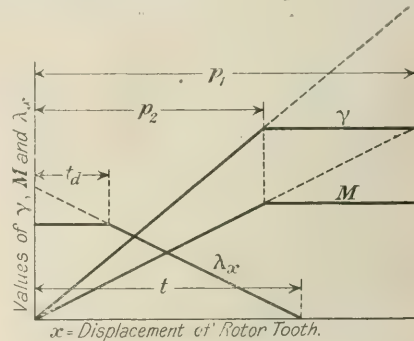


FIG. 2.

Definition of symbols:—

M = Magnetomotive force across air-gap (instantaneous) in terms of stator ampere-wires per slot.

λ_x = Instantaneous permeance per centimeter length of core.

γ = Proportion of conductors linking with the leakage flux.

δ = Air-gap.

p_1 = Stator slot pitch.

p_2 = Rotor slot pitch.

l_1 = Stator tooth breadth, measured at air-gap.

l_2 = Rotor tooth breadth, measured at air-gap.

$t = (l_1 + l_2)/2$ = Mean of stator and rotor tooth breadths.

t_d = Half difference of stator and rotor tooth breadths,

$= (l_1 - l_2)/2$ where $l_1 > l_2$.

$= (l_2 - l_1)/2$ where $l_2 > l_1$.

λ = Average permeance per centimeter of core per stator ampere-wire per slot.

There are two main cases to be considered, each with two subdivisions.

Case I., where $t > p_2$, and $t_1 > t_2$.

Case Ia., where $t > p_2$, and $t_2 > t_1$.

Case II., where $p_2 > t$, and $t_1 > t_2$.

Case IIa., where $p_2 > t$, and $t_2 > t_1$.

The curves for M , λ_x , γ , flux and linkages are shown in Fig. 2 for a typical example of Case I. The following expressions hold good for all the cases considered:—

From $x=0$ to $x=p_2$, $M=x/p_1$ and $\gamma=x/p_2$.

From $x=p_2$ to $x=p_1$, $M=p_2/p_1$, and $\gamma=1.0$.

Above $x=t$, λ is zero, so that $x=t$ is the upper limit of integration in every case.

Case I.

Here $t > p_2$, $t_1 > t_2$, $t_d = (t_1 - t_2)/2$.

From $x=0$ to $x=t_d$, $\lambda = t_2/\delta$.

From $x=t_d$ to $x=t$, $\lambda = (t-x)/\delta$.

$$\begin{aligned}\lambda &= \frac{2}{\delta p_1} \left\{ \int_0^{t_d} \frac{x^2 t_2}{p_1 p_2} dx + \int_{t_d}^t \frac{x^2}{p_1 p_2} (t-x) dx + \int_t^{p_2} \frac{p_2}{p_1} (t-x) dx \right\} \\ &= \frac{2}{\delta p_1} \left\{ \left[\frac{x^3 t_2}{3 p_1 p_2} \right]_0^{t_d} + \left[\frac{t x^3}{3 p_1 p_2} - \frac{x^4}{4 p_1 p_2} \right]_{t_d}^t + \frac{p_2}{p_1} \left[-\frac{(t-x)^2}{2} \right]_t^{p_2} \right\} \\ &= \frac{2}{\delta p_1} \left\{ \frac{t_d^3 t_2}{3 p_1 p_2} - \frac{t p_d^3}{3 p_1 p_2} - \frac{t_d^4}{4 p_1 p_2} - \frac{(p_2^4 - t_d^4)}{4 p_1 p_2} + \frac{p_2}{p_1} \frac{(t-p_2)^2}{2} \right\},\end{aligned}$$

and since $t_d^3 (t_2 - t) = -t_d^4$

$$\lambda = \frac{2}{\delta p_1} \left\{ \frac{(t p_2^3 - t_d^4)}{3 p_1 p_2} - \frac{(p_2^4 - t_d^4)}{4 p_1 p_2} + \frac{p_2}{p_1} \frac{(t-p_2)^2}{2} \right\}.$$

Case Ia.

The original expression for λ is exactly the same except that t_2 is replaced by t_1 , and since in this case $t_d = (t_2 - t_1)/2$, the expression $t_d^3 (t_1 - t)$ becomes $-t_d^4$ as before, so that the solution for this case is identical with that for Case I.

Case II.

Here $p_2 > t$ and $t_1 > t_2$, $t_d = (t_1 - t_2)/2$.

The expression for λ is the same as for Case I., except that the upper limit of the second integral is now " t " and the third integral disappears.

$$\begin{aligned}\lambda &= \frac{2}{\delta p_1} \left\{ \int_0^{t_d} \frac{x^2 t_2}{p_1 p_2} dx + \int_{t_d}^t \frac{x^2}{p_1 p_2} (t-x) dx \right\} \\ &= \frac{2}{\delta p_1} \left\{ \left[\frac{t_2 x^3}{3 p_1 p_2} \right]_0^{t_d} + \left[\frac{t x^3}{3 p_1 p_2} - \frac{x^4}{4 p_1 p_2} \right]_{t_d}^t \right\} \\ &= \frac{2}{\delta p_1} \left\{ \frac{t_2 t_d^3}{3 p_1 p_2} + \frac{t^4}{3 p_1 p_2} - \frac{t t_d^3}{3 p_1 p_2} - \frac{(t^4 - t_d^4)}{4 p_1 p_2} \right\},\end{aligned}$$

and since $t_d^3 (t_2 - t) = -t_d^4$

$$\begin{aligned}\lambda &= \frac{2}{\delta p_1} \left\{ \frac{(t^4 - t_d^4)}{3 p_1 p_2} - \frac{(t^4 - t_d^4)}{4 p_1 p_2} \right\} \\ &= \frac{(t^4 - t_d^4)}{6 \delta p_1^2 p_2}.\end{aligned}$$

Case IIa.

Just as in Case Ia., the effect of replacing t_2 by t_1 is cancelled out by rewriting t_d in the form $(t_2 - t_1)/2$ so that the solution for this case is the same as that for Case II.

If Fig. 2 be examined it will be seen that the resulting curve of $\gamma M \lambda_x$ is practically identical with the dotted curve obtained by taking the three straight line laws throughout, that is

$$\gamma = x/p_2, M = x/p_1, \text{ and } \lambda_x = (t-x)/\delta.$$

Hence to a close degree of accuracy, the simpler form may be written

$$\begin{aligned}\lambda &= \frac{2}{\delta p_1} \int_0^t \frac{x^2 (t-x)}{p_1 p_2} dx \\ &= \frac{2}{\delta p_1} \left[\frac{t x^3}{3 p_1 p_2} - \frac{x^4}{4 p_1 p_2} \right]_0^t \\ &= \frac{t^4}{6 \delta p_1^2 p_2}.\end{aligned}$$

This form, being simpler to deal with, and giving results within 2 or 3 per cent. of the correct value, is much more convenient, and is the form recommended for practical use.

Where the rotor has fewer slots than the stator, it is clear that the same expression may be used with subscripts reversed, to give the permeance λ_2 referred to a rotor slot.

The permeance λ_1 per stator ampere-wire per slot equals λ_2 multiplied by the ratio stator slots/rotor slots, or

$$\lambda_1 = p_2 \lambda_2 / p_1.$$

Hence the exact form for Case I., becomes

$$\lambda = \frac{2}{\delta p_1^2} \left\{ \frac{(t p_1^3 - t_d^4)}{3 p_1 p_2} - \frac{(p_1^4 - t_d^4)}{4 p_1 p_2} - \frac{p_1}{p_2} \frac{(t-p_1)^2}{2} \right\},$$

and for Case II.

$$\lambda = \frac{(t^4 - t_d^4)}{6 \delta p_1^2 p_2},$$

while the approximate, or practical, form

$$\lambda = \frac{t^4}{6 \delta p_1^2 p_2}$$

remains unaltered, whether the rotor slots are more or less in number than the stator slots.

Tramways and Road Construction.

At the Conference of the Institution of Municipal and County Engineers, which was held at Birmingham last week, Mr. Herbert H. Humphries (Birmingham City engineer and surveyor) read a Paper on "The Extension and Co-ordination of arterial road schemes in the Midlands." He emphasised the urgent necessity of some definite scheme of co-operation between local authorities for areas having interests more or less common to all, in regard to the extension and co-ordination of arterial road schemes as well as general town-planning and other matters of importance such as transport, water supply, provision of light and power, &c.

In considering the improvement of arterial roads long-sighted views were necessary, and the planning must be undertaken upon generous lines if satisfactory provision was to be made, not only for the vastly increased traffic which was coming, but also for that traffic to travel safely at very much higher speeds than at present. In Birmingham the following widths were adopted:—Main arterial roads (including "radial" and "ring" roads) in the suburban areas, 120 ft.; in the more built-up areas, 110 ft. Secondary arterial roads: If carrying a tramway or subject to or likely to carry an exceptional amount of through traffic, 80 ft.; if not subject to such conditions, 65 ft.; local through communication roads, 55 ft. There were arterial roads of national importance in connection with which it was advisable to have a greater width. The Birmingham arterial road cross section provided for a space in the centre of the roads for a tramway track upon wooden sleeper or light railway construction, of a width of 33 ft., leaving sufficient room in the space so reserved for trees and also a narrow strip of standing room. On either side of the central strip was a carriageway, 24 ft. in width, on the other side of each of which was a footpath 19 ft. 6 in. in width. For roads within town limits that form of construction had many advantages. It placed the provision for tramways in the centre of the road, and thus furthest from the road boundaries, and should the reservation not be required for that purpose it might be utilised for motor omnibus traffic, overhead trolley railless cars, or other fast travelling vehicles.

In connection with the form of cross section to be adopted, the possibility, and especially on those lengths of road connecting up urban areas, the probability, of provision being required for tramways must be borne in mind, despite the opinion of those who contended that such means of conveyance would shortly be superseded. The great cost of construction and maintenance of tramways upon the ordinary solid method of construction might retard and even prevent extensions of tramways upon that system, but that did not apply to those constructed upon sleeper track or light railway principles, which system, given sufficient traffic demands, would always prove a formidable opponent to motor-omnibus competition. The sphere of usefulness of such tramways might be greatly extended, especially in the way of carrying goods and produce, connections being made to warehouses, markets, railway goods stations, clearing stations, &c. The all-night usage of such tramways was not objectionable, as in the case of the solidly constructed tramways, as noise from it was reduced to a minimum. It would therefore appear to be wise when considering the width for arterial road development to allow sufficient space to provide for such possibilities.

The Prince of Wales at Trafford Park.

Visit to the Works of the Metropolitan-Vickers Electrical Co.

Accompanied by Lord Dunsley, the Lord Mayor and Lady Mayoress of Manchester, H.R.H. the PRINCE OF WALES on July 7th visited the works of the Metropolitan-Vickers Electrical Company during his Lancashire tour. Better known perhaps under its original name of the British Westinghouse Company, the works in 1917 became associated with the Vickers and Metropolitan Carriage & Wagon Companies, and the passing of the financial control into British hands was followed by a change of name. Incidentally it may be remarked that the change has in no way disturbed the

accommodation for 4 000 people is provided for in large and well-fitted buildings of a most up-to-date character. Two well-equipped ambulance rooms and a number of first aid stations are provided for prompt treatment in case of accidents.

THE RESEARCH AND EDUCATION DEPARTMENTS.

A development of considerable importance is that of the research department. After a careful study of existing laboratories and the requirements of industrial practice an E-shaped block of four buildings was planned two of which have been completed. A two-storey office block 100 ft. by 30 ft. provides for administration and the collection and distribution of scientific and commercial intelligence and a single-storey building 100 ft. by 68 ft. with exceptionally good natural lighting gives accommodation for chemical work and mechanical testing. Two other buildings contemplated will be similar in size to the latter, one providing for electrical and insulation work, workshop and heavy process work, including metallurgical equipment, the other being divided into a series of small laboratories for the conduct of pure science investigations. When complete an area of over 26 000 sq. ft. will be available. The buildings are situated at the south end of the works as far from the dust and vibration arising from the main shops as circumstances permit.

Associated with the research department, but housed in a separate building, is the education department, which is responsible for the employment and training of trade apprentices, and young men from the public schools and universities, numbering about 1 000 in all. Trade apprentices are instructed in works hours in a school and provision is made through special instructors for proper shop training.

The works power station has been considerably extended from time to time and now has an output of 7 500 h.p. During the early days of the coal strike two of a battery of water-tube boilers were rapidly converted for use with oil fuel. The motors installed in the works aggregate 10 000 h.p.

The number of workpeople at present employed is about 10,000, of whom one-fifth are ex-Service men. The Company has played a very considerable part in the movement towards the establishment of Works Committees and welfare work, and in January, 1917, inaugurated a Works Committee, which anticipated the recommen-



FIG. 1.—ARRIVAL OF THE PRINCE OF WALES AT THE METROPOLITAN-VICKERS WORKS—THE PRESENTATIONS.

cordial relations which exist between it and the parent company, the Westinghouse Company, of Pittsburgh, U.S.A., and the Metropolitan-Vickers Company is able to reinforce its own extensive experience with the technical and manufacturing knowledge of the parent company.

RECENT EXTENSIONS.

The works were established on such a large scale twenty years ago that they have changed less than the growth of the Company might lead one to anticipate. Considerable additions and extensions, however, have been made. The main policy in extending has been to make the most effective use of existing manufacturing space and crane equipment, and consequently many of the extensions have been made to accommodate non-manufacturing activities. The main shops are erected on a site 70 acres in extent, one-half of which is under roof, an area of 55 acres being also available for future developments. The main machine shop is 900 ft. long by 444 ft. wide. Including the ground floor and three galleries it affords a manufacturing area of nearly three quarters of a million square feet. The foundries, forge and other departments are built on similar proportions. The main machine shop includes departments manufacturing machined parts, punchings, windings, and assembly and testing departments for switch and control gear, electrical machines, turbines and condensing plant. In other buildings provision is made for transformers and instruments.

THE FOUNDRY.

The existing foundry has been extended by the addition of two bays each 200 ft. by 30 ft. for the purpose of removing from it fettling, grinding and sand-blasting. Six large core ovens have also been removed outside the main building and the output has been further increased by the installation of compressed air moulding machines and additional overhead electric cranes. An entirely separate building has also been erected for warehousing material awaiting packing and shipment and buildings for a central receiving department and stores are in course of construction. Canteen



FIG. 6. EXHIBITION OF COSMOS LAMPS AND HEATING AND COOKING APPLIANCES.

datations of the Whitley Report and its operations are being attended with great success. A staff committee to serve similar functions for non-manual workers also exists. Special efforts are made to ensure the welfare of the women and apprentices, but the principle

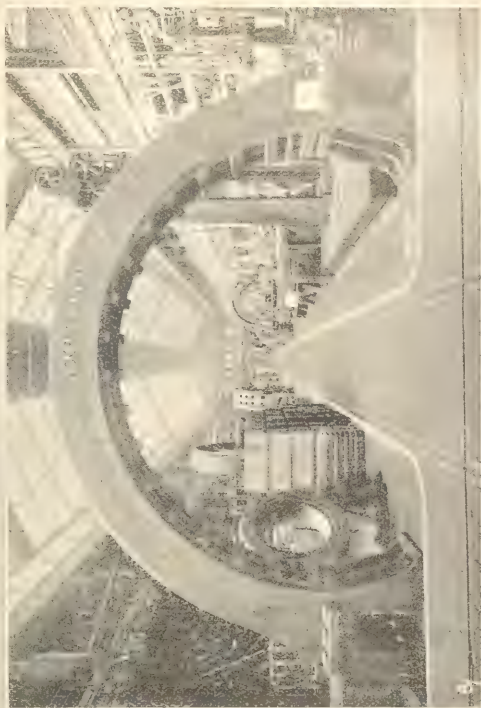


FIG. 3.—TURBINE FOR THE MANCHESTER CORPORATION BARTON STATION WATER
CUNARD LIGHTING SET IN THE FOREGROUND.

FIG. 5.—VIEW OF LARGE MACHINE AISLE THROUGH ARCHED BEAM OF A 1,200 H.P.
A.C. MOTOR FOR ITALY.



FIG. 2.—POURING A 30-TON CASTING FOR A BARTON (MANCHESTER CORPORATION) 25,000 KW
TURBO ALTERNATOR.

FIG. 4.—VIEW OF LARGE MACHINE AISLE SHOWING ROTORS AND STATORS IN VARIOUS STAGES
OF CONSTRUCTION, THE ARMATURE OF A 25,000 KW ROTARY CONVERTER IN THE FOREGROUND.

throughout is that of encouraging and assisting young workers to organise their own activities and to govern themselves.

THE PRINCE'S VISIT.

The whole of the works staff was afforded an opportunity of greeting the Prince, and, at his special request, ex-Service men were paraded and from their number several presentations were made, principally of disabled men and men with distinguished war records. The enthusiasm of the workers, men and women, on every eminence from which a view could be obtained was unbounded. Among other presentations were included the directors and principal officers of the Company, together with representatives of the numerous associations within the works of foremen, men and women workers, apprentices and staff. Owing to the exigencies of the time-table the tour through the works was unfortunately curtailed, but a large number of guests availed themselves of the opportunity to continue after the Prince's departure.

In the foundry a mould for the side frame of a 25 000 kW turbo-alternator for the new Barton super-power station was ready for pouring and by a remote electrical control the operation was commenced by Mrs. Hilton, wife of the Managing Director, Capt. R. S. Hilton, and successfully completed (Fig. 2). Returning to the large machine shop, while all sizes of turbines and electrical machines are produced, the principal items of interest lay in the number of large

sets in course of manufacture. The shell of a surface condenser for a 20 000 kW turbo-alternator set for Shanghai affording a condensing surface of 40 000 sq. ft. was being machined and a number of steam turbines, both 1 500 and 3 000 r.p.m. with outputs of all sizes up to 25 000 kW were displayed, including one of the set of three 25 000 kW Barton turbines (Fig. 3). Among the marine work was a set of double reduction gears transmitting 3 200 h.p. affording a speed reduction of 3 000 to 5 revs. per min. and a Cunard lighting set. A comparison between shafts for 20 000 kW and 100 kW sets afforded considerable interest. In the Testing Department on the Large Machine Aisle (Figs. 4 and 5) four 1 500 kW rotary converters were running. A 20 000 kW stator core for Shanghai was in process of building and the stator for a 25 000 kW machine was being machined. On the galleries, the view from which over the main machine shop is unequalled, illustrations of various types of alternating-current and direct-current switchboards and switchgear were exhibited. Railway contactor gear for the Buenos Ayres Western Railway was in operation, and a complete exhibition of the instruments and meters, lamps, heating and cooking appliances made by the Company was shown (Fig. 6).

The exceptional character of the Company's plant in the manufacture of large machines and its enterprising policy, particularly with regard to research, should enable it to play its part in the establishment of a powerful British electrical industry.

Common Sense and Co-operation.

A Plea for Cash instead of Conference.

By "ELECTROCYNIC."

Co-operation in business, to be effective, must be the outcome of financial inter-dependence. That is surely an obvious truth. Money is the beginning and end of every industrial enterprise, and, apart from certain legal and moral obligations, it is the single directing force in the management of the enterprise. Co-operation simply as an affair of conferences, conventions, and polite phrases, the question of finance may be ignored. But co-operation really means *working* together, and not merely getting together, or talking together, or thinking together.

THE LOGIC OF THE SITUATION.

In order, therefore, to get true co-operation between the various sections of the electrical industry, and between the different members of the same section, there must be a common financial interest. Call it a trust or combine, if you like; but there is no escape from the logic of the situation. If you want the manufacturers to help the central stations, you must give the former a direct financial interest in the latter; and if you want the central stations to help manufacturers, you must see to it that the supply authorities are assured of direct and immediate benefits, and not merely remote and consequential ones, as a result of enhanced manufacturing prosperity.

The present situation may be briefly summarised. Central stations throughout the country are being implored to extend their mains in order to supply streets and districts which are as yet without the sacred pale, or to put down heavier cables so that users of electric light may install electric cookers, fires, &c. In most cases they are being implored in vain. New plant and mains cost money, and money is a coy commodity, and there is no absolute assurance of adequate profits. In the nature of things the central station cannot expect an early return on capital expenditure. Many months, perhaps several years, must elapse before the expenditure receives its due justification in increased profits. It is, perhaps, natural, in the circumstances, that the clamant demand for electricity should remain unsatisfied. In a word, the central station has demand without capital.

CAPITAL WITHOUT DEMAND.

The manufacturer is equally unfortunate. His difficulty is concerned with demand rather than with capital. He can, as a rule, increase his output considerably without increasing capital expenditure. But the demand—or, at any rate, the effective demand—for apparatus is stationary, and must necessarily remain stationary until such time as central stations are able to increase their supply facilities. People obviously will not buy electrical devices which they cannot use. The manufacturer has capital without demand.

What is the remedy? Put briefly, it is this:—The supply and manufacturing sections of the industry must combine their efforts

and resources. Conferences are useless without financial co-operation. The central stations need money, the manufacturers need business, and each has what the other lacks. The makers of electric lamps and other appliances benefit immediately when supply extensions take place. Surely it is to their interest to encourage such extensions; and how can they do this better than by the provision of the necessary capital?

A HINT TO B.E.A.M.A.

Take the members of the B.E.A.M.A., for example. I suppose that, collectively, they would have little difficulty in raising two or three millions of extra capital. I suggest that they should do this and keep the money in a pool wherefrom the capital requirements of indigent supply authorities might be provided. Or, better still, the entire sum might be immediately divided, in arranged proportions, amongst the public supply companies. (Presumably the municipal authorities would have to be excluded from this arrangement.) Such a shower of gold on the arid fields of supply would do incalculable good to the industry at large. I do not, of course, suggest that two or three millions sterling would be sufficient to enable the central stations fully to discharge their duties and obligations. It would, however, be a start in the right direction, and would open the eyes of all concerned to the merits and advantages of financial combination.

One case in which such assistance would have been immensely beneficial (to me, especially) has recently engaged my indignant attention. Some months ago I took a house in the country on the understanding that a supply of electricity would be available when I began my tenancy. It wasn't, and won't be for another six months. Arrangements were made more than a year ago for the local supply company to run its mains to the district in which I live, where a hundred or so ready-wired houses are anxiously awaiting, without even the odorous consolation of gas, the advent of electric service. The extended mains were also to supply two or three small country towns *en route*. Unfortunately, the scheme was estimated to cost £20,000, and the company could not raise the money.

ANOTHER "MIGHT HAVE BEEN."

Of course, the scheme will be carried through eventually, but in the meantime the manufacturers who would have supplied the apparatus required by thousands of new consumers are sacking their staffs for lack of orders. Incidentally, a good deal of the prospective business has been definitely and permanently lost by the delay. My own house is one of a number which constitute the nucleus of a new garden city, and many of the residents would have had electric cookers and fires installed if electricity had been available. This, however, was impossible, and coal-burning range,

and fires have been put into all of the houses. When the electricity does arrive it will be too late for anything but the lighting load.

If, last autumn, the central station had been able to go to manufacturers and borrow £20,000, there might have been by this time a clean little community of all (or nearly all) electric houses in this neighbourhood. As it is, there is another "might have been" to be inscribed upon the deplorable record of this benighted industry.

CLAY FEET OR PUDDING HEADS?

I dare say instances of this sort could be multiplied almost indefinitely. Many thousands of people, no doubt, have had their household ideals shattered, as mine have been, and with me have gazed with horrified awe upon the clay feet of Electra, or, as I prefer to think, upon the pudding heads of her dilatory priesthood. Here am I, a constant and fluent lover of the goddess, condemned to candle-light and coal cookery, to the smell of burning oil, and to all the delays, annoyances and inconveniences which only she can remove. I have indeed been badly served.

This is a personal complaint, but the cause is a matter for general concern and immediate rectification. Some arrangement must be come to whereby central stations are rendered financially competent to carry out plant and mains extensions as, when and where required. Money in abundance must be available, and I suggest that it should

come from the manufacturers, who obviously stand to gain most and quickest from the extension of supply facilities. It is futile to continue to pretend that the manufacturing and supply sections of the industry can remain independent and self-supporting entities. They must coalesce, and the sooner the better. Neither can possibly progress without the other. Propaganda is useless at the present juncture. Whatever one tries to do in this direction is stultified by the depressing stagnancy of supply. You can't get blood out of a stone, and you can't get more current out of an overloaded and bankrupt station.

LE MOT D'ORDRE.

Well! *messieurs les fabricants*, what are you going to do about it? Hold a few more conferences and pass a few more resolutions, I suppose. I will tell you what to do. Hold *one* more conference and decide upon the principle of subsidising or investing in supply stations, and then circularise all non-municipal stations in the country, offering to advance them any amount of money required for mains and plant extensions at a reasonably low rate of interest. The money would, of course, be earmarked for that particular purpose.

Then you can go on advertising your own apparatus to the public, in the blissful consciousness that you have done your best to provide conditions in which it can be used.

London Electricity Inquiry.

Conclusion of Companies' Case.

The Electricity Commissioners have continued to hear evidence on the schemes submitted for the reorganisation of electricity supply in the London and Home Counties Electricity District.

Sir ALEX. KENNEDY stated, in reply to Mr. BOOTH, that cheap electric power was essential for relieving the congestion in the centre of London by enabling manufacturers to migrate to the outer districts or to provide good facilities for workmen to travel in to London from their homes in the outer districts. His scheme provided for that to some extent, but it did not take in much of the uncongested part.

Replying to Mr. PAGE: The plant and mains to be provided for the restricted area would be suitable for ultimate inclusion in a more extended scheme. The promoters were hoping that there would be a complete working arrangement with the North Metropolitan Company, although it would not be under the Joint Authority's control. His scheme would provide for linking up the group stations so that the plant capacity would be effective for the groups. He would not like to say offhand that if he were starting anew to supply the area he would prefer to supply for all purposes, including trunk railways, tube railways and tramways.

Mr. KENNEDY said it was not intended that if the Joint Authority gave an authorised undertaker part of the energy he required the whole of the undertaker's system should come under the Joint Authority's control. The clause dealing with that in the Committee's scheme required amendment.

To Mr. PAGE: With regard to the suggestion that the 2½ million pounds required for capital in the second stage might militate against the ability of the Joint Authority to sell at a sufficiently low price, it was probable that if the present undertakers were carrying on, on their own account, they also would have to spend capital on extensions, so that the 2½ millions would cancel out.

To Mr. LACKIE: In London there were very few consumers who would take 2 or 2½ million units per annum. He agreed that a consumer taking 250 000 units would not be a very large one. The reduction of 30 per cent. in cost of plant would be equivalent to 30 per cent. off capital charges.

To Sir JOHN SNELL: If there were no North Metropolitan Company or Metropolitan Company supplying in the outer area he thought his scheme would have extended further out, but he could not say how far. He was of opinion that the soundest scheme the Commissioners could sanction would be one for, approximately, the area proposed in the Committee's scheme. He admitted that the question of area was very much open to discussion. He would expect a larger industrial development in the west than in the West Kent Company's area. He would not encourage the multiplication of small stations, but if the load of any particular undertaking justified the erection of a capital station he would not object to its erection. It would be still open to the County of London Company to continue its relations with the South Metropolitan Company whether it were within or without the Joint Authority's area. The railway companies, when their electrification was extended, might offer a means of supplying outlying places for general purposes, and he thought there might be some organisation in connection with the Joint Authority to permit this to be done.

Sir JOHN SNELL suggested that if the authorities of the outer districts were under the control of a Joint Authority it might not be necessary to spend money on them at once or for many years to come. Did not Sir Alexander think that would be a better plan than to leave the whole of the Commissioners' delimited area to, say, six different organisations,

amongst which would be the Joint Authority for the inner area and, perhaps, the North Metropolitan Company, the Metropolitan Company and the County of London Company?

Sir ALEXANDER thought that might work more satisfactorily than to put the control of all the engineering details under one central authority.

MR. FLADGATE'S CROSS-EXAMINATION RESUMED.

Mr. FLADGATE said (in reply to Mr. MORSE) it was not intended that the Finance Committee should be able to spend anything without the authority of the Joint Authority. He did not think it desirable that members of the Engineering Committee should be able to refer questions to the Authority.

Cross-examined by Mr. DONALD: Witness said at a certain period when the scheme would come into operation £8 400 000 would have been written off the existing undertakers' capital expenditure. No rent would have to be paid in respect of that sum. Of the local authorities' portion of that capital expenditure a very large portion had already been paid back. In the case of the companies, 7 per cent. would have to be paid on the amount representing the useful capital expenditure written down to the depreciated figure.

Mr. DONALD said the tables accompanying the scheme did not show what the financial position of the Joint Electricity Authority would be under either of the three schemes, because there was no provision made for the rent, plus sinking fund, to be paid for the acquired stations (which worked out at £315 000 per annum) during the second period.

THE NORTH METROPOLITAN POWER COMPANY.

Mr. BAKER asked that the North Metropolitan Electric Power Company's power area should be excluded. That power area included Hendon, Finchley, Hornsey, Walthamstow and Stoke Newington. He did not ask for Willesden to be excluded, as it was not in the power area, but he asked for the exclusion of the Willesden power station, purchased under statutory powers by the Company.

Mr. FLADGATE said the Committee were prepared to exclude the Power Company's area and the districts in which it had subsidiary companies with distributing powers.

Mr. HENDERSON (L.C.C.) said he was of opinion that there was already statutory authority for acquiring stations, as proposed by the L.C.C., but that there was not such authority for leasing stations.

In re-examination Mr. FLADGATE said the supplementary particulars were supposed to show the capital charges, but without any regard to the terms of leasing. Whoever owned the plant, all the capital charges had to be paid on it, by one way or another. It was proposed that when additional authorities came in it could be done without applying to the Commissioners for consent.

REPRESENTATION ON THE JOINT AUTHORITY.

He would have no objection to one definite representative for the railway companies.

To Sir HARRY HAWARD: The maximum number of members of the Joint Authority might be 62, but his idea was that the fact that the body would be a larger one than was proposed under the other schemes would not matter, because the bulk of the work would be delegated to the Finance and Technical Committees, to which he would add a General Purposes Committee, possibly of ten members. For any practical work a body not exceeding ten was desirable.

Sir HARRY HAWARD said the introduction of the financial qualification made the matter more complicated.

Mr. FLADGATE said his companies were not satisfied with the representation proposed to be given them under the L.C.C. or Conference scheme. The companies and local authorities should have equal representation. He did not think labour should be specially represented. He estimated that the companies could raise money at $7\frac{1}{2}$ per cent. The L.C.C. could raise it at $6\frac{1}{2}$ per cent., probably. Under the L.C.C. scheme it was intended that no station should be taken over until the whole of the uneconomical plant in it was scrapped. That might be from two to four years. That there should be various times for taking over the stations appeared to him extremely inconvenient. If it were in three or four years' time there would be more depreciated plant, which would not have to be paid for, or only paid for at a very low rate. Meanwhile the Joint Authority could do linking up and other valuable work. He would have no objection to a provision being inserted in the leases that the Joint Authority could purchase the stations outright and pay in stock after three or five years, or at any time by giving notice.

Upon the request of Sir JOHN SNELL, Counsel for the various schemes agreed to have a consultation and endeavour to submit to the Commissioners' agreed proposals with regard to the terms of leasing the generating stations, or to report upon the points of difference.

THE BARKING POWER STATION SITE

Mr. G. W. PARTRIDGE, managing director of the London Electric Supply Corporation, said he had been in communication with the Gas Light & Coke Company in regard to the acquisition of land for a generating station at Beckton which would lend itself admirably to the generation of cheap electric power. An advantage of erecting a station on that side would be that a cheap supply of fuel would be obtained. There was no difficulty in burning coke or coke breeze. Coal could also be obtained from the Gas Company and from Sir Wm. Cory & Sons, who had facilities for unloading coal in large quantities adjacent to the site. There would be no difficulty in housing employees at a convenient distance. Any further improvements in the carbonisation of coal and the utilisation of waste heat at the gasworks would also be turned to the advantage of the electricity undertaking. The northern outfall sewer would enable a considerable saving to be made in the cost of laying a transmission line. Mr. Rider and Mr. Wordingham thoroughly approved the site.

To Mr. DONALD, witness said there would be a saving of probably from £300 000 to £200 000 by using the jetties already made. On a 100 000-kW station the annual saving effected by having the site would be considerable. The Greenwich, Blackwall and Beckton stations were somewhat close together, but the Greenwich and Blackwall stations were to be put there because the load there would be densest. In regard to air-raids, in case of war, it would be better to have three stations than one larger station. The three stations would be about the centre of the demand that was likely to arise in future. Putting them further down the river would avoid the payment of high rates, but longer transmission lines would be necessary.

To Mr. BAGGALLAY (Middlesex County Council): He would rather not discuss the position of the negotiations in regard to the Chiswick site.

Replying to Mr. MORSE, Mr. Partridge said it was proposed that if any question arose as to the points at which the Joint Authority should supply current to authorised undertakers it should go to arbitration. It was not proposed to charge the same price to everybody, because the cost of transmission would vary. The Joint Authority could charge companies up to their previous cost in their own stations, but it might charge less.

To Sir HARRY HAWARD: He did not think being in such close proximity to the gasworks at Beckton would lead to any difficulty with regard to loading or unloading or other matters. It would not be any disadvantage to put up a large station on a leasehold site; the lease at Beckton would be for 99 years, and the station was estimated to cost 3 million pounds. He thought that in 70 years generation might be done on entirely new methods. On that particular land there would be such a big saving that it would be worth while to take it on leasehold. Some of the stations of the London companies were on leasehold sites. If the County of London Company set up a station at Barking to supply the Romford area, in which there was a demand for 10 000 kW, he thought that they should only erect a small station to supply that area. If they wanted a cheap supply in the centre of London he imagined that they would be able to get it from one of the Joint Authority's proposed stations. The question which capital station would be taken in hand first would depend on the demand. The extension of the Stepney or Deptford stations might be carried out first.

To Mr. BOOTH: The provision in clause 13 of the Electricity No. 2 Bill that the Joint Authority must not work at a profit would increase Mr. Morse's chance of getting cheap energy.

FUEL TO BE OBTAINED FROM THE GAS COMPANY.

Questioned by Mr. PAGE: The question of reduction of cost of fuel depended on the extent to which breeze was used. Coke cost nearly as much as coal, but breeze only cost half as much. With breeze of a calorific value of 9 500 and coal of 11 000 it was obvious that it was advantageous to use the former. He had already burned 13 000 or 14 000 tons of breeze. There had been a certain amount of trouble with it, but it had been overcome. The Gas Company handled about two million tons of coal per annum. There would be storage at the generating station for about 30 000 tons of coal.

To Sir JOHN SNELL: He did not think it was good from an engineering point of view that there should be two stations so close together as Beckton and Barking operating separately. It would be better that the smaller supply required at Barking should be given from Beckton.

The Barking site was chosen by the County of London Company so that it should not be purchasable by the London County Council. The Barking site was a suitable one, but he thought the Beckton site better. The County of London Company's requirements could be better supplied under the Committee's scheme than by erecting their own station at Barking. Apart from railways, he did not think that the Commissioners ought to give consent to anyone other than the Joint Authority to erect a station within the area in the Committee's scheme. Apart from cost, Barking would be as suitable as Beckton as the location of a station to supply the Great Eastern Railway.

Sir JOHN SNELL said the Committee were concerned in getting a profitable area, but the Commissioners had the duty of also considering the interests of consumers and potential consumers on the outer fringe.

Mr. W. H. PEARMAN, secretary and accountant of the Westminster Electric Supply Corporation and secretary to the Joint Electricity Committee, said he had been engaged in assisting in the compilation of the tables. They had been prepared on the assumption that the capital charges were the whole of the capital charges the industry had to bear, and were not prepared on any assumption as to stations having been taken over. In making the estimates of the capital charges it had not been assumed that the capital would be raised in any particular way. The amount of capital, after depreciation, to be liquidated was 10 608 millions. The rent of the companies' generating stations was calculated at £742 000 per annum, and he has assumed that there would be a surplus of £413 000 placed into a sinking fund at 4 per cent. That gave 4.98 millions, leaving 5.6 millions, or 4.775 millions after deducting the scrap value, to be provided for after the end of the life of the plant. The rent of 7 per cent.—or £742 000 a year—would be payable for 50 years from 1921.

Mr. D. MILNE WATSON (Gas Light & Coke Company) said he had come to the conclusion that satisfactory agreement could be come to for leasing the site at Beckton to the Joint Authority. It could be done by his company without any further statutory authority.

To Mr. BOOTH: The time for a cut-throat policy between electric and gas supply was gone. It would be in the national interest to have the two mutually assisting each other. There would be always an ample supply of coke and coke breeze available for the electricity works.

To Sir JOHN SNELL: The subject of low-temperature coal carbonisation was being followed up by his company. He assumed that an electric supply station could be one of the most efficient users of the gas so generated. Co-operative working between the gas company and the electric supply industry would lead to economy.

THE LEASING OF THE COMPANIES' STATIONS.

Mr. PEARMAN was then recalled, and, in regard to the proposed terms of the leases of the companies' stations, he agreed with Mr. Henderson that the capital expenditure was taken as 14.9 millions; deducting one-third of that as the cost of buildings, left 9.46 millions as the expenditure on plant, and after depreciating that on income-tax methods, the value at the end of 10 years, i.e., at the date of the lease, would be reduced from 9.46 millions to 5.657 millions. The rent was 7 per cent., and that represented £742 000 as an annual charge. The total capital charges on the capital would be £1 155 000. Deducting the portion now called rent, there was a balance of £413 000 as a surplus, which could be used as a sinking fund, and that set aside at 4 per cent. for 10 years would amount to 4.98 millions. The value for the lease was 10.608 millions. Taking the one from the other, it was found that 5.628 millions was unprovided for, but by allowing 5 per cent. for scrap value of the plant it was reduced to 4.775 millions. The plant would be scrapped at the end of another 10 years, and there would be a balance of 4.775 millions of capital expenditure to be still provided for at the end of that time. The Joint Authority would have to pay £742 000 a year rent, plus sinking fund £413 000. It was intended that they should continue to pay the rent during the whole term—50 years from 1931. The 10.608 millions had to be liquidated, and he agreed that it did not matter whether it was paid in a lump sum, or by instalments, or in the form of rent plus sinking fund.

To Sir JOHN SNELL witness said it was the intention of the companies to transfer their generating stations, whether by sale or lease, and whether the payments were spread over 60 years or only over the life of the plant, at a price equal to the cost of the plant, less depreciation.

FINANCIAL EVIDENCE.

Mr. ARTHUR COLLINS, City Treasurer of Birmingham, said he had been advising the Conference of Local Authorities. The rate of interest at which the Joint Authority could borrow and which had been taken as 6½ per cent. might vary, according to the financial conditions at the time of issuing the capital. If the electricity requirements of the proposed area could be dealt with, even at some slight disadvantage, by the modified scheme, it would be better than trying to raise large sums of money at present. Having regard to the sympathy of the local authorities and of many of the companies to the proposals, the question of pledging the rates to raise money at 6½ per cent. was not so material as it had been in connection with other electrical schemes upon which he had advised. An issue could be carried through at a reasonable rate of interest if it had a guarantee in the price per unit plus a precept on the local authorities. He was not sure that pledging the rates would not do more harm than good. He thought the experts in the Stock Exchange would be as willing to provide a loan on the guarantee basis as they would be to do it on a rate-aid basis. The prospectus for the first loan might have to be issued without any assets behind it. He thought the Commissioners might ask for an advance from the Treasury to help the Joint Authority to get over the first stile.

Sir HENRY HAWARD said it would have to be done by certain responsible persons on behalf of the Joint Authority asking the Minister of

Transport to apply to the Treasury for money for certain works. There was no question of the Treasury taking up part of a loan.

WITNESS said he believed that if Parliament were convinced that electrical schemes were in danger of becoming abortive for want of capital it would not take long to induce the Government to advance money on repayment terms, as they had done in the case of housing schemes. With a guaranteed revenue, without pledging the rates, he thought the Joint Authority would have an advantage of about 2 per cent. compared with the rate at which the companies could borrow, and he did not think the railway companies could get capital much cheaper than any of the nine companies concerned in the Joint Committee scheme. There ought not to be a material difference between the terms on which companies and local authorities' stations were taken over. The goodwill was not comprised in the generation part of the undertaking, but in the distribution. This was the most difficult case he had known in which to forecast the charges to be made for current. An alteration in the cost of money alone might have an important effect upon it. He was, however, confident that some saving would be effected by treating the proposed district as a whole for electrical purposes.

To Mr. HENDERSON, witness said in his opinion the administration expenses of the Joint Authority in the early days should be paid by the partners, i.e., those who transferred their undertakings to, or took current from the Authority, also to a less extent by authorised undertakers in the area, but not included in the scheme, and also by other local authorities. Of those other authorities the County Councils would be the only ones from whom he would demand substantial contributions.

Mr. COLLINS, replying to Mr. DONALD, said the figure of £11 470 000 given in the Committee's supplementary particulars represented the capital used in the production of electricity during the first stage. It was impossible to state what the position as regarded capital employed in 1925 and 1931 would be, because of the difficulty of forecasting how the Joint Authority would have proceeded to meet the demand at those dates. He agreed that the rental (£742 000) and sinking fund could not be paid out of the £478 000 which it was calculated would be available for those purposes in the second stage.

Mr. HENDERSON suggested that the period for redeeming the capital cost of the plant should be based on the life of the assets and be severed entirely from the question of the extension of the companies' tenure of their distribution systems. It would simplify the matter if the generating stations passed completely into the Joint Authority's possession at the end of the life of the plant taken over.

CONTRIBUTIONS TO THE ADMINISTRATION EXPENSES.

He thought if the County Councils paid a comparatively small contribution to the Joint Authority's administration expenses in its early days, even though the Authority were not supplying in the Councils' areas, it would be a cheap means of insurance which would ensure a satisfactory supply of electrical energy in their districts when necessary. No one had any idea how soon such districts would require such supply. If the contributions were confined to authorities getting immediate benefit from the scheme it would be taking a very narrow view. He was not sure that there was anything wrong in the representation of the London County Council on the Joint Authority, as they were or could be the custodian of the rights of the consumers and of the smaller authorities in the County.

To Mr. WROTESLEY (for Middlesex Council) witness said representation and contributions should go together. The smaller authorities not taking electricity would not have to pay more than about £10 a year, and the London, Middlesex and Surrey Councils might have to pay £100 each. He would advise that the Joint Authority should establish a reserve fund, in addition to providing for capital repayments and interest. He did not think a uniform charge could be applied throughout the large area contemplated. Otherwise it might happen that the price charged to an outer area would not cover the cost of laying the transmission main.

To Mr. MOSELEY, Mr. Collins said it would be a serious loss if the Metropolitan Electric Supply Company's power area were excluded from the scheme. He was influenced in his answers by the principle that a long view should be taken; the most practical men were those who took that attitude. The contribution to the administration expenses to be paid in respect of the Metropolitan Company's power area would probably be about £500 per annum.

To Mr. BAKER (North Metropolitan Electric Power Company), Mr. Collins said he believed the administration expenses of the Joint Authority, according to the Joint Committee's scheme, would not exceed £10 000 a year, as it did not propose to establish a large central office staff; the business would be carried on much on the present lines, but with central control. The North Metropolitan Company would benefit by the Joint Authority giving advice to the local authorities in the Company's area or in an area into which the company might seek authority to extend.

Mr. RIDGE handed in a map of the Woolwich footway tunnel, the only tunnel under the Thames east of the Blackwall tunnel, to show that there was no space for high tension mains in that tunnel.

THE POPLAR SCHEME.

Mr. DONALD then opened the case for Poplar Council. He said the Council's view was that where there was an industrial area sufficiently large to absorb the energies of a capital station and where joining such an area up to a larger area would cause an increase in the cost of electrical energy, it should be allowed to remain separate. Poplar sought financial autonomy, but not to be electrically separate nor separate from some amount of control by the Joint Authority. Though he had behind him only one local authority at that moment, he would put

forward proposals which he ventured to think would carry weight with the Commissioners. The area proposed by the Poplar scheme included Islington, Bethnal Green, Stepney, Lambeth, Beckenham, the South Metropolitan Electric Light & Power Company's district to the borders of Woolwich, the borough of Woolwich, Bexley, Dartford and the boundaries of Dartford up to the Thames, Gravesend and the whole of the Romford district included in the County of London Company's area. The proposed northern boundary would follow that company's area, and took in Ilford, Walthamstow and Stoke Newington. If the establishment of a separate authority for this area were decided upon, he was convinced that a number of the local authorities would join the project. If the Commissioners did not authorise the scheme at once he asked them to leave the door open for the institution of such a separate area later. In the area described the increase in units supplied between 1914 and 1920 was 46 per cent., while the increase in the outside area was only 28 per cent. The increase of maximum demand was 39 per cent. compared with 30 per cent., and the load factor increased 1.2 per cent., compared with a decrease of 0.2 per cent. The cost per unit sent out was 1.434d., against 1.834d., the percentage of capital charges to total charges being 17.3 and 22.4 respectively. In the East London area 80 per cent. of the total load was for power and heating, compared with 50 per cent. in the other districts. Poplar, which was selling electricity cheaper than any other authority in the area delimited by the Commissioners, was linked up with Stepney, Hackney and Shoreditch, and Bethnal Green took a bulk supply from Stepney. Poplar deemed it necessary to leave the Conference of Local Authorities when it was seen that the question of establishing separate districts was likely to be lost sight of. Comparing with the figures of the engineering committee, it was estimated that there would still be the 30 per cent. difference in the cost of current in the East London area and the other parts of the delimited district in 1925 and 1931. That difference in cost of current existed because there were smaller capital charges and also probably because there was a larger percentage of economical plant than in the larger area. There were also better load and diversity factors. The cost of linking up of the remainder of the undertakings in East London would be less than linking up in the remainder of the larger area, and the erection of a capital station in East London would entail less capital. The engineers for the Poplar scheme were of opinion that they should go on at once with the linking up, with the view of erecting a capital station in the near future. They estimated that it would be necessary in 1926 to proceed with a capital station of 100 000 kW, so that it should be in operation by 1931. The site of the proposed station was at Dagenham, about two miles to the east of the Barking site and $\frac{2}{3}$ to the east of the Beckton site. It would be in the middle of the area but on the extreme east of the present developed area.

THE CONSTITUTION OF THE EAST LONDON AUTHORITY.

It was suggested that on the Joint Authority or Committee for East London 22 members should represent local authority undertakings seven councils having purchase rights, three other local authorities in the area, three large consumers and railways in the area, and two labour. Upon his suggestion it had been decided to add five representatives of companies. The total number of members would be 42. Each member would have one vote, and those representing undertakings taking current would have one additional vote for each million units taken. The promoters of the East London scheme did not think it necessary to lay so much stress as the promoters of the other schemes apparently thought necessary on compulsory powers. There should be a committee representing the owners of the stations, and he thought they would agree to shutting down their stations temporarily in the interests of economy in generation and distribution, and by experiment the Joint Authority could decide which generating stations should be permanently shut down. So long as the existing plant or the plant already authorised was used in the existing stations it should belong to the existing undertakers. It was not proposed that the central authority should put in new plant in the existing stations. All new plant would be put in the new station. The charge between stations would be the same as that at present in force between the East London linked up authorities. At times of light load that charge was the fuel cost, and only the balance of the supply—i.e., the quantity by which the supply from station A to station B exceeded the supply from B to A—was taken into account. At peak load the charge was fuel cost, plus 50 per cent. It was suggested that the district areas such as was suggested for East London should contribute to the administrative expenses of the Joint Authority for the larger area and, personally, he thought loans for all the undertakings should be raised by the central authority, but if he had to choose between raising his own loans and surrendering his financial autonomy he would choose to raise his own loans. Since the scheme was drawn up it had been realised that it was hardly likely that the Commissioners would agree to the East London area being separated as an entirely independent authority upon the application of one local authority, and so it had been decided to ask that the East London area should be dealt with by a district committee to which the Joint Authority would delegate its powers for that district, or if the area were left out of the central authority's area the local authorities in East London could proceed on the lines of a joint board under the 1909 Act.

ENGINEERING EVIDENCE.

Mr. J. H. BOWDEN, manager and engineer of the Poplar electric supply undertaking, said when he saw the Conference scheme, in which the capital expenditure was estimated at 13½ million in the first stage and 30 million in the second stage, he thought that the expenditure could not be justified, but that the expense of one capital station for the East London area would be warranted, on account of the industrial load.

The present plant in the area was a little under 150 000 kW, and the limit of its possible output would be reached by 1929, when the first section of the capital station would have to be ready. It was at first proposed by the Conference of Local Authorities to form four separate London areas. He had thought it necessary in the interests of diversity to obtain the railway and tramway loads. He found that the peak of the industrial and traction loads combined was about 9 o'clock in the morning, whereas in the case of the industrial load alone the peak occurred about 4 o'clock in the afternoon. The traction loads were taken partly from the L.C.C. tramways and the Lot's-road railway power station. He estimated a diversity factor of 1.125 from the three loads combined. It would take two or three months to obtain a true diversity factor of all the electric supply and traction undertakings in London. Amongst the advantages of the Dagenham site for a power station were the fact that it was in an area where the industrial demand would increase, there were stone jetties already erected there, and the assessment would be considerably lower than on a site nearer the metropolis. The estimated saving in the disposal of ashes from that site was 9s. to 9s. 6d. per ton. If there were 15 per cent. of ash that would amount to 84 600 tons for 600 million units, and it would make £23 000 difference in the cost of disposal compared with what the cost would be if the ash had to be barged away. The area of the site was 150 acres. At low tide there was 20 ft. of water available, which would tend to reduce expenditure on condensing. The site belonged to Samuel Williams & Company, and the question of price was under negotiation. The average price received by Poplar for current in 1919-20 was 1.66d. per unit. That was the lowest in London, Stepping being next with 1.67d.

INTERLINKING.

Replying to Sir JOHN SNELL: Considerable saving was made by the interlinking of Shoreditch, Stepney, Poplar and Hackney, but he did not think the full possible benefit was being obtained. The actual saving was about 800 tons of coal, or £1 500 per annum. If one station could take the whole of the night load it was estimated that it would effect a further saving equal to £500 per annum. He did not think the best results could be obtained unless there were some authority to say definitely when certain stations should shut down. When the ring was complete the saving would be greater, as in some cases the current had to be sent too far round at present. There might be a tendency to oppose the Joint Authority, but he could not imagine any engineer objecting to his station being shut down if he were offered energy at a price cheaper than he could generate it. He thought the decisions of a committee of engineers would be more convincing to engineers whose stations were affected than the decisions of one individual. It was not proposed to purchase any station at any time. It was proposed to deal with the matter purely from a business point of view; that undertakers should be offered a supply at a price which it would pay them to accept, and the system should extend as prices became lower. The linking up of Poplar and the neighbouring boroughs had been done all along with complete good will. For the first period it was proposed to have an executive officer and in the subsequent stages an engineer.

To Mr. HENDERSON: If East London obtained loans on the security of the whole London area, other districts would have the security of the East London district in the case of their loans. Two of the sites of the proposed stations under the other schemes were situated in or immediately adjacent to his area. He admitted that there could not be so much cheapening of supply in non-industrial areas if the industrial areas were separated from them as there would be if they were connected. The non-industrial areas must expect their reduction in cost of supply mainly from the electrification of the railways. The scheme was made as much as possible a municipal scheme. In the eastern boroughs north of the river he thought they could work economically if the area were reduced to those boroughs alone. It was suggested that the Joint Authority for the whole area should act in regard to East London on the advice of an advisory committee of engineers of the East London area. In the case of a difference of opinion between the Chief Engineer of the Joint Authority and the East London committee the instructions from the Joint Authority would have to be carried out. It was intended that in any case where there was dissatisfaction with the Joint Authority's decisions there should be a right of appeal to the Electricity Commissioners. Dagenham was in the Romford district, in the County of London Company's area. There would be less cost of transmission from Beckton to the East London industrial area than from Dagenham, but this was counterbalanced by the saving on ash disposal. The saving of cost in regard to ash disposal would be made by spreading the ashes on the area instead of having it barged away. The estimates included £1 621 000 for extensions in existing stations, £2 354 000 for the capital station and £1 089 000 for the primary transmission system; total, £5 064 000. With that capital expenditure they would get plant of a total of 318 000 kW. He did not agree that the L.C.C. scheme, which Mr. Henderson had proposed for a total of 332 000 kW being obtained for an additional capital expenditure of £9 760 000, was a better one. The western districts would be linked up between themselves and with their capital station. If the Joint Authority said a station in the area should be closed down because a station outside could supply it they would have to look to it.

Replying to Mr. TURNER, witness said he did not consider the whole area so economical as the East London one because of the extra cost of mains to the outlying districts. Under the Conference scheme the Joint Authority could set up a committee to deal with the East London district, and it would go a long way towards satisfying Poplar. The power the Joint Authority would have under the Conference scheme to charge a special price to the East London industrial area if so minded would not satisfy him.

To Mr. KENNEDY witness said he thought energy generated in a new station at Dagenham could be supplied more cheaply than from a new station at Beckton. If the Joint Authority would give a supply to Poplar at as cheap a cost as the cost of generation under the East London scheme he did not think Poplar would have much to complain of.

To Mr. TYLOR, witness said he did not agree with Mr. Wordingham that the railways would suffer by this combination of the railway and general loads in one station. The combination would be an advantage to the railways. There would be a diversity factor, which would compensate for the cost of transmission lines.

Re-examined by Mr. DONALD, witness said under the Conference scheme there was nothing to prevent the establishment of a committee such as Poplar suggested, but there was a great deal of difference between that and the Commissioners saying it should be done if the local authorities desired it.

Replying to Mr. PAGE, witness said the factors which induced Poplar to put the scheme forward were the engineer's report and the belief that the people in what he called industrial London knew more about the requirements of that industrial area than people in the west knew. He was in favour of interconnection between the various districts of London, but there should be competition between them. If they failed in getting a district committee they would have to come in under one of the larger schemes. He was not a "last-ditcher." The bulk of the coal would come by the river, and there would be storage for three months' supply. The district committee's powers would be confined to operation. He found that the cost of plant was now 20, and that of cables from 20 to 25 per cent. lower than they were 12 months ago. Therefore there should be no undue delay in proceeding with capital stations. He was inclined to think the engineers who prepared the technical scheme had rather exaggerated the capital cost.

In addition to Mr. Bowden, Mr. E. M. Lacey, consulting engineer, Mr. P. J. Sutton and Mr. FRED TAIT, assistant manager of the Poplar electricity undertaking, gave evidence for the East London scheme.

No evidence was called for the RAILWAY COMPANIES, and upon Mr. Moseley's application, the two schemes were withdrawn. The hearing of the opposition witnesses was then commenced, the first two being Mr. A. W. TAIT and Mr. J. S. HIGHFIELD, for the Metropolitan Company.

Correspondence.

ELECTRICITY METERS VERSUS CURRENT LIMITERS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: In your issue of July 1 there appears an article under the above heading embodying "a description of a new form of current limiting device which is claimed to be entirely novel, and also a great advance on any apparatus hitherto designed for a similar purpose on the British or any other market," and which is said to work on "an entirely different principle" to other devices for the same purpose.



"THE HOLMES" LIMITER.

Readers may be led to suppose that the principle of automatically inserting a resistance in the circuit as soon as a predetermined current is exceeded, and again automatically short-circuiting such resistance when the current falls, is something novel. This is far from being the case, as more than 30 years ago I designed what we called a battery protector which worked precisely on this principle, and quite a number were used on private house installations to prevent damage to the accumulators by excessive discharge currents.

I enclose herewith a photograph of the apparatus (the drawings for which are dated January 13, 1890), from which

it will be seen that the short-circuiting of the resistance was done by a U-shaped piece of copper dipping into mercury cups connected to the resistance terminals. The quick make and break between the copper and the mercury was effected by a switch action, which was patented by me in 1887, and this was actuated by the movement of the hinged armature of the magnet. When the battery protector operated, all the lamps became dim, indicating throughout the house that the load was excessive, but brightness was restored by extinguishing the few lights which could be most conveniently dispensed with.

The Ediswan current limiter is, no doubt, in its details a more up-to-date device than the one I have described, and probably in every way suitable for the work it is designed for, but the claims to novelty ought not to go unchallenged.—I am, &c.,

Newcastle-on-Tyne, July 5.

J. H. HOLMES.

DR. ROSENBERG AND COPPER LOSSES.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: May I be permitted to draw the attention of Dr. E. Rosenberg (see THE ELECTRICIAN of June 3, 1921) to what I believe represents the better view with regard to armature copper losses of the parasitic type.

Firstly I should like to mention a critique of Prof. A. B. Field's work published in the "Physical Review" of last year (see Vol. XV, No. 5). There it was shown that the view of Prof. E. Arnold regarding the path of the self-induction flux was untenable. Analyses based upon this false assumption must, therefore, give way. Indeed, the proximity of iron to current carrying conductors hardly influences at all the self-induction flux, so that the writer's solution for the skin effect of massed rectangular conductors (see "Phys. Rev." Oct. 4, 1916) obtains. In the latter solution the only assumption made is that at the skin the current density is constant throughout. The blanket objections of Prof. Howe to Heaviside methods in general need not be taken too seriously since Prof. Field's solution can be obtained with infinitely less labour if desired.

However, I should like to draw attention to a much more important study of incremental copper loss, particularly in large-sized alternators and in very small-sized armatures where the magnetic density in the slots is apt to be very high. This is a still further Paper by the writer on eddy current losses in the copper of slotted armatures, which appeared in the Journal of the Institution of Electrical Engineers, June 15, 1915. According to your correspondent's experiences, despite the views of Prof. Miles Walker and others on the continent the major portion of the incremental iron and copper losses is to be attributed to effects of the main field. An engineering formula for the teeth incremental iron losses was first published by the writer in his book on Dynamo Design, New York, 1905. (See also THE ELECTRICIAN, London, 1904). I understand the latter type of formula is being employed quite generally in England, however, without credit.

Austrian engineering undoubtedly stands on a very high plane; I was thinking particularly of the field of induction motors, but I do feel that occasionally the right kind of emphasis is not being displayed.—I am, &c.,

Washington, D.C., June 30.

A. PRESS.

THE WAGNER EARTH CONNECTION.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I (and no doubt I speak for many readers of THE ELECTRICIAN) am obliged to Mr. D. W. Dye for his addendum to my article on the Wagner Earth Connection. When I was impelled to adopt an earth connection my test apparatus had been behaving erratically when periodically checked against N.P.L. calibrated standards of capacity; these standards were approximately equal to the capacities under measure-

ment and of a low order. The Carey Foster arrangement with earth connection shown in Figs. 2 and 3 of my article was adopted; in addition, the precaution of a balanced transformer with earthed shield was introduced in the alternating-current source. Owing mainly to the bridge modification, satisfactory results were obtained. It is interesting to add that the capacity limits here were of the order stated by Mr. Dye to be satisfactory with the said bridge modification.

Mr. D. W. Dye's commentary, including particularly his own bridge modification, deserves the wide publicity which its appearance in your columns has ensured.—I am, &c.,

Newcastle-upon-Tyne, July 9.

G. E. MOORE.

A REVIEW OF RECENT LARGE LOCOMOTIVES.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: You will no doubt remember that in THE ELECTRICIAN of May 13 there was an article entitled "A Review of Recent Large Locomotives," by A. Latenser. This is to call your attention to the fact that there are statements therein which are misleading and absolutely false, and I consider it a great pity that such mis-statements should appear in a paper having the standing of yours.

The mis-statements are that both the geared and gearless locomotives operating on the Chicago, Milwaukee & St. Paul's Railway, and supplied by the General Electric Company, of Schenectady, have been withdrawn from service on account of the damage they do to the track. I would say that I have personally seen and ridden on all the electric locomotives on the above line, as supplied both by the American Westinghouse and the General Electric Company, and also have up-to-date information in connection with the running of these locomotives. The original geared passenger locomotive was found by tests made by the University of Wisconsin to deliver impact on rails and structures only approximately two-thirds of the magnitude given by the steam engines tested at the same time. The statement is, therefore, entirely untrue that the geared passenger locomotives were withdrawn from service owing to their destructive effect upon the track.

The geared passenger locomotives were changed over to freight work when the new Westinghouse passenger train locomotives were delivered. The latter were specially designed for passenger train service.

As regards the gearless locomotives, these have not been withdrawn from express service, but have been running continuously in service from the day they were started, and have given great satisfaction, and, in fact, their performance has been so successful that the General Electric Company has been called upon to incur no expenses whatever for any changes, or for their upkeep. The maximum speed attained by these gearless locomotives is 83 miles per hour.—I am, &c.,

Leamington, July 8.

R. H. SIMPSON.

SHORT-RANGE HORIZONS AND CABLE LAYING.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: During a recent voyage of the Telegraph Construction & Maintenance Company's cable ship "Colonia," I carried out some very successful experiments with short range sea horizons, which I venture to think will be of interest. In these experiments I was very ably assisted by the navigating officers.

It is well known that at night the horizon, except under very exceptional circumstances, cannot be used for obtaining positions, but by using a calcium light as a short range sea horizon at a known distance, and manoeuvring the ship so as to get the required star vertically over this light, the altitude can be obtained. This operation repeated with two or more stars will give a very accurate position. In doing this it is best to use port helm, so that the calcium light comes

in the clear glass of the sextant before being under the vertical direction of the star. Likewise, in the day time accurate results can be obtained by a calcium light or a cask with a required interval between observations.

Although similar observations have been attempted before in daylight it does not seem to have been taken up with regard to obtaining positions at night. Owing to the uncertainty of the ordinary sea horizon the above method should overcome many difficulties.

When the sky is covered with cloud, which is frequently the case, it is impossible to obtain a star position at P.M. twilight; but the stars often show through a few hours later, and as, by that time, the sea horizon has become invisible, excepting, perhaps, during a favourable moon, observation is still impossible. If by my suggested method a short range sea horizon is arranged, then, at any time during the night, observations can be taken and position defined providing known stars are visible.

I am therefore inclined to think that with regard to cable laying and repairing ships this method may be of considerable importance. I am hoping in the near future to have constructed a projectile flare to be thrown from a suitable gun to a known distance in any direction, so that at times when the sea horizon cannot be depended upon, or at night time, accurate positions can be got without actually stopping the ship or altering course, providing the weather is moderately fine.

My experiments were facilitated by a Dip Table, which has been recently published by Mr. Percy H. L. Davis, late of the Nautical Almanac Office, for the purpose of correction of altitudes at given distances in yards for use with short range found sea horizons. I unders that this table will be included in Inman's Nautical Tables.—I am, &c.,

London,

June 24.

VICTOR CAMPOS,
Master c.s. "Colonia."

HIGH-TENSION WINDING AND INSULATION BY EX-SERVICE MEN.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: In addition to the ordinary workshop practice in electrical manipulation which forms a large part of the training of disabled ex-Service men at the Leeds Technical School, the men in training have recently completed the construction of a 20 000-V transformer to work on the Leeds Corporation alternating-current supply. This 2 kW transformer was of special design to meet the requirements of the Leeds University, and has been delivered and tested in the electrical engineering laboratory there. It was interesting to find that the testing pressure could be forced up to 100 000 V, *i.e.*, five times the normal capacity, before discharge took place, between the coil terminals. This result speaks well for the practical knowledge and skill of the instructors as well as indicating the careful and accurate workmanship on the part of the trainees who actually carried out the work.

Besides the armature-winding section in which the foregoing work was done, there are also sections for training fitters and instrument-makers and electrical wiremen. In the electrical fitting section the trainees have recently constructed a commutator of unusual design. The brushes work on the inside instead of the outside surface. It is 19 in. in external diameter and is built up of 299 bars.

In the installation section the wiremen in training have been given ample opportunity for carrying out practical work on a fairly large scale in various departments of the school requiring electrical extensions or alterations. In one piece of work of this kind, comprising 163 lights and four three-phase motors, the official insulation test of the Corporation Electricity Department gave an infinity reading for the lighting system and 16 megohms for the motor circuits. This also indicates very careful attention to details on the part of the trainees.—I am, &c.,

R. E. BARNETT,
Principal, Central Technical School.

Leeds,
July 7.

NEITHER CONDUIT NOR CASING.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I have read with much appreciation the excellent letter entitled "Conduit *versus* Casing," published in your current issue over the name of Mr. Wilson of Birmingham.

There appear to be several indications that both conduit and casing will be eliminated from electric light installations in the future as witness the various house systems introduced by the principal cable makers.

The field of application for un-enclosed cables is now considerably enlarged by Messrs. Glover's introduction of their Glo-Clad wiring system for industrial purposes in which the various fittings are screwed on the hardened sheath of the cable.

Further particulars of this interesting system are, of course, readily available to those concerned and I therefore do not intend to trespass on the limited space of your correspondence columns by entering into a detailed description in this letter, but I thought I should like to make this personal comment upon the interesting correspondence now appearing in your journal.—I am, &c.,

Manchester,

July 8.

HARRY ALLCOCK, M.I.E.E., M.I.Mech.E.

Heating and Cooking Notes.

THE "LIGHTNING" OVEN.

Mr. Prentice's ingenious "Lightning" oven was described in THE ELECTRICIAN* some time ago, and our readers will no doubt recollect the main features of this remarkable cooking device. As shown in Fig. 1, the oven is in the form of a cylinder, the heating elements being wound on a frame fitted to the interior surface. This cylindrical

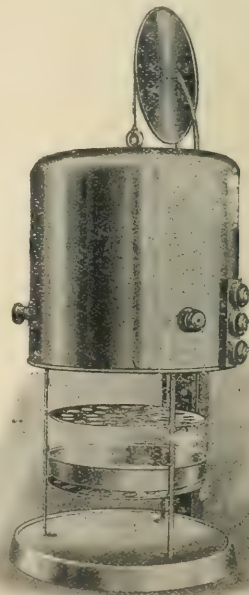


FIG. 1.—THE "LIGHTNING" OVEN.

casing, complete with elements and switches, is suspended over the oven base by means of a counter-weight, so that it can be raised for the reception or removal of food. The heating elements entirely surround the food, thus ensuring uniform cooking and browning.

Perhaps the most important merit of the "Lightning" oven is its heat-retaining quality and consequent economy. When the door

of an ordinary oven is opened, a considerable amount of heat immediately escapes through the opening; but when the casing of the "Lightning" oven is raised the heat loss is negligible. In effect, the oven carries its heat up with it, and only the food is exposed to the chilling influence of the outside air. Three control switches are provided, giving five variations of heat. The maximum consumption is 2 kW, and the minimum $\frac{1}{2}$ kW.

Although patented about 10 years ago, the manufacture and distribution of the "Lightning" oven on a commercial scale have

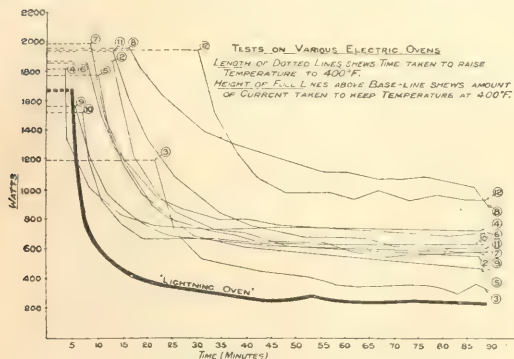


FIG. 2.

only recently been undertaken, so that, from this point of view, it may be regarded as a new development. During the period that has elapsed between invention and exploitation, the apparatus has been thoroughly tested in ordinary every-day use, and appears to have triumphantly justified the hopes and prophecies of its original sponsors. The "Lightning" oven is now being made and marketed by Messrs. ELECTRICAL UTILITIES, LTD., from whom we have just received particulars of recent performance tests.

The following tabulation shows the results obtained on test at the Aylesbury Exhibition a few months ago:—

Beef, sirloin	Initial weight of meat	9 lb. 15½ oz.
	Loss during cooking	9.6 per cent.
	Current Consumption	1.347 units.
Beef, topside	Initial weight of meat	4 lb. 1½ oz.
	Loss during cooking	7.7 per cent.
	Current consumption	0.937 units.

A NEW FIRE-BAR.

Messrs. AUTOMATIC & ELECTRIC FURNACES, LTD., send us particulars of their new "Furnace" fire-bar, which is intended to be used as a standard element in domestic heating appliances. It

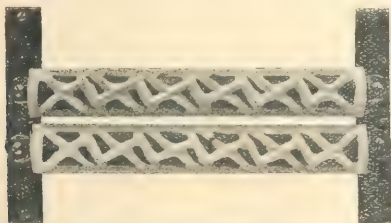


FIG. 3.—Two "FURNACE" FIRE-BARS FIXED ONE ABOVE THE OTHER.

consists of a hollow strip about 1 in. in diameter, over the open front of which are fitted in criss-cross fashion a number of irregularly-shaped pieces of incombustible material. The resistance wire is wound in a very close helix inside the strip. When placed on circuit the whole mass glows.

The "Furnace" fire-bar consumes 500 W, but, owing to its special construction, appears to provide a greater area of red heat than is commonly the case with elements of equivalent rating.

The current issue of "Railway Gazette" gives a comprehensive review of the successful scheme of traffic control which is now in operation on the Midland Railway. The article includes figures which indicate the running efficiency secured by means of this control system, but the point which will strike the electrical engineer is that the greatly improved working which has admittedly resulted would have been impossible without the very extensive employment of the telephone.

The I.M.E.A. Convention.

A complete programme of the proceedings of the annual convention of the postponed INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION which is to be held at the Institution of Electrical Engineers, or, if not available, at the Institution of Mechanical Engineers, on Wednesday, Thursday and Friday, July 20, 21, and 22 has now been issued.

On WEDNESDAY, July 20, at 2.30 p.m., Major H. Richardson will deliver his Presidential Address, and at 2.45 p.m. a Paper on "Questions Arising in the Consideration of the Financial and Business Aspects of Municipal Electricity Supply" will be read by Mr. C. W. Charlesworth. Immediately following this Paper a meeting of the Chairman Members only of the I.M.E.A. will take place.

The proceedings on THURSDAY, July 21, will commence at 10 a.m., Mr. D. Wilson reading a Paper on "Steam Raising—Yesterday, To-day and To-morrow," and Mr. W. M. Miles on "Modern Boiler House Practice." The afternoon session will open at 2.30 p.m., when Mr. E. Cross will read a Paper on "Present Day and Commercial Problems in Electricity Supply." The Annual Dinner will be held at 7 p.m. at the Hotel Cecil, Strand.

The Convention will close on FRIDAY, July 22, with the holding of the annual general meeting, which is to commence at 10.15 a.m.

A Portable Disinfecter.

Modern expert opinion tends to assign to fomites a dominant part in the spread of infection and regards steam as the only absolutely reliable method of their disinfection. Usually, disinfection necessitates the employment of a large vehicle for carrying articles between the infection site and a central disinfection station—an arrangement which is costly and often ineffective.

A portable sack steam disinfecter which has recently been placed on the market by Messrs. MELDRUMS, LTD., should therefore be of the greatest use in bringing about a more healthy and cleanly state of things. In the sack steam disinfecter a suspended charge is covered by a waterproof, but steam permeable, wrapper, and is then drawn up into the inverted sack where it is steamed in three minutes. On being lowered clear of the sack it is so slightly damp and so intensely hot that the garments dry in two minutes. One sack enables 10 suits to be steamed, dried and re-worn within 10 minutes. Blankets, mattresses and other similar articles can be packed into the container and dealt with in the same way. The small initial cost and low working expenses of this apparatus should be a determining factor in its ever-increasing employment. The price of the latest pattern of disinfecter is £57, and it has been found that 1 000 army blankets can be disinfected with a consumption of 5½ gallons of oil, costing 11s. 6d. or, using coal, at a cost of 2s. The apparatus is so portable that it can be carried on the back of a motor cycle.

The Telephone Inquiry.

The Select Committee on the Telephones has continued its sittings, but it hopes to conclude the taking of evidence before the end of the Session. Its assessor (Mr. W. W. Cook) is to prepare a report on the telephone systems of the United States, Canada, Sweden, Norway and Denmark. We give below a summary of the evidence of witnesses recently heard.

Mr. T. HOLME, engineer and manager of the Hull Corporation telephone system, said that he saw no reason why flat rates should not be associated with measured rates in a system such as that in the Hull area. Of their subscribers, 76 per cent. were below the 2 000 calls per annum point, and only 24 per cent. above; whereas the call requirements were almost reversed, 24 per cent. of the subscribers originating 66 per cent. of the calls and 76 per cent. of the subscribers originating only 34 per cent. of the calls. For public call boxes they still charged only 1d. per call, but they did not expect to make profit out of them.

COMPETITION.

As competition between telephone systems in the same district was undesirable, there should be more than one administrative unit. That would necessitate decentralisation, with the possible delegation of some of the systems to independent authorities. He gave a list of present annual tariffs in Hull. The wages paid were the same as those paid by the Post Office system. Down to two years ago they had a net profit, after providing for interest and sinking fund, royalties and other charges. This year they had sustained a loss to March 31, but they expected to clear that with the increases in their tariff. They put this up in November, but they had an increase of 200 subscribers in the first two months. They had one automatic exchange, and if it turned out as satisfactory as was anticipated they would install automatic exchanges in future.

COUNCILLOR ANBLER, Chairman of the Hull Telephone Committee, said they were not satisfied with the Government's scale of wages and the bonuses and thought the bonus ought to be reduced. That was the cause of the loss they had sustained. He did not think London ought to have the flat rate retained, because there was such a high percentage

of calls that had to go through two exchanges. They had been so successful in Hull that he would strongly favour the municipal system. There would be healthy competition between municipalities.

Mr. FRANK BIRD, the secretary of the Newspaper Society, in the course of his evidence, said he was decidedly in favour of the flat rate of charge. He could imagine nothing more directly calculated to put a drag on business than the sweeping away of the flat-rate system. Claims that it led to overloading of wires could not apply to newspaper offices, where the receipt and despatch of information was of such urgency that a number of wires far in excess of actual requirements were needed. He suggested £25 per annum as a fair sum for a flat rate. He also condemned the new system of trunk charges, which were, he considered, *very objectionable*.

Mr. G. L. HARDING expressed the opinion that no improvement would be effected by separating the telephone and telegraph branches. The present system was quite satisfactory as long as he, as district surveyor, had under him a telephone expert as district manager on whom he could rely. Supervisors were only appointed to exchanges having eight or more operators. He had had no special training in telephone work, and, although without technical knowledge, he directed others who were technical experts. He did not see that it would make for greater efficiency if he had not under his supervision such duties as parcels post, ordinary post, postal orders, telegraphs, &c., in addition to the telephones. If the telegraphs and telephones were made into a special department, it would result in enormously increased expenditure both as to staff and buildings.

Mr. B. WAITE, district manager for Cardiff and Newport, said the quality of the telephone service at the larger exchanges was under regular daily observation, and elsewhere service tests were made from subscribers' offices. Written complaints were dealt with by the district manager, who also received at regular intervals summaries of all verbal complaints at exchanges. Under the National Telephone Company the provincial superintendents, who corresponded to the district surveyors, were telephone experts, and that was of great assistance, naturally. He thought more decentralisation would not do any harm. The surveyor had so many matters under his control and some important matters, such as engineering, not under his control. He did think that in large towns it would make for efficiency if the telephones were kept apart from the Post Office altogether.

Mr. W. H. ALLEN, Controller of the P.O. Stores Department, presented a statement showing that as to new and manufactured stores and apparatus tenders were invited from firms in an approved list, which safeguarded against "rings" and other combinations to keep up prices. As to repairs and conversions, the policy was to maintain their own factories, but not to undertake work in them unless some marked advantage could be obtained by doing so. The Post Office did repair work more cheaply than contractors. In the case of manufacture generally the advantages of Post Office factories over outsiders were less pronounced, and for telephone instruments there were sufficient manufacturers to provide real competition.

The Priory Ceiling Fitting.

We have received from the PRIORY ELECTRICAL ENGINEERING COMPANY, of Bath-street, Birmingham, an ingeniously designed ceiling fitting whose use should not only lead to safety in operation, but to a saving in time of installation and to an elimination of those troubles which arise from careless workmanship in connection with apparatus of the usual kind. This fitting might not inappropriately be termed an "all-metal" fitting as it consists essentially of a brass base, which is secured to the ceiling directly or with the aid of the usual patena block. To this brass base is securely fixed a moulded composition fireproof block which contains brass terminal blocks of the usual design. This moulded block is fitted with a distance piece to separate the two wires of flex and so ensures that no trouble can arise from contact between wires. It also allows all the tension to be taken off the terminals and is estimated to take a breaking strain of 20 lbs. The base and block fit into a conical brass stamping, being held firmly in position by a bayonet joint. This base contains two small holes into which bosses on the brass base fit, thus giving additional security. The fittings are finished in the following colours: polished brass, antique brass, imitation gilt, steel bronze, Florentine bronze, oxidised silver. The whole arrangement is neat and should be efficient. It at least possesses the advantage by its design and nature generally of preventing the accumulation of dust which so often renders ceiling roses unsightly.

Selective Publicity.

The latest production in that wonderful publicity mill, the BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION, is a series of business-getting letters which are intended for reproduction and subsequent circulation amongst present and potential customers. Along with these aids to revenue a complete scheme of publicity is given in outline of such excellence that it might well be adopted by installation contractors and electricity supply undertakings with great benefit to themselves. The idea is an excellent one, as the intending beginner in publicity work is often so frightened by the costs which he thinks are the inevitable companion of any such campaign that he never begins the campaign at all with disastrous results to himself. The specimen letters are illustrated, and the blocks for these can be obtained from the Association.

Legal Intelligence.

Hastings Front Lighting.

Recently Mr. Wm. W. Szlumper, M.C.E., sat as arbitrator to hear evidence in a dispute between Hastings Corporation and the Hastings Tramways Company as to the re-lighting of the Front, which the company have to undertake under their Act of last year. The Act authorised them to construct overhead wires for working their tramways on the line in lieu of the then existing petrol electric system, and a question arose as to whether it was the duty of the Corporation or the Company to supply a new or supplemental cable in connection with the re-lighting.

Mr. MACMORRAN said that the Corporation, in giving up their objection to overhead wires, got an agreement with the Company under which the latter were to substitute a new system of lighting for the old arc lighting. The company were to provide lamps to be placed on their posts, and, at their own expense, as the Corporation might require, provide everything for the purpose. He proposed to submit expert evidence and to ask for a decision in favour of the Corporation to the extent that, in so far as it was necessary to provide any new cable by reason of the alteration of the lighting system provided by Clause 6 of the Act, it should be done by the Company at their expense.

Mr. ROSKILL submitted that the question was not whether the existing cable was sufficient or insufficient, but (having regard to the words of the Act), whether the liability which it was sought to put upon the Company was a liability imposed by the Act. That was a question of law, and he submitted, therefore, that no evidence was admissible. Apart from that, there was a question of law whether that came within sec. 33 of the Tramways Act, 1870, and was subject to arbitration.

Mr. MACMORRAN contended that the short point was whether the word "cable" in the section in question included part of the Corporation's main cable. The Arbitrator would really have to interpret the section as it stood. The company wanted to remove the restrictions which had been placed upon them, and in consideration of the Corporation consenting to their proposals the provisions in sec. 6 were inserted for the protection of the Corporation. The section involved the abolition of the existing system and the substitution of something else.

Mr. C. H. WORDINGHAM, C.B.E., consulting electrical engineer, said he had inspected the sea front along which the tramway they were dealing with ran. He had read and considered the clauses of the Acts of 1903 and 1905. The present system of lighting consisted of an arc lamp on its own special pole. The current was transmitted along the sea front at a pressure of 600 V, and was transformed down to each post to a suitable pressure, and approximating 50 V. By switching off and on at a single point there was a double saving of labour. He had read the Act of 1920, and knew it was proposed to make what he might call a new system of lighting on the front. As he understood it, it was a substitution of another complete and different system for the existing method of street lighting. With the new system there were twice as many posts, and each post was to carry two 200 W lamps. The new posts would be 40 yds. apart instead of 80. Under the new system the power consumption would be 33% per cent. more, and in order that it might be complete and equivalent to the old one it must be capable of giving the light provided for in the clause, and of enabling the lamps to be switched on and off from a central point. Under the new system they must provide for a greater consumption, partly because the watts to be transmitted were greater, and partly because the pressure was lower. There must either be a new cable or the existing one must be supplemented. The most economical way would be to supplement the existing cable along a portion of the front.

In cross-examination Mr. WORDINGHAM said he thought the agreement prevented the old arc lamps being put on new standards. He was not prepared to say it was a better system; it was a better distributing system, and there were more lamps.

Mr. ROSKILL (for the Tramways Company) said the correspondence showed that the Town Clerk, on behalf of the Corporation, intimated that they would be willing that the cable should be sectionalised provided the company paid for it. On that occasion the Town Clerk wrote the Corporation were not desirous that the company should be put to any unnecessary expense, and therefore would be prepared to consider any reasonable alternative. He was authorised to intimate that if the company submitted a scheme for sectionalising the existing lighting cable, and connecting each section to the Corporation's general supply, and carrying out such work and supplying such switches as the Corporation required to the satisfaction of the Borough Electrical Engineer, the Corporation would favourably consider the scheme. That fell through because the company, being advised they were not liable, declined to do it. On the point at issue the company submitted that their only liability was to make the necessary connections with the new standards. First of all, the company had to place on the standards erected by them, as the Corporation might require, electric lamps in substitution for the existing lamps. The next step was that the company, at their expense, had to provide, fix and properly connect all necessary cable, wires, appliances and apparatus in connection therewith. That provision clearly dealt with fitting and not constructive work. The next clause was: "The Corporation shall be entitled to the use of such posts and standards for the said lamps, cables, wires, appliances and apparatus free of cost." The word "cables," he submitted had no reference to the main cable. How could it include the main cable, which already belonged to the Corporation? It must be something to the use of which they would be entitled free of cost. There was not a single word in any of the clauses that could be interpreted to mean the provision of a new cable.

Mr. WORDINGHAM said he did not think the attachment, from an

engineering point of view, could be called a cable, for the reason that the current to be carried up any individual lamp-post and down again was such that he took it the connection would be very small. The current would be only 1 A per lamp, and to talk about a cable to carry 1 A would be almost absurd. The cable could be attached to a standard or post, but it could not be connected to it; it must be connected to the lamp.

The Arbitrator has now issued his award in the form of a special case, and he has determined, subject to the opinion of the Court, that, having regard to the fact that either a new cable laid along the route of tramway No. 1, or a sufficient addition to the existing cable, is necessary in connection with the substituted lighting, the provisions of sec. 6 (3) of the 1920 Act place upon the company an obligation at their own expense to provide and lay such a cable or such an addition to the existing cable.

Hairdresser and Electrical Fittings Shop.

An extraordinary story as to a hairdresser and an electric lamp and fittings business was told in the Shoreditch County Court on Friday, before Judge Cluer, when the Weston Electric Lamp Company sued Mr. Street, Hill-street, Peckham, for £5. 3s. 6d. for goods supplied.

Mr. CRIPWELL (for plaintiffs) said delivery was proved to Alfred Street, and the man who had been served with the summons said he was that individual. He admitted the signature, but said the goods had nothing to do with him, but were for his son's business. His son was 22 years, and dealt in electrical goods, using the front window of his (defendant's) shop to show them off. Defendant was a hairdresser and always had been, and he knew nothing about electric lamps and bulbs.

Judge CLUER: I see the customer's signature to the order is "B. Street."

DEFENDANT: "That is my son; I am a hairdresser, and don't understand the goods. I might have served customers with goods if my son was away." He did not know exactly where his son lived, but he used the Peckham address. He was sometimes away for months. Certainly he was at home on Sunday, but he did not know where he lived.

Judge CLUER: That is the answer of a hairdresser and not an honest man. He might just as well say he does not know where a twenty-month-old baby lives because it is out in the "pram." It was evident they had got hold of the wrong man, so the summons would have to be dismissed against defendant, with costs.

Parliamentary Intelligence.

COUNTY OF LONDON BILL.

The Bill of the County of London Electric Supply Company was read a second time in the House of Commons on Monday.

Mr. J. D. GILBERT moved the rejection of the Bill on behalf of the London County Council. He urged that in the interests of unity in the supply of electricity in the metropolis no Bill of that kind should be passed until the schemes submitted to the Electricity Commissioners for the constitution of a joint electricity authority had been inquired into.

Mr. P. J. HANCOCK and other members supported the Bill on the ground that it was absolutely necessary if the company was to develop and fulfil its existing statutory obligations.

Mr. A. NEAL said that the Bill having passed the House of Lords, it would be a strong measure for the Commons to reject it on second reading and not allow it to be examined in Committee. A considerable part of the Bill dealt with financial requirements to enable the company to carry out powers conferred in 1913.

Electric Traction.

The annual accounts of the tramways department were presented to GLASGOW Corporation on the 7th inst. The revenue had increased by £671,954 over the previous year, but the expenditure had also increased very considerably. On the year's working there was a surplus of £105,796, although they had still a debit balance to carry forward.

In a report on the WAGES OF TRAMWAY EMPLOYEES, the Highways Committee of the London County Council states that the National Joint Industrial Council for the Tramways Industry has adopted the recommendations of a special Joint Committee, which had considered the report of the Court of Inquiry on wages. It is recommended that the present rate of wages should be maintained until the first full pay period in August, and that thereafter reductions from and additions to wages shall be at the rate of 1s. per week for each complete five points variation either way in the cost of living index figure commencing from the figure of 135 per cent. above the August, 1914, cost of living. Thereafter the adjustment of wages are to be regulated every three months.

The Minister of Transport (Sir E. Geddes) stated in the House of Commons on Monday that the ELECTRIFICATION SCHEME OF THE LONDON, BRIGHTON & SOUTH COAST RAILWAY has not been submitted to them for approval, but their proposals had been before him on a request from the company for State assistance in the provision of capital, for which, however, no public funds were available. The scheme had been considered by the Electrification of Railways Advisory Committee and was dealt with in their interim report of July, 1920. He was in agreement with their conclusions. The company were fully alive to the importance of proceeding with the electrification of the remaining portion of their suburban system, and at present they were installing electric equipment up to Croydon. When this was completed it would greatly relieve existing pressure. Future extensions, including the electrification of the main line to Brighton and other places, depended upon financial considerations.

Electricity Supply.

The LOCHABER WATER POWER BILL came before the Lord Chairman of Committees in the House of Lords on the 7th inst., and, there being no opposition, the measure was passed for third reading.

STEPNEY (London) Electricity Committee report to the Council that they have given an order to Messrs. Babcock & Wilcox to fit two boilers at the Limehouse generating station with 16 steam oil burners.

The STAFFORD Electricity Committee have ordered an additional length of 500 yds. of h.t. cable from the Pirelli Cable Works in order to complete the main now being laid to the works of the English Electric Company.

On the occasion of the visit of the Prince of Wales to ROTHERHAM on the 20th inst. His Royal Highness will inaugurate the Corporation Electricity Works, in Rawmarsh-road and start the principal generating set.

The HESTON AND ISLEWORTH Urban Council, in conjunction with EALING Corporation, have submitted proposals to the Electricity Commissioners for erecting a new generating station for supplying the combined districts. The station will be near the Duke of Northumberland's residence at Syon, on the banks of the Thames.

Owing to an accident to one of the turbine sets at the TREFOREST POWER STATION the SOUTH WALES ELECTRICAL POWER DISTRIBUTION COMPANY is unable to give a full supply of electricity to several collieries in the Rhondda and Merthyr Valleys. A system of rationing has been introduced, and the collieries obtain electricity for pumping and for the ventilating fans, but in some cases it is found impossible to supply sufficient for haulage purposes.

In consequence of the recent decision of the DOVER CORPORATION to terminate the engagements of the Chief Assistant Electrical Engineer, the Mains and the Shift Engineers, with the option of being re-appointed at lower salaries. The Electrical Power Engineers' Association is instructing its members not to accept re-appointment at the new terms and is also instituting a boycott of the undertaking by advising all qualified engineers not to apply for the vacant positions.

The chairman of the Electricity Committee (Sir Chas. Starmer) announced at the meeting of DARLINGTON Corporation last week that about £4,000 additional cost at the electricity works has been entailed by the coal dispute, but with a reduction of 6s. per week in the men's wages and various economies, together with increased consumption, the committee hoped to make up this amount without increasing the charges either for power or lighting.

The Special Committee appointed by WALLASEY Corporation to consider the position of the electricity undertaking have resolved that the electrical engineer and manager shall reside within the borough, and a house is to be erected on land near the works for the residence of the station superintendent. The Committee also find that there has not been that co-operation between the various committees of the Council which there ought to have been in a public utility service such as electricity.

An interesting statement has been issued by the LEEDS Electricity Department in regard to supplies of coal, &c., during the strike. On March 23 the stock of coal held was 12,744 tons, and the consumption was about 500 tons per week. Further purchases (all British) amounted to 9,000 tons, but owing to the low value of some of it, this would be equivalent to about 7,000 tons of coal of ordinary quality. At the end of the stoppage the stock was 2,045 tons, and orders had been placed for about 1,000 tons of Canadian coal which could have been further increased as required for an indefinite period. The inferior quality of much of the fuel received threw a severe strain upon the firemen and the supervising engineers, and great credit is due to them for maintaining the supply of electric current under such difficulties.

Two boilers were converted to make them adaptable for the use of oil exclusively in place of coal, but it did not become necessary to consider the purchase of oil until near the end of the stoppage, when arrangements were made to ensure a small but regular supply to help out the coal. The quantity actually purchased was 60 tons. The power supply was not restricted until May 1, and it is believed that no serious loss or inconvenience was caused by the restrictions, which were suspended from June 27. There was no interference with ordinary lighting or heating supplies, and on some 20 or 30 days the Tramways Committee, in addition to taking their normal quantity of current from the electricity department, were furnished with larger supplies to keep the trams running when the supply of oil failed, or when the service of cars would otherwise have had to be suspended or reduced. It is hoped that the reduction in the supply of current for power may be regarded largely as a postponement of income rather than as an actual loss, and therefore no account is taken of this. The 10,000 tons of coal was purchased at an average price of 52s. 6d., compared with a pre-stoppage value (allowing for difference in quality) of 20s. per ton, or a difference of £16,250. The cost of leading coal from the stock at Hunslet was £2,000, and the slight extra cost of burning oil (say £200) brings the total cost of the stoppage to the Department to approximately £18,500.

We are informed by Mr. Hefford that the experiments referred to on page 60 of our last issue, as to the relative merits of coal and oil fuel, are being carried out by the Leeds Tramways Department upon an installation of Lancashire boilers. The boilers of the electric supply undertaking are of the Babcock & Wilcox type, and the question of converting from coal to oil has never been seriously contemplated owing to the magnitude of the task. Two boilers were converted to oil fuel during the recent dispute, but the large stock of coal carried in reserve and the considerable success achieved in obtaining supplies during the stoppage provided for an adequate supply of electricity throughout the crisis.

Imperial and Foreign Notes.

The PAIDEE CABLE Board has decided to reinstate the Deferred Press Service between the United Kingdom and Canada on the one hand and Australasia on the other.

The SOCIETA EGIZIANA PRODOTTI PIRELLI has been found to manufacture and sell "Pirelli" india rubber goods, electric cables and accessories, etc., in Egypt. The capital is £500,000 in 3,000 shares of £120 each, and the headquarters are at Milan. The directors are: Dr. Piero and Dr. Alberto Pirelli, of Milan, who will be represented by Comm. Ugo Cavallero (Milan), Signori Camillo Viterbo, Rurio Lucuo and Mr. Roberto Auritano (Alexandria).

In consequence of a disastrous fire on Friday last the ASNIERES POWER STATION, which supplies electric current to the north-western suburbs of Paris, was totally destroyed.

The "Kölnische Zeitung" reports a fusion of SIX GERMAN RAILWAY, TRAMWAY and other carriage-manufacturing companies. The new company (registered in Düsseldorf) comprises the Dessauer Waggonfabrik A.G., Düsseldorf Eisenbahnbedarf vorm. Karl Weyer & Company, H. Fuchs Waggonfabrik A.G. (Heidelberg), the Siegerner Eisenbahnbedarf A.G., the Waggonfabrik A.G. (Uerdingen a/Rh.) and Wegmann & Company (Cassel).

The U.S.A. State Department has intimated to the Chinese Minister that it will support the FEDERAL TELEGRAPH COMPANY'S RIGHTS under its contract with the Chinese Government for the erection of wireless stations at Shanghai and elsewhere, notwithstanding protests by the British, Japanese and Danish Governments. The Department believes that the protesting Governments' desire to exclude the American company is "founded upon assertions of monopolistic or preferential rights in Chinese governmental enterprise which cannot be reconciled with the treaty rights of American citizens in China or the principle of the open door."

Institution Notes.

We understand that the offer of Mr. E. M. Hughman, of Bombay, to give a donation of £250 to the Benevolent Fund of the INSTITUTION OF ELECTRICAL ENGINEERS on condition that nineteen similar amounts were contributed by June 30, has been extended to Dec. 31, 1921.

According to the "Electrical World" the vacancy on the staff of the BUREAU OF STANDARDS caused by the death of Dr. E. B. Rosa has not yet been filled. It is not improbable that the work in electrical physics and in electrical engineering which were combined under Dr. Rosa's superintendence will in future be conducted by separate departments.

The following Council and Officers of the NORTH-EAST COAST INSTITUTION OF ENGINEERS & SHIPBUILDERS have been elected for 1921-1922:—*President*: Sir William J. Noble, Bart.; *Vice-Presidents*: Messrs. C. W. Cairns, M.Sc., A. Laing, C.B.E., C. D. Smith, O.B.E., and R. Wallis, Wh.Sc., M.B.E.; *Ordinary Members of Council*: Messrs. B. C. Browne, Eng.-Commander C. J. Hawkes, R.N. (ret.), R. Hinchcliffe, M.B.E., H. Laing, O.B.E., and J. E. Stead, D.Met., D.Sc., F.R.S.; *Hon. Treasurer*: R. H. Winstanley.

The first general meeting of the SOCIETY OF RADIOGRAPHERS was held at University College, Gower-street, on the 8th inst., when the president (Sir Archibald Reid) announced that the membership had increased to 74. The society was formed to promote the science, regulate the practice of radiography, consider and discuss all subjects affecting it and to increase the facilities for the interchange of ideas and information on matters affecting radiography and allied subjects. There were no "associate" members, and it was the hope and desire of the council that all membership should be by examination only. One examination had already been held, and the majority of the members had passed it and been granted diplomas. With regard to the programme for the current session, it was hoped, by the courtesy of the Institution of Electrical Engineers, to hold meetings in their lecture-room on the second Tuesday in the months of October and December, 1921, and February and April, 1922. It was proposed to invite theses in radiography and electro-therapy from present members of the society, for which two presentations would be made of 10 guineas each.

Bankruptcies, Liquidations, &c.

The ARMOURDUT BRITISH COMPANY, LTD., is being wound up voluntarily, and Mr. H. A. Pepper, 14, Temple-street, Birmingham, has been appointed liquidator.

Claims against WALTER HEDGECOX, electrical engineer, 121, Salop-street, Wolverhampton, are to be sent by July 22 to Mr. S. W. Page, 30, Lichfield-street, Wolverhampton.

Claims against ALFRED ROWLAND MEGGETT, electrical engineer, 45, Thrumpton-lane, East Retford, are to be sent by July 20 to Mr. F. C. Brogden, 10, Bank-street, Lincoln.

A petition for the winding up of the E.B.C. ELECTRICAL COMPANY, LTD., has been presented to the High Court of Justice by Mr. L. C. Harvey, of 25, Victoria-street, S.W.1, and will be heard on July 19.

The public examination of Robt. Chas. Jones, lately trading as ELECT-MA ENGINEERING COMPANY at 10, Caledonia-street, King's Cross, London, N., will be proceeded with on July 29 at Bankruptcy Buildings, London, W.C.2.

HARRY MICHAEL WOLLMAN, electrical factor, lately trading at 9, Greensboro'-road, Parkgate, near Rotherham, has been adjudicated bankrupt. First meeting of creditors will take place on July 19 at the Official Receiver's office, Finsbury-lane, and the public examination on Aug. 4 at the County Court Hall, Sheffield.

Catalogues, Price Lists, &c.

We have received from Mr. GEORGE ELLISON a very complete catalogue containing technical data, prices, illustrations and dimensions of their well known range of manufacture. The design and production of this apparatus include so many interesting points that we shall hope to refer to them at length in an early issue.

A new booklet on "CLEAN YOUR HOUSE THE ELECTROLUX WAY" has been prepared by the Z. Electric Lamp & Supplies Company, Ltd., and describes the various domestic purposes for which the company's "electrolux" portable cleaning apparatus can be employed. Supplies of the booklet, with trade buyers' names and addresses over-printed, can be obtained from a company, 73, Newman-street, London, W. 1.

The EDISON SWAN ELECTRIC COMPANY, LTD., have issued four nicely illustrated price lists of Royal Edisonwan gasfilled, drawn wire and automobile lamps. Recent extensions at the Company's City warehouse (13/5, Queen Victoria-street, E.C.4) enable them to carry large stocks of lamps and fittings and two stock lists of gasfilled and vacuum lamps have been prepared. The City branch is under the control of Mr. T. S. Reed.

The "INSTALLATION NEWS" of Messrs. SIMPLEX CONDUITS, LTD., Garrison-lane, Birmingham, is one of the few house organs which contain interesting original contributions. The July issue of the journal has a useful article on "Earthing of Factory and Works Installations" and a contribution on "Wiring in Modern Concrete Buildings." It also gives an illustrated description of a new pattern of simplex standard hand lamp and some information concerning the company's water-tight fittings for colliery lighting and of the Simplex "Stellite" lanterns for industrial and street lighting. A brief outline is given of the design and construction of the fittings and lanterns, which are available in a wide range and suitable for all purposes. The lamp and fittings comply with the Home Office and other Departmental Regulations.

Personal and Appointments.

H.R.H. THE PRINCE OF WALES, K.G., has accepted the office of Vice-Patron of the Royal Society of Arts.

Among the medals awarded by the Society for Papers read during the session is one to Dr. W. CRAMP for his contribution on "Pneumatic Elevators in Theory and Practice."

Mr. A. L. TACKLEY has been appointed one of H.M. electrical inspectors of factories.

Mr. AMBROSE SWASEY has been elected an honorary member of the Institution of Mechanical Engineers.

Mr. A. J. STUBBS, assistant engineer-in-chief at the General Post Office, London, is retiring under the age limit rule.

Mr. JAMES T. MILTON is retiring from the post of chief engineer surveyor to Lloyds Register, and Mr. H. Ruck-Keene, M.Inst.C.E., who has been Mr. Milton's assistant for 12 years, will succeed him.

On the 6th inst. the permanent staff of the London Chamber of Commerce presented Mr. C. E. TOWN, the recently retired assistant secretary of the Chamber, with an antique mahogany bookcase and an illuminated framed address, bearing the names of 78 members of the staff.

Mr. WILFRID PLANT, electrical engineer, late of the dockyard, Invergordon, has been appointed burgh electrical engineer at Tain, in connection with the new electric lighting scheme. Mr. Plant, who served throughout the war, obtained a commission, reaching the rank of Captain.

The Postmaster-General has appointed a POST OFFICE BOARD, consisting of the heads of the most important branches of Post Office work, in order to improve the organisation, &c. The members are:—The Postmaster-General and Assistant Postmaster-General; Sir Evelyn Murray, Secretary, and Mr. E. Raven, Second Secretary to the P.O.; Sir Henry N. Bunbury, K.C.B., Comptroller and Accountant-General; the following Assistant Secretaries: Mr. W. G. Gates (Home Mails), Mr. F. J. Brown (Telegraph), Brigadier-General F. H. Williamson (Foreign and Colonial), Mr. J. Y. Bell (Establishments), Mr. A. R. Kidner (Telephone), Mr. W. T. Leech (Staff), Mr. W. E. Parsons (Buildings and Supplies), and Sir William Noble, Engineer-in-Chief. Lieutenant-Colonel T. M. Banks will act as Secretary.

Business Items, &c.

Owing to the annual holidays, the works of Messrs. THOS. BROADBENT & SONS, LTD., Huddersfield, will be closed from Friday evening, July 15, until Wednesday, July 27.

The ELECTRIC LAMP MANUFACTURERS' ASSOCIATION OF GREAT BRITAIN, LTD., has moved to Elma House, 25, Bedford-square, London, W.C.1. Telephone numbers, Museum 7828 and 7829; telegraphic address, Britelma, Westcent, London.

The CARDIFF BRANCH OFFICE of the EDISON SWAN ELECTRIC COMPANY, LTD., has been removed to 25-27, Charles-street, and in order to make for better efficiency and service to the trade, the branch is now in direct touch with the Company's works instead of being a subsidiary branch working from Bristol. Mr. W. Elliott, B.Sc., A.M.I.E.E., has been appointed superintendent of the new district.

Messrs. BRUCE PEEBLES & COMPANY, LTD., have recently appointed Charlesworth Peebles & Company, 134, St. Vincent-street, Glasgow, as their agents for the whole of Scotland, with the exception of the area in the East of Scotland, which for many years has been efficiently covered and will still be covered by Messrs. Mitchell, Graham & Son, Ltd., 56, Buccleuch-street, Edinburgh. This new development does not in any way affect the position of Mr. J. A. Hood, who remains the Bruce Peebles Scottish representative.

Miscellaneous.

The SLOAN ELECTRICAL COMPANY, LTD., call our attention to the fact that the correct spelling of the makers of the ½ c.p. night lamp described in our issue of July 1, is Philips, and not Phillips.

We are asked to state that the "Duros" storage cells which we described in our issue of July 1, are not made by Messrs. E. G. LIND & COMPANY, who are the sole agents for this equipment in Great Britain and the Colonies. The cells are manufactured by the Accumulatoren Fabrik Aktiengesellschaft.

The staff and employees of WAYGOOD-OTIS, LTD., recently held their twelfth annual sports and garden party, a most successful afternoon being spent. There were three more races in the programme than last year, and the total number of competitors was 540, showing a 50 per cent. increase. The club has a valuable collection of trophies given by the directors, who are keen in the encouragement of sports and in addition a large number of very handsome prizes were provided. Dancing followed the prize giving.

We regret to record the death of LORD BALFOUR OF BURLEIGH, K.T. The deceased peer, who was a director of the Western Telegraph Company, Ltd., was a statesman of the first rank and he performed much useful work during the war by serving on various committees and commissions.

We also regret to announce the death of Mr. C. E. TAYLOR, A.M.I.E.E., an electrical engineer, in the service of the North-Eastern Railway Company's electrical department. Mr. Taylor joined the Company in 1898, being in charge of the electrical plant at the carriage works at York and Shildon. Subsequently he superintended the electrification of the two lines to the coast.

We have received from Sir ROBERT HADFELD a copy of an address of thanks presented by him to the members of the Engineering Society of the United States as a token of his high appreciation of the honour conferred upon him by the presentation of the John Fritz medal, and of the manifold kindnesses and courtesies extended to him on many occasions in the United States. This pamphlet besides dealing with the question more particularly at issue gives an interesting account of Sir Robert's researches in manganese and other steels, and a short history of the Royal Society. The whole is bound up in pamphlet form, and is illustrated with some interesting reproductions of portraits, book plates and signatures connected with the history of that famous body.

IMPORTS.—The following are official values of electrical machinery, apparatus and material imported into this country (a) during May, 1921, and (b) the aggregate figures from Jan. 1 to May 31, with increase or decrease compared with corresponding periods of 1920:—

Electrical machinery, (a) £93 622 (increase £31 784), (b) £392 695 (decrease £11 267); telegraph and telephone cables, submarine (a) nil, (b) nil (decrease £50); other than submarine, (a) £5 155 (increase £4 901), (b) £43 499 (increase £41 041); telegraph and telephone apparatus, (a) £28 347 (increase £20 409), (b) £153 807 (increase £98 330); other electrical wires and cables, rubber insulated, (a) £1 114 (decrease £1 093), (b) £11 737 (increase £814); with other insulations, (a) £11 928 (decrease £3 580), (b) £54 927 (increase £20 417); carbons, (a) £8 544 (decrease £150), (b) £49 528 (decrease £3 544); glow lamps, (a) £25 998 (increase £19 829), (b) £126 721 (increase £109 771); arc lamps and electric searchlights, (a) £9 (decrease £30), (b) £5 644 (increase £3 125); parts of arc lamps and searchlights (other than carbons), (a) £2 913 (increase £1 728), (b) £8 965 (increase £2 786); batteries, (a) £5 941 (increase £2 668), (b) £65 459 (increase £37 979); meters and measuring instruments, (a) £14 936 (increase £9 888), (b) £24 170 (increase £75 826); switchboards, (a) £3 115 (increase £3 095), (b) £4 391 (increase £3 398); electrical goods and apparatus unenumerated, (a) £43 021 (decrease £18 071), (b) £422 638 (increase £187 322). Total of electrical machinery, apparatus and material, other than uninsulated wire, (a) £244 643 (increase £71 388), (b) £1 440 006 (increase £565 948).

EXPORTS.—The exports of electrical machinery, apparatus and material (a) during May, 1921, and (b) from Jan. 1 to May 31, with increase or decrease compared with 1920, were as follows:—

Electrical machinery, (a) £459 625 (increase £314 601), (b) £2 137 103 (increase £1 351 641); including railway and tramway motors, (a) £33 695 (increase £27 118), (b) £116 271 (increase £100 163); other generators and motors, (a) £251 649 (increase £167 774), (b) £1 178 992 (increase £741 789); and electrical machinery unenumerated, (a) £174 281 (increase £119 709), (b) £841 930 (increase £509 689); telegraph and telephone cables, submarine, (a) £807 090 (increase £699 563), (b) £1 481 971 (increase £861 623); other than submarine, (a) £128 075 (increase £29 454), (b) £935 929 (increase £333 225); telegraph and telephone apparatus, (a) £171 642 (increase £80 189), (b) £747 963 (increase £373 323); other electrical wires and cables, rubber insulated, (a) £112 239 (decrease £30 380), (b) £768 816 (increase £161 946); with other insulations, (a) £201 298 (decrease £69 433), (b) £1 031 608 (increase £239 281); carbons, (a) £3 134 (decrease £7 553), (b) £46 770 (increase £5 784); glow lamps, (a) £45 798 (increase £26 287), (b) £238 440 (increase £162 874); arc lamps and searchlights, (a) £2 922 (increase £1 657), (b) £6 898 (increase £409); parts of arc lamps and searchlights (other than carbons), (a) £271 (decrease £1 084), (b) £3 294 (decrease £1 760); batteries, (a) £71 908 (increase £23 394), (b) £363 820 (increase £179 989); meters and measuring instruments, (a) £46 727 (increase £2 557), (b) £206 392 (increase £56 137); switchboards, (a) £16 826 (increase £11 652), (b) £85 393 (increase £51 033); electrical goods and apparatus unenumerated, (a) £174 649 (increase £12 086), (b) £1 076 811 (increase £446 471). Total of electrical machinery, material and apparatus, other than uninsulated wire, (a) £1 243 204 (increase £92 970), (b) £8 931 298 (increase £4 111 976).

Tenders Invited.

RATHMINES and RATHGAR Urban Council invite tenders by the 25th inst. for the supply of swan-neck brackets, cable and service boxes. Tender forms from the electricity works.

The METROPOLITAN ASYLUMS BOARD require tenders by July 20 for alterations and repairs to electric lighting, fire alarm and bell installations at St. George's Home, Chelsea. Specification can be obtained at the Board's Offices, Embankment, E.C.4.

MEXBOROUGH Borough Council invite tenders for supply and erection of e.h.t. switchgear and l.t. d.c. switchboard. Specifications from the engineer and manager (Mr. J. B. Feltham, A.M.I.E.E.), and tenders to the Clerk (Mr. J. W. Hattersley) by noon, July 23.

NEWPORT Corporation invite tenders for the supply of a 750 kW rotary converter, transformers and switchgear. Specifications from the Borough electrical and tramways engineer, and tenders by July 25 to the Town Clerk, Mr. Albert A. Newman, Town Hall, Newport, Mon.

Tenders are invited by Aug. 15 for the supply and delivery to the Postmaster-General's Department, State of TASMANIA, of switchboard material. Tenders, forms, &c., from the High Commissioner for Australia, Room E.5, Australia House, Strand, London, W.C.2.

BRISTOL Electrical Committee invite tenders for the supply of a 3,000-kW single-phase and a 6,000-kW 3-phase turbo-alternators, with condensing plant and auxiliaries. Specifications and forms of tender from the chief engineer and general manager (Mr. H. Faraday Proctor, M.I.C.E., M.I.E.E.), to whom tenders are to be sent by noon, August 15.

The NEW ZEALAND PUBLIC WORKS DEPARTMENT invite tenders for suspension type porcelain insulators to carry 110,000 V 50-cycle transmission lines in connection with the Waikato power scheme. Tenders by August 9 to the Secretary, Public Works Tenders Board, Wellington. Specifications may be seen at the Department of Overseas Trade.

The Secretary of the NEW ZEALAND PUBLIC WORKS TENDER BOARD (Wellington) invites tenders (by Nov. 1) for the supply and erection of new or second-hand auxiliary plant for the Roturua electric supply as follows:—One oil engine (200 to 250 B.H.P.) and one three-phase 50 cycle alternator of 190-kW (power factor of 0.8) with exciter and switchgear. Specifications at Department of Overseas Trade, 35, Old Queen-street, S.W. 1.

THE VICTORIAN RAILWAY COMMISSIONERS invite tenders (by August 3) for the supply of a 5-h.p. electric motor, controller, &c.; by Aug. 10 for 250 impedance bonds for power signalling (Contract 34 130) and 56 miles of insulated copper wire (Contract 34 131); by Aug. 17 for renewals for 3,000 sets of caustic soda primary cells (Contract 34 145); and by Aug. 24, for motor generator set, accessories and switchgear for automatic telephone exchange (Contract No. 34 132); also (by Aug. 31) for the supply and delivery of accumulator cells and accessories (Contract No. 34 171), including (a) 100 sets, 140 Ah capacity in sets of 12, and (b) 32 sets, 200 Ah in sets of 12 cells (electrolyte not included); also for electric lighting equipment (axle generator system), including (a) 45 sets, 30 A set for passenger car, (b) 10 sets 30 A set for van, (c) 16 sets, 40 A set for special car; (d) 72 main car switches (chopper or rotary type), and an extra battery, &c. Tenders to the Commissioners, Spencer-street, Melbourne, and must be accompanied by a preliminary deposit of ½ per cent. of the total offer. Local representation is essential. Specifications at Department of Overseas Trade.

Tenders are invited for the supply of the following plant and material for the Municipality of BULAWAYO (Rhodesia):—(A) two sets of gas-producing plant, (B) gas engines, (C) 3, with alternative of 4, three-phase 300-kW generators, (C') alternative steam plant, (D) main switchboard, (E) switchgear distribution and transformer houses, (F) poles and cross-arms, (G) insulators and shackles, (H) h.d. copper wire, (J) three-core cable, (K) insulated cable, (L) lightning arresters and choke coils, (M) transformers, (N) bus-bar copper, insulators and Crosby clips, (P) stay rods, stay wires and swivels. Specifications from Messrs. Davis & Soper, 54, St. Mary Axe, London, E.C. 3, to whom tenders by Aug. 3.

PAISLEY Corporation has accepted the tender of W. T. Glover & Co., pany for e.h.t. cables from West Croft to Murray-street sub-station, £925.

STOKE NEWINGTON (London) Borough Council has accepted the tenders of the General Electric Company for h.t. and l.t. switchboards, £4 976; and for extra cubical accommodation, £115.

By way of protest against what is alleged to be a ring of cable manufacturers EDINBURGH Corporation have accepted a Belgian tender for the supply of cables, although it was only £216 under the next lowest tender.

DONCASTER Corporation has accepted the following tenders: G. Percy Trentham, Ltd., excavation, laying tramway rails, &c., to Balby, £3 712; Enfield Edison Cable Works, Ltd., l.t. cables, £1 380; Callender's Cable and Construction Co., e.h.t. cables, £1 146.

SHEFFIELD Corporation have provisionally decided to buy 10,000-kW generating set of German manufacture from Amsterdam Corporation (through the White Taylor Marine Corporation) for £49 900. The lowest British quotation was between £90 000 and £100 000, and the next lowest quotation was £80 000 from Switzerland.

The VICTORIAN ELECTRICITY Commissioners have accepted the tender of Messrs. Miliken Brothers, of London, for the manufacture in the United Kingdom and for delivery at port of shipment of 643 towers of galvanised steel for the main transmission line of the Morwell power scheme. The amount (£72 858) was £23 250 below the lowest Australian offers.

WIRELESS TELEGRAPHY.

The Western Union believes the wireless to be a valuable means of international communication and that it will continue to grow as an important factor in overseas transmission, subject always to the solution of existing difficulties connected with static disturbance and the lack of message secrecy. There is no reason why the ocean cable, secret and unhampered by atmospheric conditions, should be superseded as the pre-eminent means of overseas communication. There is a wide field for overseas communication as yet untouched, to many points of which cables will not be laid. The advent of wireless into that field will help materially in the general and much-desired expansion of trade and commerce. This in turn will add to the value and increase the volume of telegraph traffic.

THE SOUTH AMERICAN CABLE DISPUTE.

The report deals fully with the projected South American cable connection. In 1917, the Western Union Company opened negotiations with the Republic of Brazil, and a concession was granted covering a cable from Brazil to the United States. In 1873 Brazil granted a 60-year concession to the Western Telegraph Company whereby all other cable companies were precluded from connecting any two points already connected by the Western system. The Western Company had connected all coastal points of commercial importance. It was the Western Union's intention to run the proposed cable to Rio de Janeiro, and from Rio south to Buenos Aires, and to connect with the important points on the Brazilian coast by means of land lines. On study, however, it was found that the land lines were impracticable, and in order to reach other important Brazilian cities the system of the Western Company had to be utilised. The distance from New York to Buenos Aires is approximately 7 500 miles and the lowest cost, owing to a sudden and phenomenal rise in the price of cable due to the war, was \$15 000 000, for the complete project. Careful consideration was given to the advisability of investing that sum in a cable reaching only to Buenos Aires and Rio de Janeiro, and it was found that not only would it be unprofitable to do so but that in the development of American commerce so many other cable extensions would be needed—to the Orient, to Southern Europe and to Northern Europe—that it was unwise to make so large an investment in one direction. Furthermore, no deep-sea cable is manufactured in the United States, and the output of the various cable manufacturers was contracted for so far in advance that several years might elapse before the cable could be obtained. Though the cable for the world is at present practically all supplied by British companies, there is no reason why deep-sea cable cannot be manufactured in the United States, and one of the largest American electrical concerns has plans under way for manufacturing deep-sea cable. The elements of time and cost being against the Western Union, the best and quickest way of connecting the two continents was to lay a cable from the United States to Barbados, then meeting the Western Company and utilising that company's comprehensive system of terminals in South America for United States business to and from Brazil and the Argentine. A contract with the Western Company was concluded on July 15, 1919, and an order was later placed for the cable from Miami to Barbados at a cost of about \$3 000 000. A provision was inserted in the contract to the effect that the All America Company (which serves the west coast of South America mainly) might, if it chose, come into the co-operative arrangement between the two contracting parties, whereby the All America Company would continue the development of the west coast and Buenos Aires, and the Western Company the east coast north of and including Buenos Aires—thus dividing South America into the two spheres of cable development. The proposal was, however, rejected by the All America Company.

In the early spring of 1920, the Western Union applied for permission to lay a cable through the territorial waters off Miami, Florida, thence to Barbados, to be connected with a cable of the Western system. Never had a cable landing been denied an American company and there was no reason for suspecting that there would be any hostility to the present application. The cable was nearing completion when the Western Union communicated with the State Department and informed them that the cable (1 630 miles in length) could not be stored when finished and that because of the paucity of cable ships capable of laying long lengths—there being two available in the world and both owned by British-cable manufacturers—the programme could not be changed after the ship was loaded. No word was received in answer to this, but early in August, the cable ship reached the United States and discharged the United States shore end, subject to duty. The ship was ready to begin laying the cable, but was met by a squadron of United States ships of war to prevent the work. The remainder of the report is devoted to a recital of the subsequent legal proceedings and to a criticism of the policy of the U.S.A. Government, &c.

The directors of the TELEGRAPH CONSTRUCTION & MAINTENANCE COMPANY, LTD., have declared an interim dividend of 6s. per share, tax free.

The directors of the DUBLIN UNITED TRAMWAYS COMPANY, LTD., have declared a dividend for the past half-year at the rate of 3 per cent. per annum less tax.

In order to avoid the necessity of paying income-tax in this country as well as in Australia the shareholders of the MELBOURNE ELECTRIC SUPPLY COMPANY, LTD., decided unanimously on Monday to transfer the control of the company from London to Melbourne.

Letters of allotment and regret in connection with the recent issue of £228 460 7½ per cent. debenture stock of the NORTH METROPOLITAN

ELECTRIC POWER SUPPLY COMPANY have been posted. The issue was subscribed 11 times over.

The accounts of the ELECTRIC SUPPLY CORPORATION, LTD., for 1920 show, after transferring £7 196 to repairs and renewals fund, and including £621 brought forward, an available balance of £3 403. The directors propose to place £3 000 to reserve fund and to carry forward £403.

The directors of the ST. JAMES and PALL MALL ELECTRIC LIGHT COMPANY, LTD., have declared an interim dividend at the rate of 7 per cent. per annum on the preference and ordinary shares for the half year ending June 30, payable on the 4th August. The share transfer books will be closed from the 21st inst. to August 3 inclusive.

At the recent annual meeting of the RANGOON ELECTRIC TRAMWAY & SUPPLY COMPANY, LTD., at Rangoon, it was reported that the gross trading profit for the past year was £98 000, an increase of nearly £9 000 over the previous year. Income tax was less by £10 000, due to the transfer of the control of the company from London to Rangoon and the escape from the heavy English taxation. The net profit was £37 642, and a dividend of Rs.1.8.0 per share was declared. The tramways carried two million more passengers than in the previous year, and 20 new cars have been added to the rolling-stock. The electric supply branch of the business continued to increase, and in order to keep pace with developments it is proposed to increase the capital.

At the meeting of the WEST INDIAN & PANAMA TELEGRAPH COMPANY, on the 29th ult., the chairman (Sir A. F. King) said that the company had a more disastrous year than in 1919. Their cable steamer "Henry Holmes" was only released from Trinidad dock in October last, more than 20 months after she was handed over. The cost of her survey and repairs, originally estimated at about £10 000, amounted to £74 252, or nearly three and a-half times the reserve of £21 589 provided to meet her depreciation. In the absence of the ship, they found it impossible to get their cables repaired quickly, and consequently their traffic receipts fell off to the extent of over £30 000 compared with 1919. Under the circumstances the Company had been obliged to sell most of its investments at a loss of over £30 000, and there was also a loss of £12 450 through forfeited subsidies. The proposal of an American company to lay a cable from Porto Rico to Cuba would affect the India Company's revenue as Cuba was already joined up to New York by cable.

The chairman of the SOUTH WALES ELECTRICAL POWER DISTRIBUTION COMPANY (Mr. W. G. Dalziel) announced at the meeting last week that the funding of £95 000 arrears of interest on debenture stock had been substantially completed, and the two amounts of £95 000 for deferred interest and £42 750 accumulated interest had disappeared. On the past year's working, after payment of all expenses and bringing forward £672, there was a credit balance of £35 149. After deducting debenture interest and placing £9 735 to depreciation of new plant account, a balance of £4 417 was carried forward. The units sold amounted to 57 043 647, an increase of 11 915 662 units, notwithstanding the dislocation of trade and consequent serious check upon the progressive increase in their output brought about by the strike in the coalfields in October last. Having regard to all the circumstances and the trying conditions which prevailed, the result of the year's working indicated a substantial expansion of the business. That was due not only to the connecting up of new consumers, but also to the increasing demands of those already taking supplies. During the year they carried out several important extensions of mains, and connected up 12 545 additional horse-power, bringing up the total connected up to 60 844 H.P.

The report of the directors of the GENERAL ELECTRIC COMPANY, LTD., states that the net profit for the year ended March 31 amounts to £796 149, and with the balance brought forward (£175 068), the total is £971 817. After deducting debenture stock interest (£8 000), depreciation (£157 915), contribution to pension fund (£17 266), dividends at rate of 6½ per cent. per annum on the "A" preference shares (£107 626), and at rate of 7½ per cent. per annum on the "B" preference shares for the year (£121 718), there remains an available balance of £559 291. The directors recommended payment of a dividend at the rate of 10 per cent. per annum, tax free, on the ordinary share capital for the year (£211 197 10s.), leaving to be carried forward, subject to taxation demands, £348 094.

The directors state that the satisfactory results of the year's trading show that the additional capital obtained at the close of the last financial year is being employed usefully. The general decline of trade throughout the country during the latter half of the financial year did not immediately affect the electrical industry. Contracts in hand assisted in keeping the majority of the Company's works fully employed up to March 31. The results of the Company's Overseas branches have in nearly all cases been satisfactory, though they have suffered from exchange difficulties, and the allied and subsidiary companies continue to make a considerable contribution to the profits. The number of employees increased during the year, and on March 31 totalled over 16 000. Owing to the present state of industry, the directors consider the usual allocation to reserve out of profits inadvisable, and recommend that the amount which they would have allocated under normal conditions should remain in the "carry forward" to next account, which thus stands at the total of £348 000. They feel all the more justified in making this recommendation as the reserve account has benefited during the year by the sum of £257 016, through the transfer of net premiums received on the share issue of March, 1920, thus making the total of this account over £700 000.

The assets of the Company amount to over £11 000 000, an increase of £4 000 000 upon last year's figures. The considerable increase in the fixed assets is mainly accounted for by the absorption of the Peel Conner Company with its works at Manchester and Coventry, the further large extensions to the engineering works at Witton and the Osram Works at Hammersmith, and the completion of the building in Kingway. "Stock-

in-Trade and Work in Progress" valued in the usual manner show a large increase, which is accounted for to a considerable extent by work in progress for actual orders. Mr. M. Solomon has been appointed managing director of the Pirelli-General Cable Works, Limited, one of the Company's Allied organisations, and has resigned from the Board of the G.E.C. in order to devote his whole time to the work involved, but Mr. M. S. Conner, formerly managing director of the Peel Conner Telephone Works, has joined the Board.

New Companies.

The following list is compiled from information supplied by Messrs. Jordan & Sons, Ltd., company registration agents, Chancery-lane, London, W.C.2.—

ALLIANCE WHOLESALE ELECTRICAL, LTD. (175 447).—Reg. June 29, capital £3,000 in £1 shares, to carry on business of wholesale suppliers and manufacturers of machinery and apparatus used in connection with electricity. Directors, W. F. White (93, Hamlet-gardens, Ravenscourt Park, W.6.), H. J. Grant and Elizabeth McArthur. Private company.

AQUATOLE COMPANY, LTD. (175 448).—Reg. June 29, capital £12,000 in 10,000 £1 and 40,000 1s. shares, to develop or otherwise turn to account inventions relating to the lifting of water and other fluids, and to carry on the business of mechanical and electrical engineers. Directors, F. P. Robjeat (Newport, Mon.), J. C. Grant, S. Bouvrie and L. H. Nelles.

BINCO, LTD. (175 363).—Reg. June 24, capital £100 in £1 shares, to carry on business of engineers and manufacturers of precision instruments and motor accessories. Directors, H. Bingley and F. Cooper. Reg. office: 1, Montague-street, W.C.1. Private company.

LANDSDOWNE GARAGE & ENGINEERING WORKS, LTD. (175 413).—Reg. June 27, capital £5,000 in 10,000 5s. preference and 2,500 £1 ordinary shares, to acquire and carry on business of motor, electrical and general engineers. Directors, H. C. Garner, W. H. Hughes, W. J. Wright and F. J. Payne. Reg. office: 66, Lansdowne-road, Stockwell, S.W.8. Private company.

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"The Cabinet Maker":—"Furnishing of New Midland Railway Dining Cars (illustrated)"; "Exports of Furnishing Goods for the Past Half Year"; and "Practical Polishing."

"Chemical Age":—"Association of British Chemical Manufacturers: Historical Sketch with Photographs; and "History of British Dyestuffs Industry (concluded)."

"Farm & Home":—"Royal Shows of the Past," by Prof. James Long; "Why Farming is Decontrolled"; and "Wages Board Split." "The Fruit-Grower":—"Fruit-Growing in Ontario"; "West Country Orchards"; and "The Marketing of Fruit." "The Gas World":—"How the Gas Industry met the Coal Stoppage," and "Promotion of Employees."

"Hardware Trade Journal":—"The Uses of the Tool Store"; "Electric Pocket Lamps and Novelties"; and "Changes in the Prices of Building Materials."

"Gardening Illustrated":—"Rose Betty Uprichard (illustrated)"; "The Prolonged Drought"; and "Annals in the Garden."

Books Received.

[Copies of the undermentioned works can be had from THE ELECTRICIAN Offices on receipt of published price, plus postage.]

"Theory of Wave Transmission." By G. Constantinesco. Vol. I. (London: W. Haddon.) Pp. 211.

"Modern Central Stations." By C. W. Marshall, B.Sc. (London: Sir Isaac Pitman & Sons.) Pp. x+112. 2s. 6d. net.

"Een Hoogspanningslichtnet voor Nederland." Vol. 8. (Amsterdam: D. N. Van Kampen & Zoon.) Pp. 120.

"Electrical Machinery," by F. A. Annett. (London: Hill Publishing Company.) Pp. xiii+431. 18s. net.

Dictionary of British Scientific Instruments Issued by the British Optical Instrument Manufacturers' Association. (London: Constable & Company.) Pp. iii+344.

"Thermionic Tubes in Radio Telegraphy and Telephony." By J. Scott-Taggart. (London: Wireless Press.) Pp. xiii+121. 25s.

"Power House Design." By Sir John F. C. Snell. (London: Longmans, Green & Company.) 2nd edition. Pp. xi+535. 42s. net.

"Engineering Steels." By Leslie Aitchison, D.Met. (London: Macdonald & Evans.) Pp. xxxi+396. 25s. net.

"Die Porzellan-Isolatoren." By Prof. Dr. G. Benischke. (Berlin: Julius Springer.) Pp. 94. M. 24.

"Die Asynchronen Drehtrommotoren Induktions- und Kommutatormotoren," by Prof. Dr. G. Benischke. (Braunschweig: F. Vieweg & Sohn.) Pp. viii+232. M. 24.

"Electrical Rates," by G. P. Watkins. (New York: D. Van Nostrand Co.) Pp. 228.

Arrangements for the Week.

FRIDAY, July 15th (to-day).

TRAMWAYS AND LIGHT RAILWAYS ASSOCIATION.

2 p.m. At Caxton Hall, London, S.W. Annual General Meeting and Annual Congress.

INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

Wednesday, July 20th.

At the Institution of Electrical Engineers, Victoria Embankment, London, W.C.

2.30 p.m. Presidential Address by Major H. Richardson.

2.45 p.m. Paper on "Questions Arising in the Consideration of the Financial and Business Aspects of Municipal Electricity Supply," by Mr. C. W. Charlesworth.

Thursday, July 21st.

10 a.m. Papers on "Steam Raising—Yesterday, To-day and To-morrow," by Mr. D. Wilson, and "Modern Boiler House Practice," by Mr. W. H. Miles.

2.30 p.m. Paper on "Present Day and Commercial Problems in Electricity Supply," by Mr. E. Cross.

7 p.m. At the Hotel Cecil, Strand, London, W.C. Annual Dinner.

Friday, July 22nd.

10.15 a.m. Annual General Meeting.

Forty Years Ago.

(THE ELECTRICIAN, JULY 15, 1881.)

CANADIAN GOVERNMENT AND THE TELEGRAPHS.—News from New York says that the report that the Canadian Government intends to assume the control of the telegraph lines is denied.

AN ELECTRIC MOTOR.—Mr. A. H. Doane, of Cincinnati, claims to have invented an electric motor which he can attach to a street car at an expense of 50 dollars and then run the car for 10 cents a day.

NEW YORK STREET LIGHTING.—As in London a short time since, so in New York the electric lights will go out occasionally. Those on Broadway were recently extinguished during a storm, and it was several hours before they were brought into working order again.

QUICK WORK.—The result of the Derby was transmitted to New York in wonderfully quick time. The following are the times of receipt and despatch of the message announcing the victory of Iroquois to the New York Telegram: "Horses got away at 10: 21: 5, New York time. Iroquois passed winning post 10: 23: 55, New York time. Result reached New York 10: 24. Time occupied in transmission, 5 seconds."

Prices of Metals, Chemicals, &c.

			TUESDAY, July 12.	
			Inc.	Dec.
<i>Copper—</i>			Price.	
Best selected.....	per ton		£74 0 0	£1 0 0
Electro Wirebars ..	"		£77 10 0	—
H.C. wire, basis	per lb.		0s. 11 ¹³ / ₁₆ d.	—
Sheet	"		1s. 0d.	—
<i>Phosphor Bronze Wire (Telephone)—</i>				
Phosphor-bronze				
wire, basis	"		1s. 3 ¹³ / ₁₆ d.	—
<i>Brass 60/40—</i>				
Rod, basis	"		0s. 8d.	—
Sheet, basis	"		0s. 11 ¹³ / ₁₆ d.	—
Wire, basis	"		0s. 11 ¹³ / ₁₆ d.	—
<i>Pig Iron—</i>				
Cleveland Warrants .	per ton		£6 10 0	—
Galvanised steel				
wire, basis 8 SWG ..	"		£27 0 0	—
<i>Lead Pig—</i>				
English	"		£24 10 0	—
Foreign or Colonial ...	"		£23 2 6	2s. 6d.
<i>Tin—</i>				
Ingot	"		£166 5 0	£4 15 0
Wire, basis	per lb.		2s. 3 ¹ / ₂ d.	3 ¹ / ₂ d.
<i>Salammoniac.—Per cwt. 75s.-70s.</i>			<i>Copper Sulphate.—Per ton £30.</i>	
<i>Sulphur (Flowers).—Ton £15.</i>			<i>Boric Acid (Crystals).—Per ton</i>	
<i>" (Roll-Brimstone).—Per ton</i>			<i>£69.</i>	
<i>£15.</i>			<i>Sodium Bichromate.—Per lb. 7¹/₂ d.</i>	
<i>Sulphuric Acid (Pyrites, 168°).—</i>			<i>Sodium Chlorate.—Per lb. 4d.</i>	
<i>Per ton, £9 17s. 6d.</i>				

The metal prices are supplied by British Insulated & Helsby Cables, and the rubber prices by W. T. Henley Telegraph Co., Ltd.

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Notes.

Are Joint Authorities Necessary?

THE question whether Joint Authorities are really necessary in the electricity supply industry is raised by the recent representations made to the Electricity Commissioners by the Yorkshire Electric Power Company. It appears that a large part of the North-East Midlands District is already covered by the Yorkshire Company or the Derbyshire & Nottinghamshire Electric Power Company and it is submitted that in the co-operation of these two companies lies the best chance of an economical development of electricity supply, while the interests of consumers are sufficiently safeguarded by the existing limitations as to the dividends and charges. The Yorkshire Company already co-operates closely with other undertakers in the supply of electricity in the district, has agreements with 62 authorised distributors for supply and for an interchange of supply with the Sheffield, Rotherham and Mexborough Councils. Its area of supply includes the Yorkshire coalfield, which extends continuously from north to South across the boundary, a fact which should lead to a development of the load and to satisfactory arrangements for the supply of waste heat and surplus power. No doubt there is great force in the arguments of the Company and we hope that some policy will be adopted which will permit of its continued development.

Why a Joint Authority is Required.

THE Company has rendered great service to the industries of Yorkshire, more particularly by providing a supply of electric power for collieries and large factories and it would therefore be unfortunate if anything happened to limit its usefulness or to check its progress. Nevertheless, we think that though a Joint Authority for the district may not be essential, it would be useful in co-ordinating the work of existing undertakers, in extending supply to outlying areas and in safeguarding the general interests of consumers. A Joint Authority need not necessarily purchase existing

undertakings outright. The alternative plan of leasing might be adopted and thus avoid the issue of a large amount of capital. We notice that the Commissioners are requested to remove the restriction upon the company supplying electricity for lighting in districts where there are no authorised distributors and that permission is also asked to supply such demands as may arise on equitable terms. Failing the creation of a Joint Authority, this obsolete restriction should be removed. It is an obstacle to progress and either the company or a Joint Authority should have the right to supply in bulk or, if necessary, in retail throughout the whole area.

Protecting the Public.

APART, however, from all these considerations, the Joint Authorities' most useful function will lie in ensuring that the consumers of electricity are not harmfully affected by the operations of concerns approaching a trust in size and influence. There is no doubt that in many ways the facilities for getting about London quickly, cheaply and efficiently have been increased by the amalgamation of the various transport undertakings which now form the Underground group. So far the financial results to the shareholders have not been gratifying as was expected, but doubtless this will come. On the other hand, there has been a distinct change for the worse in the attitude of all classes of employees towards the travelling public they are supposed to serve, a tendency to look upon passengers as cattle, to treat them cavalierly and generally to regard them as an annoying if necessary drawback to what would otherwise be a pleasant occupation. The sense of power which a monopoly gives operates in a variety of ways harmful to the public good and we hope that this aspect will be borne in mind by those who see in the erection of a trust a solution of many electricity supply problems.

A Substitute for a Joint Authority.

A SIMPLE way of avoiding the trouble and friction suggested by the formation of Joint Electricity Authorities is suggested in the scheme proposed for the reorganisation of electricity

supply in the South West Midlands District. About 98 per cent. of the electricity in this area is generated either by Birmingham Corporation or the Shropshire, Worcestershire & Staffordshire Electric Power Company, and as both undertakings give an identical three-phase 25-period supply at 5 500 V, it is considered that the requirements of the district would best be served by retaining the existing organisation and by dividing up the area between the Corporation and the company. It is also recommended that Atherstone rural district and a portion of Tamworth rural district should be excluded from the de-limited district, that the Birmingham Corporation should be responsible for the electrical requirements of the city of Birmingham and the whole of Warwickshire, while the company would have as its sphere of operations the counties of Shropshire, Worcestershire and Staffordshire. The two undertakings would be ultimately linked together for mutual assistance, the parties concerned would exercise control of the generating stations and main transmission lines belonging to them in their respective areas, and they would also be responsible for the capital expenditure and the financial arrangements which would continue on a separate basis. A committee of four members, two representing the Corporation and two the company, would be formed for the purpose of acting in an advisory capacity, so as to secure an ample supply of electricity in the district and to deal with questions of the best load factor obtainable, conservation of fuel, standardisation of systems, and generally to carry out the directions of the Electricity Commissioners.

A Business-like Arrangement.

OF course, the suggested arrangement will have to be submitted to and approved by the Electricity Commissioners, and some of the smaller local authorities in the district may want some representation on the committee which it is proposed to create. Subject to these conditions, and to the requirements of the Electricity Supply Act regarding the constitution of a Joint Authority, we think the arrangement a most business-like one, which would work well and prove satisfactory in practice. Our only objection to it is that it should be thought necessary to have a division at all. It will be remembered that in February last the Birmingham Finance Committee held up, on account of financial stringency, the extension of the Nechells permanent station. But the Committee now states that, having regard to the necessity for providing the electricity which is essential to the industries of the city, the Council would not be taking an undue risk if the Electric Supply Committee were authorised to enter into contracts for the provision of a 15 000 kW generating set with three boilers, which was part of the original scheme, and for which it will only be necessary to raise the money in instalments between 1922 and 1925. Second thoughts are sometimes best.

Tramways and Light Railways Association.

THE annual report of the Tramways & Light Railways Association expatiated by Mr. C. G. TEGETMEIER last week does not make very cheerful reading. Like many another industry, tramways are suffering from the large increase in the cost of living caused by, and causing, an upward tendency in wages irrespective of an increased earning power. Fortunately the tendency is now in the other direction, we hope permanently, and within the next two or three months it should be possible to save a fairly large sum on the wages bill even in the tramways industry. But the effect of this on the prosperity of the undertakings must be slow and the disease will be more than usually hard to shake off. Wages fluctuations are, however, only one of the disabilities under which the tramways industry suffers, and these other disabilities

still bear heavily and are likely to continue to do so. Among the most important and in some ways unjust of these are the charges made for road maintenance. These charges have always been, and rightly, a sore point with tramways undertakings, but if the latest reply of the Ministry of Transport is to be taken as a guide, little relief from this oppressive tax can be expected. But road maintenance is a matter not for tramway undertakings alone, but for all road users and we hope, therefore, that the tramways will join with their natural enemies, the motor-car industry, and insist that the roads used by tramways should be properly designed for such traffic and that the cost of their building and maintenance should fall equitably on all road users.

Tramways and Road Construction.

FOR it cannot be denied that the question of the proper design and construction of main and arterial roads is of national importance. Not only is this a matter of special interest to electrical engineers as a whole, for well laid out and efficiently constructed roads cannot be without their beneficial effect on the development of the electric vehicle, but the tramway engineer must closely consider how various schemes which are now being propounded for road improvement affect the lay-out and construction of his track. This question has recently received consideration from two different points of view: by Lord MONTAGU of BEAULIEU, who considers the question from the standpoint of the motorist pure and simple, and by Mr. HERBERT HUMPHRIES, the city engineer and surveyor of Birmingham, who deals with the matter as the engineer responsible for the construction of the road sees it. Both of them look at tramways as at present constructed as an unmitigated nuisance. Lord MONTAGU points out that the industrial traffic which is especially heavy in the neighbourhood of London, in Lancashire and in the West Riding of Yorkshire is calling for new and more rigid methods of road construction and that the tramways are preventing this desired end being obtained, not only from the fact that they are often rate aided (he should make Mr. TEGETMEIER's acquaintance), but owing to the construction of the lines down the middle of the road being a direct disadvantage to development of the kind he desires.

The Light Railway Principle.

IT is evident that Mr. HUMPHRIES is more or less of the same opinion, though, unlike Lord MONTAGU, he sees a future for the tramways. He points out, however, that extensions on the present system are costly to construct and maintain and that many advantages would accrue from the adoption of a construction based on light railway principles on the lines suggested by Mr. JOHN BRODIE in his Presidential Address to the Institution of Civil Engineers. It follows, therefore, that in designing new road sufficient space must be allowed to give the tramways a right of way. Tramways in this country have grown rather curiously and not always beneficially under municipal patronage. But while it is very doubtful, if we were starting again, that that development would be carried out on the same lines, the tramway is not dead and we even assert that it might be relieved from its present moribund condition if extensions were carried out on the lines that have just been suggested. The advantage, thus obtainable from using a clear road, higher speeds and cheaper construction would greatly assist the development of an outer urban traffic both of passengers and goods.

Tramway Track Maintenance.

MR. R. B. HOLZ's Paper on "Tramway Track Maintenance," read before the Tramways and Light Railways Association

last week shows that conditions during the war have had a most unfortunate effect on track maintenance, and that post-war conditions have been, in many respects, equally unfavourable. During the war upkeep was simply neglected, and so much of the improvement brought about in pre-war years was lost. Subsequently arrears of maintenance have been dealt with but necessarily on a severely economical basis. It was formerly the custom to curtail repairs on failing tracks and to aim at renewal of bad sections. Present high costs tend to reverse this policy, sections of rail being kept in use long after they would have been discarded according to pre-war practice. Hence methods of remodelling and strengthening rails have come to the front. The former methods can only be pursued to a point, as they involve milling away the surface. The special SANDBERG hardening methods, however, seem to have led to very useful results, the rate of wear in some cases being reduced two and a half times. Mr. HOLT suggests that the time is now ripe for a revision of the existing tramrail specifications. In particular he quotes evidence to show that a higher elastic limit is desirable. On this, apparently, freedom from corrugation largely depends.

Steel for Tramway Rails.

THE discussion which took place at the meeting of the Tramways and Light Railways Association last week on the question on the best composition of steel for the rails used in tramway work should be read in conjunction with some information given in a recent Bulletin of the International Railway Association. Here Mr. W. C. CUSHING, engineer of standards to the Pennsylvania Railway, discusses the special materials used in railway construction and arrives at the conclusion that cast manganese steel has been proved suitable for many of the appliances used on railways, that while manganese steel for rails has not been so extensively tried the results that have so far been obtained are satisfactory. On the other hand, experiments with nickel steel and nickel and chromium steel rails have not been so successful though the results obtained by using these alloys for bridge construction have justified its further use. Experiments with these two alloys in the case of 85 lb. rails, however, have not given good results, but this view may be modified in the case of heavier rails. It would seem, therefore, that the employment of this material on tramway work is ruled out if these American results can be safely applied to conditions over here. Mr. CUSHING also points out that the further study of the properties of high silicon rails is advisable and that while the use of titanium is beneficial in some respects it is apt to deepen the pipe of the ingot. It is further interesting to note that promising results have been obtained from re-treated and electrically manufactured rails. The report concludes by pointing out that it is very desirable that the manufacture of ingots should be improved and that attempts should be made to increase the hardness of rails without sacrificing their toughness. We are now beginning to learn a great deal about the effects of using steel of various kinds, but the effect which methods of manufacture and pre-treatment have on the results obtained is not so well understood and must receive the closest attention.

Electrical Manufacturers' Reports.

FROM the reports of electrical manufacturing companies that have recently been published it would appear that, notwithstanding industrial troubles and other difficulties, quite satisfactory working results have been obtained during the past year. The net profit of the General Electric Company for the period ended March last was £783 149 compared with £630 143 in the previous year, so that it is possible,

after adding £175 181 to reserves to pay the usual dividend of 10 per cent. (tax free) on an increased capital and to carry £348 094 forward, as against £251 423 in 1919-20. The organisation of the allied companies has also been strengthened and we are not surprised to find the report speaking in optimistic tones of the outlook. We are also glad to learn that one of the oldest of the British electrical manufacturing firms, Messrs. Crompton & Co. are able to report a satisfactory expansion of their foreign and export trade during the year. As Mr. CAMPBELL SWINTON pointed out at the recent annual general meeting profits in Australia and India have been particularly encouraging, though the fall in the value of the rupee had sadly depleted their Calcutta profits. The drain which Excess Profits Duty imposes upon an undertaking of this kind is made clear by the statement that for every £1 000 earned by the company £734 went in taxation of various kinds. It is extraordinarily difficult under such conditions to make both ends meet let alone to carry out that development which is necessary for even ordinary progress. Nevertheless, the board were able to report a net available balance of £66 000 as against £52 000 last year and, after making satisfactory provision for reserve, to declare a dividend of 10 per cent. on both preference and ordinary shares, at the same time carrying forward the sum of £18 370.

Heavy Engineering and Cables.

THE accounts of the Electric Construction Company, Ltd., for the past year created a record, the net profit being £83 110, an increase of nearly £17 000 over the sum secured in 1919-20. A dividend of 9 per cent., together with a bonus of 2½ per cent., was paid on the ordinary shares and, after placing £19 851 to reserve, a sum of £53 497 was carried forward. Last, but by no means least, Callender's Cable & Construction Company was able to pay, once again, an ordinary dividend of 15 per cent., to make ample provision for depreciation and reserve and to add several thousand pounds to the amount carried forward. Callender's are now paying particular attention to the development of their colonial and foreign business, and though the conditions of the exchange and other difficulties do not render development too easy, considerable progress has been made. We are also glad to learn that the manufacture of super-tension cables for 33 000 V and upwards is proceeding satisfactorily, for with the projected developments in the electricity supply industry there should be a considerably increased demand for this type of cable. The chairman again emphasised the urgent need for a decrease in the cost of production, especially in the export trade, in order to meet foreign competition. There are prospective orders for plant and apparatus in plenty, but buyers are holding back in the expectation of a drop in prices, which is only natural.

The Sheffield Turbo-Generator.

SHEFFIELD is making quite a niche for itself in the electricity supply world. Some of its city fathers hold weird and un-economic opinions on the question of the rates that should be charged for electrical energy for power purposes, and the Electricity Committee recently proposed to purchase a 10 000kW German turbo-alternator on the ground that by so doing they would save between £50 000 and £60 000. In this way is fame obtained, for such an event is always treated as if it had never happened before, and this occasion is no exception. The usual strident and uninformed outcries have arisen while expert representatives of various schools have published reasoned arguments showing why the action of the Sheffield Electricity Committee supports their own views on the present

conditions and future prospects of British trade. For ourselves we feel that comment on so weighty a matter cannot be undertaken without much prayer and fasting, knowing well that whatever we say we shall run counter to some one's ideas, and, not unlikely, find our statements used as a lever to press home arguments with which we are not the least in agreement. As a matter of fact comment in this case would be particularly futile, as the members of the Electricity Committee changed their minds at the last minute and with the approval of the Council withdrew their recommendation.

Rates and Trade.

THERE is, however, one point connected with this event which gives it a kind of novelty. It is obvious that the City of Sheffield largely depends for its upkeep and prosperity upon the efforts of the iron and steel trade. If that trade suffers in any way, the finances of the Sheffield Corporation must also eventually suffer. It is therefore to the municipality's advantage to encourage those trades in every possible way—by reducing the rates for a start. To purchase a turbo-generator in this country would obviously help to do this. On the other hand £50 000 is a large sum, and the City Council might, with some justice, consider that in saving this sum they would still be on the right side after having allowed for extra expenditure caused by unemployment. They may also consider that patriotic benevolence may be carried too far, and that to a large extent the industry of the country in general, and of Sheffield in particular will be assisted in the long run if they refuse to pay prices which they think unnecessarily high. We do not know what they really think, but it is significant that the original recommendation is said to have brought prices down. Meanwhile Sheffield still wants a turbo-generator.

Telephone Developments.

THOUGH the House of Commons authorised the raising of £5 000 000 for the development of the telephone service, before doing so it allowed itself the indulgence of much criticism of the Post Office. Mr. KELLAWAY, who has the gift of lucid exposition and is able to tell a tale of woe as if it were one of prosperity, explained that £2 350 000 was to be spent on trunk lines, over £6 000 000 on new exchanges and subscribers' circuits and £500 000 on sites and buildings, or a total expenditure of nine million pounds on capital account during the current year. After this there should be no complaint about the telephones being starved. The other side of the picture is turned to the public when he admitted that 23 000 subscribers had surrendered their telephones owing to the increased tariff, but he excused this by claiming that in the same period they had added 27 000 new instruments and 23 000 applicants were eagerly awaiting connection.

Red Tape and Sealing Wax.

IN commercial circles anyone who came forward with a story like this would probably suffer personal violence and certainly would not get the capital he required, but the best we can hope in a Government department is that with the new vote the POSTMASTER-GENERAL will be able to place the department in a position to meet all demands as they arise. Telephone communication is necessary for the well-being of the commerce of the nation and Mr. KELLAWAY must see that the requirements of the nation are met without delay. That this is not being done is the real grievance which business men have against the Post Office. For instance, Mr. MACQUISTEN, who has a flow of language whose picturesqueness is only exceeded by its pungency, described the telephone service as "a mere chaos of different departments" doing

what they like. The war bonuses of the Post Office exceeded the wages, which was a scandal at a time when the workers' wages were being cut down. The telephones would always be mismanaged as long as they were under a Government Department, tied up with red tape and sealing wax. The more they were given the more they would spend and the more inefficient, useless and expensive they would become. All this is, we fear, only too true, but that complacency which is always a vice among bureaucrats is not likely to be shaken thereby.

Electric Traction and Rural Amenities.

AMONG the many economic and engineering advantages of electric traction it is surprising to find little mention made of one amenity which can be justly included under both headings. If we think a moment it is evident that without electric traction, with its absence of smoke and fire, the tube railways of London which, with all their faults, play a great part in the transport of many thousands of the population per day, could not exist, while as the "Railway Gazette" points out in a recent issue, similar advantages are not without their weight on tourist lines, such as the St. Gothard Railway. In this famous tunnel the long suffering aspirant after Swiss scenery had up till quite recently to spend 20 to 25 minutes in a suffocating and sulphurous atmosphere with all the carriage windows shut. With electric traction the journey through the tunnel takes about half the time, the atmosphere is perfectly clean and the windows can be kept open. To a less extent the same benefits apply to the rest of the line. Owing to the many twists and turns the passenger was formerly liable to perform his journey in a cloud of smoky vapour and to complete it with generous deposits of ash and grit on various parts of his person. Now it is possible to enjoy the wonderful scenery this route has to offer under ideal conditions, especially as the starting of the train is remarkably smooth and the running leaves nothing to be desired.

Troubles of Anglo-Foreign Companies.

SOME of the South American Republics appear to be anxious to emulate those European countries where civilisation is superficially on a higher plane by inaugurating great schemes of social legislation. They even go a step farther than our most advanced country, and in some respects excel those of our statesmen who are imbued with socialistic ideas. For instance, the Uruguayan Government has already enacted legislation authorising the eight hours day, the establishment of old-age pensions, and the superannuation of public service employees, while minimum salary and weekly rest laws are projected. Somewhat similar, though less ambitious legislation has been enacted in the Argentine Republic and other countries on the same Continent are preparing to follow suit, so that South America will soon be a country fit for heroes to live in. Less could be urged against any of these measures if the economic condition of the national finances in these undeveloped countries rendered the heavy burden entailed by this rash legislation possible to bear. But it does not, and this is a matter in which the British electrical industry is intimately concerned. For many of the public service undertakings in both the countries mentioned above are run by English companies, and financed by English capital, so that the luxuries of a minimum salary and eight hours a day will be reaped at the expense of the shareholders, whose shortcomings are more picturesquely than correctly described by the local orators. The case of the United Electric Tramways of Monte Video will show how true this is. The ordinary shareholders have not received a dividend for years, while the average dividend since the formation of the company over 17 years ago, has been only 3½ per cent. If

those responsible for the Government of the country persist in making such frequent and rash experiments in social legislation, no foreign capital will be available for industrial development, and all progress will cease, as, apparently, it is not in the nature of the natives of Latin America to run such undertakings as tramways with any success.

History and Engineering.

WHEN we examine and criticise the doings and motives of kings, princes and even of the less exalted denizens of times gone by the result is called history and we hope to derive from our study of the performances of our ancestors lessons which we can apply to our progress through this present epoch. Even if the assistance we so obtain is only of a negative character and shows us mainly what to avoid, it is none the less useful for that. Curiously enough, however, this form of deduction as an aid to future conduct seems to be limited to functions which directly concern the governance and hostilities of the human element and troubles itself very little if at all with inanimate material objects, except as a background to these functions. We can obtain plenty of information on the enlightening theme of what a certain king meant when he performed a certain action or enunciated a certain apothegm, but little about the sanitary conditions of his palaces or what the reasons were for building his fortresses in a particular position, and in a particular way. Yet information on this would at least be interesting and might even be useful.

THE PROBABLE AND THE UNTRUE.

This is not to say that there is no information on these subjects, but that it is difficult to separate what is probable in it from what is manifestly untrue without leaving an anomalous mass which is of little use to anyone. Yet could we get at facts such as these, we should not only have the basis of a real history of engineering but almost as certainly find suggestions and starting points for lines of future thought, which would be of the greatest utility in assisting our progress in engineering, as history, as we now understand it, assists our political development, though that assistance would more likely be of a positive than a negative character.

A USEFUL SOCIETY.

Having these facts in mind we welcomed heartily at the time of its formation rather over twelve months ago the Newcomen Society, a body which has for its object the study of the history of engineering and technology. The Newcomen Society beginning in a small way and without any flourish of trumpets has, as Mr. ARTHUR TITEY pointed out in the presidential address which he delivered recently, made a most successful start and is now well on the way, to adapt the phrase of SMILES, to bring to constructive heroes the posthumous fame which has far too long been the prerogative of those engaged in the work of destruction. We hope in doing this the Society will not follow SMILES' methods too closely and we are glad that it will not confine itself to the doings of the engineer, but will deal in the broadest way with the whole field of engineering. What has been done is after all more important than who did it. To fulfil this aim a very wide vision will be necessary, for the field is fortunately one in which the individual member can pursue his own bent and at the same time derive that fine assistance from fellow-workers which follows the reception of advice and in the equally useful form of indicating false scents and unproductive byways. For the Society is not only to read Papers, but to conduct research and to exchange ideas

THE STUDY OF ANCIENT ENGINEERING METHODS.

But apart from this portion of the Newcomen Society's activities, which are obviously of a more or less personal character, and at first sight cannot be expected to give rise to results which are of more than limited interest, the study of ancient engineering methods, which is another of the members' aims, will be of the highest educational value, and we hope that every effort will be made to develop this part of their activities. For, as Mr. TITEY points out, in reading old engineering books or studying old drawings, processes, machines or details of machines and methods of construction are discovered which have dropped out of use apparently for no reason, and the possibility of whose reintroduction in a new form must not be discarded. The changes, for instance, in the design of a particular piece of apparatus, such as the electric motor, might well form the subject of special study to discover how many of the changes were imposed by the character of work the machine was called upon to perform, and how many were due to the whims of individual designers. It would also be interesting to examine the ideas and processes that have been dropped to see whether their germ has not reappeared successfully in a form which makes its relation to the original idea hard to discover, in some other apparatus. Such an examination might be of use in future practice by helping us to find out with the least trouble that vital germ which transforms dull marble into living flesh as much in engineering as in sculpture.

HOW THE ANCIENT CAN HELP THE MODERN.

Lest this be thought to be mere speculation, Mr. TITEY gives an example of the good that may come by the suggestive study of history by instancing JOHN RIDLEY's invention of the stripper for harvesting grain in countries where the straw has no commercial value. That germ of the idea employed is described by PLINY, and as a result of his study of this ancient writer RIDLEY was able to devise a machine which automatically stripped off the ears of the corn, and by adding a thresher and a winnower allowed the grain to be collected ready for despatch in one process. In this way corn can be harvested at 3½d. instead of 2s. per bushel.

While we do not recommend electrical engineers to search ARISTOTLE with the definite aim of deriving from his views on the ARCHIMEDEAN philosophy an easy guide to some new and startling kind of electric motor, yet it is quite conceivable that the methods and especially the train of thought followed by these ancient philosophers would contain something which would be of distinct use to us. After all, our problems only differ from theirs in degree and not in kind, and with an increased knowledge or, perhaps, it would be more correct to say with our different view point we might see light where to them there was nothing but darkness.

THE NEED FOR PROPER RECORDS.

This course is the more to be recommended as we are daily using the details and methods of the workers of old adapted often somewhat crudely to modern requirements, and it is further necessary to examine and record not only the details of our engineering successes, but of our failures.

We have said we know little of the details of the engineering design and practice of the past. But the little we do know is of the designers and equipment that was used at least for a short time. And while in days gone by development was slow and each invention had a fair chance of trial, in these days development is rapid, and it is becoming increasingly difficult to keep track of the ideas which are submerged in favour of solutions which seem to offer more prospect of success, but which might contain with some adaptation some point which would make their employment worth while. If the Newcomen Society can help us in this respect it will have justified its existence.

A Method of Directly Indicating the Insulation Resistance of a Live Direct Current Network.

By G. W. STUBBINGS.

The present article describes a method by which the insulation resistance of a direct-current network can be indicated directly by an ordinary moving coil instrument. The only method hitherto available for this purpose has involved the use of a double instrument with overlapping pointers. The arrangement described below requires one instrument only, the scale of which can be marked to read directly in ohms.

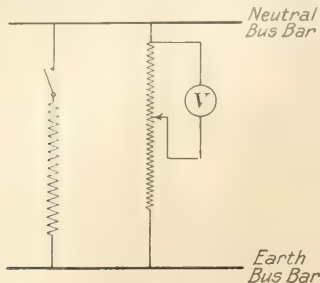


FIG. 1.

It is well known that the value R of the insulation resistance of a direct-current system can be obtained from a knowledge of the potentials of one main—usually the neutral in the case of a three-wire system—first when it is disconnected from earth, and secondly when it is connected to earth through a resistance of known value, r . If these two potentials be v and v_1 ,

$$R = r \frac{v - v_1}{v_1}$$

If

$$x = \frac{v - v_1}{v}$$

the first equation can be written

$$R = r \frac{x}{1 - x}$$

A method by which x can be directly observed consists in measuring the potentials of the neutral main by means of a moving coil instrument with an adjustable resistance so arranged that the greater potential v can give the maximum scale reading. When the resistance is so adjusted, and the earth switch is closed, the voltage across the instrument will be reduced and the pointer of the instrument will recede through an angle corresponding to the change of potential $v - v_1$. The angular distance through which the pointer recedes is directly observable since movement takes place from a definite point on the

scale, and if θ be this angle and α the angle of full scale deflection, then $x = \frac{\theta}{\alpha}$ and

$$R = r \frac{\theta}{\alpha - \theta}$$

The adjustable resistance can either be in series with the instrument or the necessary adjustment can be made by a potentiometer connection from the voltmeter. This latter arrangement is shown in Fig. 1. Both methods give rise to inaccuracy, in that the instrument and its resistance leave a small fault on the system when the earth switch is broken. This error can easily be corrected with the potentiometer arrangement, if the resistance of the instrument be so high as to be negligible. If ρ be the value of the potentiometer resistance this will be the value of the fault left on the system when the earth switch is broken.

$$\frac{\rho R}{\rho + R} = r \frac{x}{1 - x}$$

Whence

$$R = \frac{\rho r x}{\rho - x(\rho + r)}$$

or, if

$$m = 1 + \frac{r}{\rho}$$

$$R = r \frac{x}{1 - mx}$$

This correction can easily be applied when marking the scale of the instrument.

It is easily seen that for a given value of r , the scale of the instrument can be graduated direct in ohms. The appearance of such a scale, for an earthing resistance of 20 ohms, is shown in Fig. 2. Using an instrument with a scale so graduated,

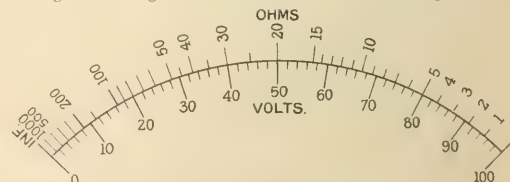


FIG. 2.

the procedure for an insulation test will be to open the earthing switch, and adjust the potentiometer slide or the adjustable resistance that the pointer of the instrument stands at zero on the ohm scale. The earth switch is then closed and the pointer directly indicates the insulation resistance of the system in ohms.

Continuous-Wave Wireless Telegraphy.*

By E. H. SHAUGHNESSY.

The present volume is stated to be the first part of a reasoned exposition of continuous-wave wireless telegraphy. As mentioned in the preface, the book does not deal with practical applications but with the fundamental principles. The work can be conveniently grouped into three sections, the first section of 80 pages deals with electrostatics and electrodynamics, the second section of 159 pages deals with alternating-current circuits and transformers, the final section of 139 pages is devoted to the physical properties of thermionic valves.

FOR THE STUDENT RATHER THAN THE ENGINEER.

As the work is of general physical interest and is a work rather for the student than for the wireless engineer, we * CONTINUOUS-WAVE WIRELESS TELEGRAPHY. PART I. By W. H. ECCLES, D.Sc., F.R.S. (London: The Wireless Press, Ltd.) Pp. vii.+407. 25s. net.

think that the title of this work is somewhat of a misnomer. The currents used in continuous-wave telegraphy can be regarded as ordinary alternating currents if we neglect the initial and final conditions. The mathematical treatment of such currents is well established in power engineering, and this treatment can be applied to solve problems in continuous-wave telegraph circuits. Dr. Eccles develops this treatment of alternating currents in the first section of the book by the differential-operator method and also by the rotating-vector method. The subject is dealt with in a lucid manner and in greater detail than is usually found in works on alternating currents.

INITIAL AND FINAL COMPLICATIONS.

While the majority of problems can be dealt with in this simple manner, in practice the initial and final conditions introduce complications in continuous-wave systems utilising

a suppression of the spacing wave such that on long wave-lengths, and at high speeds the current conditions become very little different from those met with in spark telegraphy.

In the final section the physical properties of thermionic valves are very fully dealt with, as might be expected from Dr. Eccles' previous contributions to this subject. The importance of thermionic three-electrode valves in present-day wireless telegraphy is, of course, generally known. Their use both for transmitting and for receiving purposes has enabled the advantages of continuous-wave methods over methods using damped waves to be more fully realised. As a consequence spark telegraphy, as far as new installations are concerned, is practically confined to small power ship sets with their corresponding shore installations.

So far as transmitting gear is concerned, while effective substitutes exist for the valve as an oscillation generator for the longer wave-lengths, there is no effective substitute for the valve for the generation of continuous oscillations of short wave-length.

THE VALVE AND RECEPTION.

With regard to receiving gear, no effective substitute for the valve is available for amplification purposes; further, although the heterodyne method of detection of continuous waves was known prior to the introduction of the thermionic valve, it was not in common use owing to the lack of a stable

and reliable source of local oscillations, a deficiency which the thermionic three-electrode valve has successfully removed. The same can be said regarding wireless telephony, the principles being known long before the introduction of the valve, yet, with the solitary exception of Alexanderson's arrangement of circuits using his magnetic amplifier, no satisfactory method of modulating the output current at vocal frequency was evolved until use was made of the thermionic valve.

AN OUTSTANDING DEVELOPMENT.

The introduction of the hard valve was, of course, the outstanding event in this development, as this modification not only made the valve a stable and reliable piece of apparatus suitable for receiving purposes, but also made it possible to apply far higher potentials to the anode, thus increasing the power that could be dealt with and enabling the valve to be used as a generator for transmitting purposes.

The mathematical and physical principles of the thermionic valve have been very fully investigated during recent years by Dr. Eccles and other scientists and the present work contains a clear and lucid exposition of these principles.

The book is conveniently arranged, well printed, while the diagrams are clearly reproduced, and we look forward with interest to the publication of the second part.

Protection Against Earths.*

By A. ROTH.

Despite numerous publications, there seems to be room for a general comprehensive survey of earths and of the various protective devices used to deal with them in order to find which system is the best for given conditions. The importance of good earth protection is clear from the fact that most disturbances in overhead networks are caused by earths, while earths are the main cause of excess pressures. The more extensive the network, the greater the need of protection, because the frequency of anticipated earths is about proportional to the length of network.

Earths are mostly due to mechanical or electrical failure of the insulation at any point, usually in the open. Disturbances in overhead lines may result from faulty insulation, birds, excess pressures (caused by lightning discharges in or near the line), stone-throwing, falling trees, &c. In cables, earths are caused by mechanical injury, faulty places, injury from excess pressures and defective connections often arising from mechanical injury in earlier short-circuits. Earths in switchgear and machines are of much rarer occurrence.

According to Petersen, excess pressures accompanying earths are produced by the combined action of free surges in the oscillatory circuit, formed by the inductance of the machines and the capacity of the network, and separate continuous-current residual charges. Another, much rarer fault is produced by resonance with the supply frequency. These occur in overhead lines, however, in case of a break in the wires under certain conditions, and in large cable networks 50 to 100 km. in length when the lead sheath is not metallically faultless, or when cables are joined to long overhead lines. The number of earths is largely affected by weather conditions, prevalence of birds and the type of insulator and poles—iron poles being more dangerous than wooden poles.

Earths which begin as permanent earths often become intermittent earths; e.g., with paper insulation, an arc may be maintained for several minutes until it has burnt away the material, and then become intermittent.

As it is not always possible to remove the causes of earths, it becomes essential to protect the system against the results of earths.

RESULTS OF EARTHS.

When the current exceeds a few amperes, the arc to earth moves readily and reaches great lengths. In overhead networks and switch installations it may thus easily extend to the other phases and so form a short-circuit. In the most favourable case, the conductor in question is cut out and service is interrupted for about three minutes. Usually, however, the heat of the short-circuit arc, which may reach some thousands of amperes, leads to much damage in the line. Finding and removing the fault may entail a service interruption of several hours' duration. This is the chief result of

an earth—though loss in revenue and the effects on the consumers must not be forgotten, while penalties may be incurred.

EXCESS PRESSURES TO EARTH AND DOUBLE EARTHS.

With intermittent earths, the pressure to earth in the sound phases of unprotected networks may reach two to three times the line pressure, and cause further earths in these phases. This may lead to temporary or long interruptions in other networks hundreds of kilometres away.

There is the further danger of the much-feared "double earth." Two simultaneous earths in different places and phases together form a short-circuit through earth, and produce dangerous potential differences in the ground near the faults—particularly when the earth at one of the two places is not very good. The current with a double earth generally suffices to cut out one of the earthed lines; though with a single earth in an overhead line the earth current is usually only a fraction of the load current and therefore insufficient to operate the overload relay. The full short-circuit current can generally be expected in high-voltage systems, because here the resistance of the earths is too small to have much effect on the current.

SUDDEN WAVES.

With intermittent earths, the arc is reformed every half-wave, i.e., 100 times per second. As a result, the pressure at this place in the faulty line sinks suddenly from several times the line pressure to zero, and discharge waves travel in both directions. If there are machines or transformers near the earth, then dangerous pressures between the turns in the windings are produced, which may break down the insulation. If the discharge is over a long line, the wave-form is smoothed and the danger is much less.

RISE OF PRESSURE TO EARTH IN THE SOUND PHASES.

Even when the earth is not intermittent, but permanent, the pressure between the sound phases and earth is raised to the line pressure. Since in all weathers the insulation should be sufficient to withstand double this pressure, there should be no trouble from this cause, but networks often do not fulfil this condition.

In general there is no protection against this pressure rise. Even earthing the neutral direct can prevent it only when it is carried out on a machine supplying a large part of the total load. Earthing all neutrals would be helpful, but this is seldom permissible on account of equalising currents. With transformers all the neutrals of at least one or two stations can be earthed, so that in a simple network the pressure rise can be suppressed.

PROTECTIVE DEVICES.

There are various arrangements: Petersen's earthing coil, Jonas's extinguishing coil, and Bauch's extinguishing transformer, for compensating the earth current. An inductance, generally

*Abstract of an article in "B.B.C. Mitteilungen," Vol. viii., p. 71.

connected between the neutral of the installation and earth, partly or completely compensates the leading earth current by a lagging current, and so automatically quenches the arc to earth. The arc does not extend before it is extinguished, so that in all cases, provided that the solid insulation is not damaged, both temporary and long interruptions of service are prevented. Petersen has also shown that the extinguishing and the earthing coil prevent almost completely the occurrence of excess pressures to earth and discharge waves, through not allowing the arc to re-form. Consequently the extinguishing coil is an excellent protection against earths.

Long ago it was found that most earths in overhead networks are of a very transient nature, and pass unnoticed unless a recording instrument is used. Experience shows that networks protected by an extinguishing or earthing coil are very rarely out of circuit; while excess pressures are no longer produced by earths.

EXTINGUISHING COILS.

The extinguishing coils are constructed as air-cooled, oil-insulated transformers, and are sometimes provided with tappings for extensions. The rating has not yet been determined. Even with a permanent earth, the extinguishing coil permits the service to be continued, provided that the other phases are in order. In order to take advantage of this, the rating of the extinguishing coil should enable the defective line to remain in service until the fault is located—say, for two hours.

It is important that the extinguishing coils should be adjusted to the load. Since it is inconvenient and unreliable to be continually changing tappings, it is better to provide each larger section of the network that can be separately operated with its own coil, by connecting the latter to a transformer in the section. Thus care must be taken in arranging the extinguishing coils, but there is no need to be unduly anxious, because the setting can be fairly bad before the protective action is disturbed. Extinguishing coils do not cause trouble in parallel operation.

EARTHING THE NEUTRAL.

When one or several generators or transformers are connected to earth either direct or through a resistance, earthing cannot prevent temporary interruption of service, because the arc is not suppressed, as with extinguishing coils. On the other hand, it no longer renders the cutting out of the faulty conductor a matter of chance, i.e., to the production of a short-circuit by the arc; because every earth now carries not only the earth current of the system, which is nearly always too small to operate the overload relays set for the working current, but in addition the current flowing through the earthed neutral. By suitably adjusting the earthing resistance, this current can nearly always be made large enough to actuate the overload relay of the section in question. In this way, a long interruption of service can be prevented, because the current in the arc is limited in strength and duration, and consequently material damage in the overhead network need no longer be expected. Likewise earthing the neutral prevents excess pressures to earth, because the continuous-current discharges with intermittent earths are led to earth. The oscillations set up in the circuit formed by the earth capacity and the machine inductance, which alone are fairly harmless, are suppressed by earthing through a resistance.

The good results which are obtained with direct earthing seem to prove, however, that these oscillations in the network are unimportant. Since the pressure cannot exceed twice the phase pressure when the arc re-forms, with the continuous-current discharges led away to earth, it is seen that danger to windings is practically removed.

Under certain conditions direct earthing of the neutral can reduce the pressure rise in the sound phases to the line pressure. This action depends on the ratio of the impedance of the earthed transformer and generator to the short-circuit impedance of the whole system, i.e., on the ratio of the output of the earthed transformer to the total power of the installation.

LIMITATION OF EARTHING.

Owing to equalising currents, it is not permissible to earth all generators or transformers—only very few units are actually earthed. If the output of these earthed units is small compared with the total output of the machines, then in the transformer windings of the sound phases, a pressure drop is produced equal to the line pressure; or, in other words, the machines not earthed attempt to maintain the line pressure between the outer lines.

Thus earthing the neutral prevents long interruption of service and excess pressures, but not temporary interruptions due to the operation of the cut out. Care must be taken, however, in earthing the neutral because of the increased current at the earth. This increase produces a greater pressure drop in the fault, and consequently a danger to persons. With cables, and probably also with overhead conductors with an earth cable, the current flows back

along the cable sheath direct, or along the earth cable, and is therefore harmless, in contradistinction to installations without an earth cable. Of course, it may be said that with a double earth in an unearthed system the current is much greater, but this occurrence is rare. Naturally earthing the neutral entails the use of relays in all phases. The resistances are made of cast-iron in air or are water resistances. They must be rated so that they can withstand the load for several operations of the longest time relay.

HORN ARRESTERS WITH RESISTANCES.

Horn arresters with resistances are the best known protective devices. If provided in sufficient number they can limit the excess pressures to earth. On the other hand, they permit the formation of the short-circuit arc at the fault and thus prevent neither short nor long interruptions in the service. One disadvantage of this device is the extraordinary space needed for the extension of the arc. These arresters are usually arranged "according to feeling," and are therefore useless in many systems. The prevention of excess pressures to earth requires a certain minimum discharge resistance in the system, or, in other words, a minimum number of arresters of given resistance. Petersen chooses the number so that the continuous-current charges are conducted to earth, Schrottkie so that the oscillations are damped. Since excess pressures arise from a combination of these phenomena, either will effect what is needed. It is always uncertain, of course, whether all the arresters operate. Petersen's method gives the number as proportional to the length of line—e.g., with a given type of arrester, in a 50 kV system, one set of horn arresters is necessary every 100 km. In Schrottkie's method the inductance of the machines has to be taken into account. Petersen's method is preferable, because it usually gives a smaller number of arresters.

ROLLER DISCHARGES WITH RESISTANCES.

The power of roller discharges with resistances for quenching the arc is much inferior to that of horn arresters. If the resistance is made so large as to correspond with this feeble quenching power, the conductivity and protective power becomes so small that effective protection is no longer possible. It would appear that their quenching power is much greater for high-frequency excess pressures, which probably explains why they work well in certain installations. If, however, the arc is maintained from any cause so that the load current can flow, the discharger no longer extinguishes the arc, but melts into a solid mass. These dischargers are therefore unreliable, and they are rarely used.

ALUMINIUM CELLS OR ELECTROLYTIC DISCHARGERS.

Aluminium cells or electrolytic dischargers are connected in series with a horn between the line and earth, and they allow a current to flow when an arc is formed, thereby making an almost direct connection between the line and earth. When the excess pressure ceases, the cell acts as a valve and interrupts the current. Thus, these dischargers have the same effect as horn arresters with resistances, but their conductive power to earth is much greater—consequently far fewer are needed. On the other hand, the requisite attendance is a great disadvantage. Further, when acting they produce discharge waves corresponding at least to the horn adjustment—i.e., about 1.4 times the line pressure; but which may be much higher with retarded discharge, and cause breakdowns in transformer coils. For these reasons these dischargers have not been used in Europe. In America they are widely employed, but with varying results.

LEAD-PEROXIDE DISCHARGERS.

The lead peroxide discharger is based on a similar principle to the aluminium cells—a layer of varnish is pierced by the excess pressure, so that the current can flow to earth without hindrance. The hole in the layer of varnish is then closed by the lead peroxide reduced to PbO, which forms an insulator, so that the discharger is restored to its original condition. The attention (charging) with aluminium cells is avoided here, but the discharger has its other disadvantages. Further experience of these dischargers has yet to be gained—laboratory experiments at the working frequency have not given promising results.

In Nicholsons's arc extinguisher and earthing switch the faulty phase is automatically earthed, whereby the arc to earth is quenched. The principle is correct, but wide experience is not yet available.

ARRANGEMENT OF PROTECTIVE DEVICES.

In order to decide which method of protection against earths should be used in a given case, we must first inquire which of the results outlined above can be prevented by the device in question. It has been shown that only in exceptional circumstances can we avoid having the line pressure to earth in the sound phases. A fundamental difference arises from the nature of the network—

overhead or cable. Since earths in an overhead system are mostly temporary in character (insulation flash-overs, birds), the complete suppression of the arc, *i.e.*, its immediate quenching, is to be aimed at; so that temporary service interruption is also prevented. Cutting out of the faulty section is to be avoided, wherever possible. The opposite holds for a cable network. Here all earths, except the few which occur in switchgear, imply defects in material. A pierced cable or a defective junction box ought not to remain in service; but the faulty section—at least in polyphase cables—should be cut out as soon as possible, so that the earth does not become a short-circuit through the heating or other injury of the surrounding parts. Such short-circuits in junction boxes and in systems with large short-circuit currents may cause explosions. Thus the faulty section of the cable must be cut out at once.

OVERHEAD NETWORKS.

From the above considerations it is seen that the extinguishing coil is better than all other devices, since it is the only protective device which prevents arcing and any kind of service interruption, and in addition suppresses pressure surges and removes the danger of the double short-circuit arising therefrom. It can be confidently stated that in networks protected by extinguishing coils an insulation flash-over is quite harmless and is only revealed by the recording instruments.

For reasons of cost, horn arresters with resistances may be considered instead of extinguishing coils in small installations; but it must be examined whether these are really cheaper when they are sufficiently numerous to protect excess pressures to earth. Building costs must, of course, be taken into account. It has been shown that horn arresters cannot prevent service interruption.

In cases where horn arresters have been provided for other purposes, it must, of course, be considered whether extinguishing coils shall also be provided. In important networks the matter admits of no doubt—in several networks horn arresters have been or are being replaced by extinguishing coils. In less important systems, horn arresters may suffice. Among "other purposes" only pro-

tection against lightning comes into consideration, and this only for pressures up to 12 000 V, because both theory and practice show that above this pressure horn arresters cannot be regarded as protection against lightning.

Contrary to European development, direct earthing is preferred in America for overhead systems over 70 kV. Though this affords better protection against excess pressures to earth, and partly reduces the pressure rise in the sound phases, yet service interruption is not prevented. Rather every earth opens the switch unless this is specially prevented, *e.g.*, by cutting off the excitation, which is only possible in simple cases. For these reasons, protection with extinguishing coils may be better.

CABLE NETWORKS.

Earthing the neutral through a low resistance is the most perfect protective device in these cases, it prevents excess pressures and causes the defective section to be cut out at once by the usual overload or differential relay. Extinguishing coils and similar devices cannot be used here advantageously, because cable defects are permanent and not transient in character. Horn arresters have similar disadvantages and are costly when supplied in sufficient numbers. The cutting out of a faulty cable can be accelerated by special relays and other devices.

MIXED NETWORKS.

According to the importance of one part or the other, extinguishing coils or earthing resistances will be used. For mixed networks, a reliable protection against earths is very important; for on the one hand earths are common with overhead conductors, and on the other hand cables are sensitive to excess pressures. Breakdowns in cables produce very unpleasant service troubles.

EXPERIMENTS WITH EXTINGUISHING COILS.

The article closes with a lengthy description of tests carried out with extinguishing coils to investigate their capacity for extinguishing the arc, suppressing excess pressures, &c.

Tramways and Light Railways Association.

Proceedings at the Annual General Meeting.

The annual general meeting and congress of the TRAMWAYS & LIGHT RAILWAYS ASSOCIATION was held at Caxton Hall, Westminster, London, on Friday last.

THE WORK OF THE COUNCIL.

Mr. C. G. TEGETMEIER, who presided at the annual general meeting, formally proposed the adoption of the Council's report and accounts for the past year. In doing so, he gave a short review of the work of the Council during that period. The total revenue for the year amounted to £799 and the expenditure to £774. The balance of £25 increased the assets of the Association to £670. The work done during the past year must be regarded in conjunction with the work of the Conference of Tramway and Light Railway Companies, which was a separate body from the Association itself, although constituted within it for dealing with matters relating to the tramway industry outside the scope of the Association as such, more particularly in regard to wages and labour questions generally. One of the important functions of the Conference was to elect representatives of the industry to sit on the National Industrial Joint Council, and the Municipal Tramways Association had now a similar organisation. During the past year labour and wages questions had constituted the most important matters which had had to be dealt with and much time and work had been devoted to them by the various representatives on the National Joint Council. All tramway undertakings had now been graded into three groups according to local conditions and financial capacity to pay certain rates of wages, and the latest settlement has been to take the best rate of wage in each district and add 3s., 2s. and 1s. per week respectively, there being a slide up or down according to the index figure for the cost of living. The large increases in wages which had taken place had put the tramway industry in a very difficult position, and it had only been able to carry on by reason of the Temporary Increase of Charges Act of 1920. Among the other matters which had called for the attention of the Association during the year was some relief for tramway undertakings from the heavy burdens imposed upon them in respect of road maintenance, but certain amendments proposed by the Association to the Roads Bill of 1920 were not accepted by the Minister of Transport. More

recently representations had been made on the subject, but a communication had been received from the Minister of Transport to the effect that he could not see his way to promote legislation for the purpose of relieving tramway authorities from their statutory obligations under Section 28 of the Tramway Act of 1870 or to make any contribution to the cost referred to out of the Road Fund. There, unfortunately, the matter remained for the present.

It was announced that the following members of Council retired:—Mr. F. Coutts, Mr. E. H. Edwards, Mr. H. England, Mr. A. L. C. Fell, Ald. R. Mayne and Mr. W. Shearer. To fill the vacancies the following were elected:—Mr. W. V. Edwards, Mr. R. J. Howley, Mr. McGill, Mr. F. E. Gripper, Mr. J. K. Bruce and Mr. I. Bulfin.

TRAMWAY TRACK MAINTENANCE.

Two Papers were then read and discussed, Alderman SMITHSON, of Leeds, being in the chair. The first was, "Tramway Track Maintenance," by Mr. R. B. Holt. This we give in abstract below.

Tramway Track Maintenance.

By R. B. HOLT.

The standard of to-day on many tramway tracks is that of over fifteen years ago. Owing to neglect during the war, and subsequent increased costs of labour and material much of the improvement effected has been lost. It was formerly usual to do as few repairs as possible on aging track and concentrate on early renewals; to-day the converse practice obtains, life being prolonged by every expedient such as rail hardening, groove deepening, &c.

Rail-wear continues to be the most important of all problems. It is evident that the standard section should now have a deeper groove. There is no reason why the width of flange of any paved-in British tramway rail should exceed 5 in. The author illustrates a suggested alteration in B.S.S. No. 4 providing for a groove $1\frac{1}{2}$ in. deep. The wear of rails is naturally very variable according to the nature of the traffic, &c., and the author presents figures for different provincial cities. Generally speaking values range from about 0.025 to 0.13 in. wear during twelve months. At last year's conference Mr. Ireland laid stress on the influence of the shape of the

type in determining the worn profile of the rail, and also pointed out the importance of area of contact. He found that the load per sq. in. was 65 tons, from which it appears that rails are being overloaded. The writer agrees, remarking, however, that wear due to brakes must also be considered. The origin of rail corrugation is not clearly established. Such corrugations do not occur in rails as received from the mills, but are believed to be due to the culminating effect of a pressure exceeding the elastic limit of the rail. The tensile strength of most existing rails is about 45 tons per sq. in., the elastic limit only 20 tons per sq. in. Mr. Sellon has recommended that the latter should be 60 tons per sq. in., which, in view of Mr. Ireland's experience, appears desirable. The time is therefore ripe for the Standards Association to revise the Tramrail Specification. Too much insistence on chemical composition is not needed; most failures are due to alternating stresses which exceed the elastic limit.

Turning to the strengthening and repairing processes the author refers to the superior wearing qualities of rails that have undergone the Sandberg Norbetic treatment. Tests of the process on the Pennsylvania Railroad showed a wear of only 7 lb. per yard of rail for rails so treated, as compared with 13 lb. for untreated rails. The gain in life is assessed at 85 per cent. The best effects from the treatment are, however, obtained from steel of uniform grade. Curves illustrating the results are given in Fig. 1.

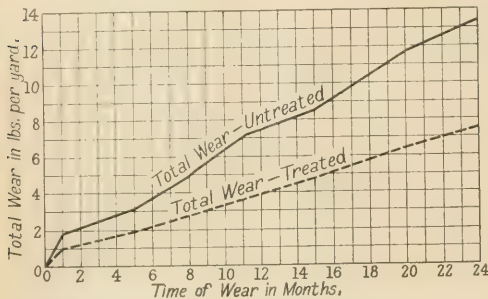


FIG. 1.—COMPARATIVE WEARING RESULTS OF ORDINARY RAILS AND RAILS TREATED BY THE SANDBERG NORBETIC PROCESS.

The Woods-Gilbert re-modelling process is also an effective way of prolonging the life of existing rails. The groove is milled away about 5/16 in. allowing the wheel flanges to travel free on the groove for a considerable period; irregular ridges of extruded metal are also cleared away. However, the depth of metal remaining after milling operations should not be less than 5/16 in., i.e., on B.S. rails about half the total metal may be removed.

GOOD RESULTS FROM ELECTRIC WELDING.

The writer has also had experience of excellent salvage work done by arc and autogenous welding processes. Good results can be obtained by either process, but both depend greatly on the skill and conscientiousness of the operator. Material deposited should preferably be of the same chemical composition and hardness as the rail itself. In many repaired joints the deposited metal is softer than the original material, containing less carbon. Sufficient carbon should be allowed to pass over in the weld, a condition which, it is said, can be obtained by regulating the length of arc. Excellent results have also been obtained with thermite welds, and it is stated that the conductivity of the welded joint is nearly double that of the rail, rendering bonds unnecessary. The Sandberg "Insitu" rail hardening process utilises an oxy-acetylene equipment, an area of the tread being brought to a temperature above the critical range and then sprayed with jets of water immediately behind the flames, thus quenching and cooling the heated portion. This produces a hardening effect for about 1/8 in. depth, consisting of martensite. About 100 miles of track have been treated to date. Results are given in the original Paper for a number of cities in this country, whence it appears that the wear on untreated rails is about 2½ times that on rails treated by the "Insitu" process.

In the concluding section of the Paper the author refers to rail-wear due to track brakes, rail-packing and track pavement. Considerable difficulty has lately been experienced in maintaining track pavement largely owing to the effect of the steel-tired wheels of modern mechanically propelled steel traffic, especially where areas are paved with granite. In the metropolis as a rule, wood or asphalt pavements are the only ones permitted by the authorities. The costs of special trackwork, points and crossings, &c., is a serious item and the writer suggests that marked economies might often be se-

cured by the use of shorter and lighter points and crossings. In conclusion reference is made to a recent decision that a tramway undertaking is responsible for accidents arising through the worn state of rails. Clearly some authoritative ruling is needed as to the condition that can be described as dangerously worn.

Mr. HOLZ added that the description of the Arc Welding Company's process in the Paper was not quite up to date. He understood the present practice was to entirely weld up the horizontal joints between the head of the flange of the rail and the fish-plates.

DISCUSSION.

Mr. A. NORTON said that the post war cost of maintenance had kept rails in service long after their effective life, but the Sandberg process, according to the Paper, had been instrumental in allowing a very much longer life to be obtained from the rails. At the same time, the operation was costly. To deepen the groove from 1¼ in. to 1½ in. would be a good thing because it would increase the area of rail head available for wear and prevent the tyre from bedding down on to the groove. With regard to special track work, it was frequently specified that the depth of the groove should not exceed 5/16 in., but the effect of that was that the tyre often ran over the grooves which wore the tyre away and did not stop the bumping which took place at the special track work. It would be very much better to keep the depth of the groove at the special track work the same as the height of the tyre flange, which was fixed at 9/16 in. for most sections on British tramways. If that was reduced there was a risk of the tyre mounting the special track work when going at high speeds. With regard to the effect of detrusion, it would be interesting to know the width of the tyres and also the angle of inclination as originally placed in service, because that had an important bearing on the question. With the tendency to increase the hardness of the tyres, one would imagine that there would be a proportionate increase in the hardness of the rails. A recent American specification showed 0.7 to 0.85 carbon, 0.20 silicon and 0.6 to 0.9 manganese, the maximum stress being 50 tons and the elongation 8 per cent. Brittleness could be overcome by suitable heat treatment, and the greater expense thus involved was more than compensated for by the longer life. Referring to the British Standards specifications, whilst a standard width had been adopted, the question of standardising the wheel centre was a very much more difficult matter.

REGULATION OF THE ARC.

Mr. W. V. EDWARDS (Hastings) asked for more information with regard to the regulation of the arc in rail welding. He had been rail welding by this means for some years, and although a good job could be made in building up joints of the ordinary rails, there was considerable difficulty in making a satisfactory job with manganese steel points and crossings. He had tried several different classes of electrode but had never yet found anything reliable. He had been gradually making all his wheel centres to one standard for some years now, to the standard of the biggest size, and that saved considerable expense.

Mr. W. THOM said his experience was that the wide flange was the best. He did not know whether the author proposed to cut the lip down because it would interfere with track brakes and road traffic. The foreign rail of the type in favour now was cheaper than the English rail and the wearing qualities better. That was to be regretted, but if manufacturers would not support those who wished to buy in this country by giving them the right article at a proper price there was no alternative but to go abroad.

Mr. E. B. PICKERING now advocated 8 ft. 6 in. points instead of 15 ft. points, recommended some time ago, and he would like to know the reason for the change. The maintenance of points was an important matter, and there could not be such satisfactory maintenance with an 8 ft. 6 in. point as with the longer point.

STANDARD SPECIFICATION DIFFICULTIES.

Mr. R. J. HOWLEY referred to the difficulties of bringing out standard specifications, many of which took so long to agree upon that they were out of date by the time they were published. Most standards were a sort of compromise owing to the conflicting views of those concerned. Quite recently the Committee had been working on a new form of rail at the instance of Mr. Fell, but there had been great opposition to altering the existing standards for the 96 and 104 lb. rails, and these were going to remain. The new rail, which was to be called No. 8, was a heavy rail of about 114 lb. and 7 in. deep. It would have a depth of groove of 1 7/16 in., but in the specification the chemical composition was set out separately for open hearth and Bessemer rails, the open hearth having 0.6 to 0.7 carbon, which was much higher than we had been using in this country. Many tramway undertakings in this country had been using American rails which were higher than this. There were objections to the use of Bessemer rails, but he believed there was a hope that we might get a harder rail in the future.

Mr. F. BLAND agreed with the use of deep grooved rails. As a member of the British Engineering Standards Committee dealing with tramway rails, he regretted the long time taken in preparing the specifications, and he believed if the manufacturers were left to do it, the standard specification would have been issued long ago. He imagined the author was advocating shorter points because of the cost. The cost of tramway rails did not increase *pro rata* to all other commodities of life, and there was not now a sufficient demand to cause a wholesale fall in price. With regard to special track work, he thought there was need for simplification of the fittings.

SOME COMMENTS ON WELDING.

Major J. CALDWELL said he understood the author to say that instead of there being spots or plates in connection with the arc-welding process

there was a continuous weld along the junction of the fish-plate and the rail. He thought there was too much metal shown in the illustrations in the Paper and that better results would be obtained with a single run weld instead of what appeared to be more or less of a mould. Tests had been carried out on the Manchester system by the Woods Gilbert people using light welds instead of the heavy welds, the advantage of the light weld being that the strength of the weld was really obtained by the fusion in the first place. Such a weld on the Manchester rails withstood 56½ tons before it broke, and then the fracture was at a distance from the weld itself.

ELECTRIC ARC WELDING.

A Paper on "Electric Arc Welding" was then read by Mr. H. M. SAYERS. This we give in abstract below.

Electric Arc Welding.

By HENRY M. SAYERS.

Tramway engineers have made full use of arc welding and are familiar with its advantages and limitations. In order to illustrate the latter the author mentions a case of a corrugated boiler flue that developed cracks near where the flanged end of the flue was fixed to the boiler end plates. The crack was chipped out and arc-welded, but after a short time failed again. Evidently the welded material could not resist the continuous stress any more than the original material. This was an ill-advised application of arc-welding. Generally speaking, when it is sought to repair a part that has failed from repeated bending or other reversed stresses the repair should involve reinforcement—which can often be done by welding on reinforcing material. If a part has failed by some unusual accident it is reasonable to make a simple weld-repair. But if a part fails under normal working conditions extra reinforcement is needed.

Apart from repair work there are various recent constructional applications of welding that deserve mention. One example is the building up of lattice work masts or poles which have some advantages over tubular poles. Reference is made to a test on a welded lattice mast 67 ft. high, used for power transmission lines. This withstood a load equivalent to a lateral pull of 600 lb.—twice that likely to be produced by a maximum gale. The deflection was well within the specified amount and there was no permanent set, as would surely have occurred with a riveted mast. The cost of construction is also about 40 per cent. less.

FLXIBILITY AND SPEED OF WELDING.

Welding is in general a "quicker" operation than riveting and allows greater flexibility in design, as there is not the same limitation as is imposed by ensuring that the work is practicable for a riveter. Many accessory plates, gussets, &c., necessitated by the weakening of members by drilling, can be dispensed with when welding is used.

It is probably known that long lengths of steam pipe have been made up with welded joints and the same applies to pipes for hydraulic power work. Another application is the welding of steel wheels for heavy motor vehicles. Welding methods may also enable the construction of car bodies to be simplified.

In this country arc welding with covered electrodes has been more fully developed than in America. Bare electrodes are cheaper, and doubtless answer for simple work on mild steel. But the covered electrode gives a better weld, as microscopical sections show. The covering protects the electrode from oxidation, and unites with any oxides to form a fusible slag which rises to the surface; further, by properly relating the chemical composition of the covering to that of the electrode, we can obtain a final composition approaching very close to that of the stock metal, and more perfect homogeneity in the weld. Finally, it appears that the use of a covering protects the metal not only against oxidation, but against the absorption of nitrogen, to form nitrides, which are apt to give rise to brittleness.

DISCUSSION.

Mr. R. J. HOWLEY said that electric welding would play an important part in tramway work in the future. He would like to know what was the effect of phosphorus, sulphur and rust in the rails. He also would be glad to know whether it was possible to harden off the tread of the rails by applying welded metal to it. More information upon the arc voltage was desirable.

ELECTRODE REQUIREMENTS.

Major J. CALDWELL recommended the use of the very best electrodes that could be obtained. Welding with a steel rod covered with a flux had led to the manufacture of cast iron, although most chemists and metallurgists could hardly credit it. There was no difficulty whatever in depositing manganese steel, but there was some difficulty in preventing the cracking of the metal during the operation. Considerable heat

must be used and in many cases it was impossible to get a satisfactory job unless the work was pre-heated before welding.

WELDING STANDARDS.

Mr. W. THOM said electric welding was not only a great convenience in enabling repairs to be carried out without pulling cars to pieces, for instance, but it enabled repairs to be carried out very cheaply, and a great deal could be done when dealing with ordinary steel. Where special steels were involved, however, it was necessary to have special electrodes, but he had been able to make some good welds on manganese steel points. Another application of electric welding was in regard to overhead wire standards, it having been found possible to fit new top sections. He understood there was a tendency at one time to use machines which required two men to work them, but the disadvantage of a large machine was the short-circuit current which was very large. With smaller machines this was one-half or one-third, which was a considerable saving.

Mr. W. J. ALLEN said bare electrodes were practically standard in America, and he thought the bare electrode deserved just as much credit for bringing the art to its present state as the coated electrode. The great essential was to have a constant heat and that could only be obtained with a constant voltage. Therefore a system had been devised in America of having a control panel in circuit with a motor generator which kept the voltage constant. He had not experienced any trouble in welding manganese.

SOME PRACTICAL QUESTIONS.

Mr. E. H. EDWARDS, who was in the chair for this Paper, said he had been electric welding for 10 or 11 years and it was a mystery to him how, in these hard times, a tramway undertaking could do without a plant. He was not yet convinced with regard to covered electrodes. They were very much more expensive than bare electrodes. He had tried all sorts of covered electrodes, but had not found that they gave better results than the bare ones and for that reason he was continuing to use bare electrodes, except in special cases like manganese steel. The greatest difficulty they were all experiencing was to get the correct hardness of metal, especially for rail welding, and although he had tried one or two systems of hardening the metal afterwards, they had been failures. He would like to know of such a process, if it existed. With cast iron the greatest difficulty was that the joint was generally cracked owing to the intense heat.

Water Power Resources of Canada.

During the past two years there has been under way in the Dominion Water-power Branch of the Canadian Department of the Interior a careful re-analysis and computation of Canada's water-power resources. All existing stream flow and power data available from Dominion and provincial sources have been systematically collated, with a view to preparing on a uniform basis from coast to coast revised estimates of the power available. While the analysis is not yet finally completed, sufficient progress has been made to warrant the publication of the figures given herein.

BASES OF COMPUTATION.

The figures given in the accompanying table and curves are based upon power sites of which the actual existent drop or the head possible of concentration is well established. Innumerable rapids and falls of greater or lesser power capacity are scattered on rivers and streams from coast to coast which are not as yet recorded. This is particularly true in the more unexplored northern districts. In brief, the figures may be said to represent the minimum water-power possibilities of the Dominion.

The power estimates have been calculated on the basis of 24-hour power at 80 per cent. efficiency on the basis of "ordinary minimum

Available and Developed Water Power in Canada.

Province.	Available 24 hr. power at 80 per cent. efficiency.		Turbine installation.
	At ordinary min. flow. H.P.	At est. flow for max. dev. (dependable for 6 mos.) H.P.	
British Columbia	1 931 142	5 103 460	304 535
Alberta	475 281	1 137 595	42 490
Saskatchewan	513 481	1 087 756	—
Manitoba	3 270 491	5 769 444	83 441
Ontario	4 950 300	6 808 190	1 042 048
Quebec	6 915 244	11 640 052	925 972
New Brunswick	50 406	120 807	24 180
Nova Scotia	20 751	128 264	35 770
Prince Edward Island	3 000	5 270	1 930
Yukon and North-west Territories	125 220	275 250	13 490
	18 255 346	32 075 998	2 470 580

flow" and "estimated flow for maximum development." The "ordinary minimum flow" is based on the averages of the minimum flow for the lowest two consecutive seven-day periods in each year over the period for which records are available. The "estimated flow for maximum development" is based upon the continuous power indicated by the flow of the stream for six months in the year. This estimated maximum development is based upon the assumption that it is good commercial practice to develop wheel installation up

tions set out in the foregoing is 18 255 000 H.P. The water-power available under estimated flow for maximum development i.e., dependable for at least six months of the year, is 32 076 000 H.P. An analysis of the water-power plants scattered from coast to coast, concerning which complete information is available as to turbine installation and satisfactory information as to stream flow, gives an average machine installation 30 per cent. greater than the six month flow maximum power. Applying this, the figures quoted above, therefore, indicate that the water-power resources of the Dominion at present recorded will permit of a turbine installation of 41 700 000 H.P. In other words, the present turbine installation represents only 5.9 per cent. of the present recorded water-power resources.

PROGRESS DURING THE PAST YEAR.

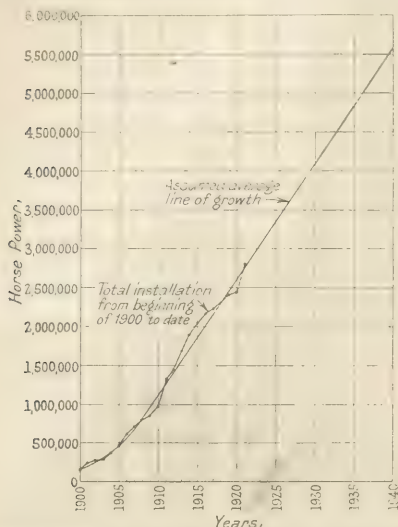
In spite of the outstanding facts that financial and commercial conditions are still far from normal, and that costs of construction are almost prohibitive for all but absolutely necessary undertakings, there has been during the past year, and is now, marked activity in hydro-power construction. This has resulted from a variety of causes, principal among which is the lack of native coal in the central industrial district and the fortunate location of economic water-power sites to industrial centres.

The total hydro-power development installed during the past year or now under construction represents approximately 560 000 H.P. of installed capacity. This figure includes only the initial installations of plants under construction, not their ultimate designed capacity. It is evidence of the manner in which the water-power resources of the Dominion are being put to effective and productive use.

TWO ESSENTIALS FOR DEVELOPMENT.

In order to ensure the most beneficial utilisation of these reserves and to provide intelligent guidance for their development, two essentials are required: An accurate knowledge of the location, capacity and the engineering and economic possibilities of development of the water-powers throughout the Dominion, together with their relationship to other natural resources of mine and forest, to industrial centres and opportunities, to transportation systems—rail and navigation, to coal and fuel supplies, to irrigation, drainage and reclamation projects, to alternative sources of power and to market for and uses of power in general. A sound governmental administrative policy designed to protect the public from inadvisable and ill-designed power schemes, and to provide for reasonable regulation and revision of rates and rentals, and at the same time to ensure satisfactory guarantees for the encouragement of legitimate investment in hydro-power enterprises.

True conservation of the water-power resources of Canada, which are inexhaustible through use, the Government considers lies, not in withholding them from development, but in their efficient utilisation in the public interest for the economic exploitation of our other natural resources, and for the conservation of our exhaustible fuel supplies.



CURVE SHOWING DATE OF INSTALLATION OF WATER WHEELS AND TURBINES NOW IN OPERATION THROUGHOUT THE DOMINION OF CANADA.

The projection of the curve indicates a water-wheel installation of 5 600 000 H.P. by the year 1940.

to an amount the continuance of which can be assured during six months of the year, on the assumption that the deficiency in power during the remainder of the year can be profitably provided from storage or by the installation of fuel power plants as auxiliaries.

AVAILABLE AND DEVELOPED TOTALS.

The recorded power available throughout the Dominion of Canada under conditions of ordinary minimum flow and within the limita-

Dinner to Mr. Ernest Benn.

Broad Impressions of a Mission to America.

MR. ERNEST J. P. BENN and MR. FRANK H. ELLIOTT, who recently acted as delegates from the Industrial League and Council to the National Civic Federation of America and made a special study of industrial conditions in the United States, were entertained at dinner by the League at the Holborn Restaurant on Thursday of last week. The Rt. Hon. G. H. ROBERTS, M.P., presided.

The Industrial League and Council provides a common platform on which employers and employees can meet for the friendly discussion of industrial problems, and the attendance at the dinner was thoroughly representative of industry generally. More than 200 persons attended, including members of leading employers' associations and of many trade unions.

GROUING IN THE DARK.

The CHAIRMAN, in proposing the toast "Our Guests," touched on the importance of the mission to America. He said there were many present who had been genuinely desirous of securing betterment and had been largely groping in the dark. They had exhausted a great deal of energy, and characteristically were learning by experience and were acknowledging today that the policy and methods advocated by the Industrial League and Council were calculated to win greater security and prosperity for the whole of the country. These qualities would be equitably shared amongst all willing workers and would be achieved by the display of the greatest possible harmony between the essential classes of the community.

THE NEED FOR THE CLOSEST UNDERSTANDING RECOGNISED.

The toast was received with musical honours, and Mr. E. J. P. BENN, in reply, said that he had been in America five weeks

just long enough to appreciate that 50 years would be insufficient to grasp all that America had to teach. But upon one point he could be definite without any qualification; the need for the closest understanding between the English-speaking peoples as the means of saving the world for civilisation was recognised by the Americans with a depth of conviction which rivalled, if it did not excel, our own. He confessed that he had returned a more confirmed individualist than when he set out. Could they imagine a land of 110 000 000 civilised persons without a political labour party; a land in which the workers, who had never heard the words "ca' canny," regarded restriction of output as a mythical madness? The differences between ourselves and our American friends in these industrial questions were so fundamental that little use could come from the discussion of matters of detail. That veteran leader of American labour, Mr. Sam Gompers, with whom he had talked, claimed that so far from being 50 years behind England in matters of labour organisation, America was 100 years ahead. He claimed that to estimate the success of a labour movement one must not judge by the violence of its political programme; a more effective test was to go to the homes of the people. Mr. Gompers pointed with pride to the 6 000 000 working-class homes which were either completely or partially owned by their workmen occupants; to the 12 000 000 automobiles among 110 000 000 people; and to the 15 000 000 owners of shares or other forms of property which existed in that wonderful country.

AN AMERICAN REVOLUTION.

America, like the rest of the world, was having her revolution, but there it was taking the form of a transference of large blocks of industrial capital into the hands of the workers in industry. Savings banks at street corners were more numerous in America than public-houses at

street corners here. Mr. Gompers claimed that he was leading the only constructive labour movement in the world.

PUSH AND LEAN.

"MAY I give you another broad impression," Mr. BENN continued, "which will help you to see what America has done. If you will go to the middle of the Atlantic you can hear, as it were, two voices; the voice of John Bull and the voice of Uncle Sam. I seemed to hear those two voices talking to their sons, the working man of England and of America. This is what it seemed to me John Bull is saying to his workman: 'Do the best you can, my good fellow; don't kill yourself at it, you were not made for work, a happy life is what you came here for. If you succeed, well and good; if you do not, you can always rely upon some form of pension or dole sufficient at least to keep you in decency. If all my arrangements are not exactly as you like—well, the Government or the Universities or the Trade Unions or some other very learned people will devise fresh ministries or new guilds to put everything alright for you.' That is what John seemed to me to be saying to his working-man. Then I turned the other ear and heard Uncle Sam, and this is the way it seemed to me Uncle Sam was talking: 'You are a man, you are as good as any other man, you can do anything that any other man can do if you will try. The world depends upon you just as much as it depends upon anybody else. If you fail, the world fails to that extent; if you succeed, the world succeeds the better. Remember, America is called to lead mankind, and you are an American citizen.' That, you may think is a little far-fetched, but it seems to me to be the sort of message that is being imparted to the workers of these two kindred countries. In a word, the whole force of public opinion in America is directed to teaching its people how to *push*. Our public opinion, on the contrary, seems to be concerned with teaching its people how to *lean*."

THE LEADERSHIP OF MANKIND.

In Chicago he heard a speaker tell a brotherhood meeting of 2,500 men that "no power in Heaven or in hell can prevent America from assuming the leadership of mankind." "I am here to say that is true," said Mr. Benn, "if we are going on in the way we have followed during the past couple of years. But if we can succeed in taking advantage of the one thing we have which America has not—the one thing which has given us the trade unions and other blessings; if we take advantage of our genius for organisation and turn it to constructive instead of destructive purposes, then America can do all the leading of mankind she likes; she will have to come here to learn how to do it." American wages were roughly two and a half times those earned in this country, but it was erroneous to suppose that American labour costs were dear. American labour, as a cast factor in production, was among the cheapest in the world. He watched a man earning 7s. 6d. per hour tending three machines, which in this country would each have required a minder and a labourer to care for. If it were true that we had to face the consequences of cheap German labour we had also to face the good, healthy, straightforward competition of efficient, hard-working, economic American labour. The Declaration of Independence gave to the American citizen the right to life, liberty and the pursuit of happiness; he found happiness, satisfaction, self-respect and independence in doing good and useful work; in rendering service.

A NATION OF CAPITALISTS.

Mr. FRANK ELLIOTT, who also replied, said the deepest impression that he had formed of America was that it was a nation of capitalists. The transference of wealth from the hands of the big people into the hands of the many was being welcomed by the leaders of industry who saw in it a bulwark for civic and industrial stability. America seemed to have passed through her industrial crisis with comparatively little trouble in the way of resentment of poverty or strikes. Wages "cuts" had been accepted in a philosophical fashion. There were no old age pensions and unemployment schemes in America, and the Secretary of State for Labour there had expressed the opinion, in conversation, that the people of England were being pauperised by their methods of social reform. After all he had seen in America, he still believed that we in England made the best goods in the world, and he still believed that if we would pull together and co-operate we should be able to regain our export trade, "because quality always tells."

Heating and Cooking Notes.

A SMALL PLANT WITH A BIG BATTERY.

MR. WALTER BALMFORD, Electric Engineer, Whitbread-street, Birmingham, sends particulars of the "British R.B." horsepower plant. This is a self-contained semi-automatic set, which can be run either on petrol or paraffin. Two important merits are claimed for the "British R.B." (see Fig. 1). One is that it includes a much larger storage battery than is usually supplied with such sets. The battery will run 15 lights for 10 hours and therefore should easily withstand the discharge rates imposed by appliances such as flat irons, vacuum cleaners, &c. The other advantage claimed for the set is that it is perfectly vibrationless when placed on a level concrete floor, and does not need bolting down. This is certainly borne out by a time-exposure photograph reproduced in the descriptive leaflet, showing a set running under full load. Although the plant is not held down in any way the photograph does not indicate the slightest movement.

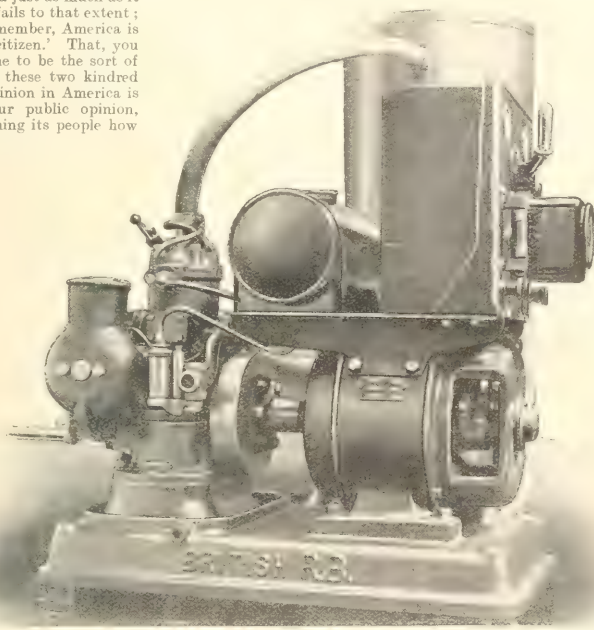


FIG. 1.—THE "BRITISH R.B." GENERATING SET.

This is a semi-automatic set, using either petrol or paraffin, and provided with a storage battery of generous capacity, i.e., 120 Ah.

A NEW LAMPHOLDER.

• The ordinary bayonet lampholder, with its irritating multiplicity of parts and pronounced tendency to "cross thread," is so deeply embedded in English electrical practice that many years must elapse before it is finally relegated to the limbo of things forgotten and unregretted. However, the day will come, and ingenious inventors are doing their utmost to hasten its advent.

In the "Scott" lampholder (see Figs. 2 and 3), of which particulars have just been received from Mr. WALTER BALMFORD, the manufacturers appear to have produced a device of considerable merit and great possibilities. The casing is in one piece and there are no joints or screwed rings. It contains a porcelain interior of simple and robust design, with solid terminals and an efficient cord-grip device on similar lines to that employed in the ordinary plug-top. This interior is easily removed by turning it until the guide slots are in line with corresponding projections on the inside of the casing. Contact between the lampholder terminals and lamp-cap is maintained by a single heavy spring which does not carry current, and is obviously less liable to weakening and deterioration than the small buffer springs of the ordinary lampholder.

An insulated bush is fitted in the top of the holder. The shade carrier is of novel design, and consists essentially of a strong helical spring with a ring at the bottom. The carrier slips over the

easing of the holder, to which it is secured by a bayonet-catch device. It is as easy to attach or detach as a lamp, even in the deepest and narrowest shade, and it automatically adjusts itself to glass of varying thickness. The shade is supported securely but not rigidly, and can only be detached by positive action.

LAMPHOLDER TESTS.

Some comparative tests between six ordinary and six Scot lampholders were recently carried out by the Bradford Corporation Electricity Supply Department. The lampholders were wired up in parallel, care being taken to have the same length and gauge of copper connection in each case. An adaptor was shorted with several strands of copper wire, and inserted in each lampholder, and, as the result of a number of drop tests taken in this way, the average resistance in microhms of the Scot lampholder was found to be 6.575, and of the ordinary lampholder 8.250. A destructive test was also carried out on one lampholder of each type by passing through



FIG. 2.—SECTIONAL VIEW OF "SCOT" LAMPHOLDER SHOWING DETAILS OF CONSTRUCTION.



FIG. 3.—"SCOT" LAMPHOLDER WITH THE INSIDE OUT.

Note the strong spring which maintains contact between holder terminals and lamp base.

it a current of 50 A for 30 minutes. In the case of the Scot lampholder the final temperature reached was 279 °F., and, in the case of the ordinary lampholder, 520 °F.

The Scot lampholder is fully protected at home and abroad by letters patent granted to the inventor, Mr. A. Peden Rutherford, late chief engineer and manager, Leith Corporation Electricity Supply Department.

A Midsummer Exhibition of Domestic Appliances.

In business, as in the tenderer affair of love, the choice of period and place may determine the success or failure of the enterprise. To get the place and the time and the prospect all together is an auspicious conjunction which cannot often be prearranged, however often it may happen accidentally. However, the Westminster Electric Supply Corporation have evidently considered this point and successfully applied its moral in organising the Midsummer Exhibition, now in full and prosperous swing at their showrooms, 6, Eccleston Place.

SIGNIFICANT DATES.

This exhibition began on July 4th and is to finish to-day. The dates are significant. It is during this period that the scrupulous majority of consumers pay their midsummer accounts. It is also a fair inference that most of the payments will be made personally, in order to avoid the cost of postage, cheque stamps, and stationery. Normally, these payments would be made in the Collector's office, but (and this is a shrewd piece of tactics) during the exhibition the

Collector sits in the showroom, and those who come to pay must stay to look at the many interesting appliances displayed, and to listen to the persuasive eloquence of the showroom manager. Circulars about the exhibition were sent out with the quarterly accounts.

As to the exhibition itself, it contains every conceivable sort of domestic electrical appliance, from a hot-plate to a washing machine. The exhibits are well arranged and attractively displayed, and most, if not all of them are, or can be, shown in operation. One very fascinating item is a set of appliances for the use of travellers of the fair and furbelowed variety. This set, contained in a neat little case about the size of a lady's handbag, consists of a diminutive flat-iron, a pair of curling tongs, and a small boiling ring. The curling tongs are heated by inserting them in a steel receptacle placed over the surface of the iron, which, for this purpose, is stood on its handle. These appliances are of the universal voltage type.

THE DESIRTS OF THE UNDESERVING.

To describe the exhibits in detail is unnecessary. They are all electrical and they are all good; and the citizen of Westminster who cannot find amongst this wonderfully complete display of fires, cookers, clothes washers, dish washers, irons, utility motors, fans, fittings, &c., something to interest him (or her), and to conjure a pound or so from super-affluent pockets, does not deserve to live in such a city, but should be exiled to a desert island where Heaven is the only authorised supplier, and the supply is flashy and inconstant.

The Westminster Electric Supply Corporation deserve a great deal of credit for having organised and equipped this exhibition in so excellent a manner. It is bound to have a good influence on electrical development in Westminster. Immediate sales are no criterion of the value of the enterprise.

THE COST OF SELF-RESPECT.

The great merit about shows of this kind is that they accustom people to the idea of electrical service, and in time make them feel a little ashamed of their conservatism and inefficiency. At this stage, self-respect can only be regained at the cost of a fairly complete equipment of electrical apparatus. This may not be bought at the Supply Company's showroom, but it will be used on the Supply Company's mains.

It is understood that a similar exhibition is to be held at the end of every quarter in the future. In a sense, of course, the showroom is a permanent exhibition, but at the quarterly exhibition periods a specially augmented display will be arranged, and consumers will be circumscribed on the present occasion. May the enterprise of Westminster be reproduced in every other supply area in the country.

Correspondence.

MECHANICAL ADVANTAGES OF ELECTRIC LOCOMOTIVES COMPARED WITH STEAM.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: May I be allowed to correct the report on p. 49 of your issue of July 8th of my remarks on Sir Vincent Raven's Paper on "Electric Locomotives Compared with Steam."

Evidently by a shorthand error you make me say that the squirrel-cage type of motor is the one which best solves the problems of the high-speed electric locomotive. Types of motor were not at the moment under discussion, and what I said was that the "quill" type of mounting is the one which best solves the problems, &c. Also, I did not say that "a great deal more experience with it was required," but, on the contrary, said that the experience with it in America was quite sufficiently satisfactory to make it perfectly safe for similar constructions to be proceeded with here—its principal disadvantage being its necessity for large diameter on some of the main bearings.

I should also like to note that what I said with regard to the overhead system was that it is the only system suitable for sidings other than the battery locomotive system, and is the only means whereby on main lines a continuous conductor could be presented to the locomotive so far as current-collecting gear is concerned.

This also is not quite what is conveyed by your report.—I am, &c.,

Derby,
July 14th.

J. DALZIEL.

ELECTRICITY METERS VERSUS CURRENT LIMITERS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: With regard to a letter from Mr. J. H. Holmes that appears in your last issue on the above subject, I wish to correct what may be a mistake in impression that I have unwittingly given.

I did not wish to convey in the article that the principle of inserting a resistance on breaking the circuit was a new one, but I did wish to imply that its use for the limitation of current to a consumer on the mains of a supply authority was new.

I am very interested to note the details of the Holmes limiter, as far as they are available from the illustration that appears, but I would like to know whether it is possible to set this device to operate without hunting. The Edison Swan limiter does operate without any hunting, and will, moreover, operate on as low a setting as 8 W on a normal 100 W circuit. I lay particular stress on this point, because one of the most difficult problems to overcome in the design of the limiter was to eliminate the tendency to hunt.—I am, &c.

E. H. MILLER,

The Edison Swan Electric Co.

Ponders End.

July 15th.

AN "ALL ELECTRIC" CONVENTION.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: The proposal put forward in last week's *ELECTRICIAN* for one great "all electric" Convention annually in place of the many sectional conferences is one that has much to recommend it, but I doubt whether it will ever be carried into effect. Like the vision which many of us have had in the past of one "Institution of Engineers," including in its membership Civil, Electrical and Mechanical Engineers, Consulting Engineers, Contractors, Manufacturers and Officials, each with their own sectional organisation under one main Council, its advantages from the point of view of efficiency,

economy and general convenience appear at first sight evident but I doubt whether these will be sufficient to ensure its realisation.

There is something in the atmosphere of America and in the mentality of its citizens which favours giant conventions; here the tendency always seems to be to work through a number of independent associations, and it is this tendency which has earned for us the reputation of the country "with one sauce and a hundred different religions."

The Englishman, despite all that has been said of late years in favour of communism, is at heart an individualist, and the ordinary member of the electrical profession will take much more interest in, and do much more work for, his own specialised association, with the members of which he is in close touch and on the governing body of which he may probably himself serve, than he will in any all-embracing association with the governing body of which he never comes into close contact.

Apart from the effect on the outside public of one huge "all electric" convention, the individual electrical man probably derives much more benefit from a number of smaller meetings. The whole world learns more about the Royal Horticultural Society when it holds a monster show at Chelsea or Holland House, but, I at any rate, as a lover of flowers, find the ordinary bi-weekly meetings at Vincent Square much more enjoyable and more instructive.

One can make an effort to assimilate the Papers and discussions which interest one at sectional conventions when there is a small interval between, but if all were to be crowded into one week devoted to the reading of papers on all the multifarious questions of interest to electrical men, I fear the newspapers, as well as their readers, would suffer from a severe attack of mental indigestion.

At the same time a determined effort should be made to secure some form of co-operation between the different bodies so that we do not have again, as this year, the Convention of the Institution of Civil Engineers and an important Convention called by the Mechanical Engineers fixed for the same week.—I am, etc.,

London, July 19th.

A. H. DYKES.

London Electricity Inquiry.

The Electricity Commissioners are approaching the end of their long inquiry into the organisation of electricity supply in the London area. During the week the case for Poplar was completed, and evidence in opposition to the schemes was given on behalf of the Metropolitan Electric Supply, the North Metropolitan Electric Power and the County of London Electric Supply Companies, the Hertfordshire and Middlesex County Councils, &c.

A CONSULTING ENGINEER'S EVIDENCE FOR POPLAR.

Mr. E. M. LACEY stated that in 1918 he advised on schemes for the development of electricity supply in Poplar and West Ham, and the future supply of electricity throughout East London. He prepared a preliminary report in March, 1919, and he attended, with a deputation, a conference called in April, 1919. His suggestion in the report referred to was that a central authority for London should confine itself to broad principles, and that the supply should be carried out by district committees, to which the actual administration should be delegated. In preparing the scheme of Poplar Council now under consideration he came to much the same conclusions as the engineers' committee for the other schemes. He felt that there was a difficulty in proceeding with capital stations for a long time to come. He agreed that a densely populated industrial area should receive special consideration from the Commissioners. The cost of erecting a capital station for East London would not much exceed the cost of extending the existing stations, and the adoption of the latter method would be to perpetuate the bad old system of having a large number of small units. Both the general supply and the railway load would gain by the combination of their loads. The combined load factor was higher than either of the two separate loads. In tests he had made electricity supply had a load factor of 22.7, the tramway load 23.367, and the combined load 26.51 per cent. The electrification of the railways was likely to be so gradual that it would pay the railway companies better to take their current from a public system. He handed in a table which showed that, according to his estimates, the cost per unit under the East London scheme would be lower at any load factor than the figures given for the Conference and the L.C.C. schemes. The estimated cost per unit in the first stage of the scheme

was 0.999d., and in 1926 the cost would be 0.912d. The disparity between the present cost in East London and the outside area would still exist in 1926 and 1931 if the figures of the L.C.C. were correct. A considerable amount would be saved in building construction work and also in the cost of land at Dagenham, compared with Beckton. He was of opinion that as good results could be got by having a committee of engineers as by having the autocratic control proposed by other schemes. Even though a generating station were shut down, the engineer of that station would still retain his seat on the board by virtue of his station continuing as a distributing station.

Replying to Mr. HENDERSON, witness said the advisory committee of engineers would only exist until the capital station stage was reached, when there would be a chief engineer to the district board. The organisation was the same as that proposed by the L.C.C. as far as having one responsible head was concerned, but the East London area was of a suitable size for such management, while the L.C.C. area was too large. He did not say the district boards should be free from control by a central joint authority, but that they should have the power to deal with local needs, which they would be better qualified to do than a central authority. The district board would decide as to the necessity of capital expenditure for their district, but there would always be the right of appeal to the Electricity Commissioners. The first consideration in an industrial area was getting current at the lowest possible figure, whereas a farthing a unit more did not matter to West End shops. That was what he thought justified the segregation of the East London area from the other areas.

BENEFITS FOR EAST LONDON.

To Mr. TURNER, witness said he thought the district scheme would afford benefits to East London which would not be obtained under the larger schemes. There would be a separate engineering scheme for the district. He did not adopt the view that so long as they got the district committee and the price was satisfactory the district would have its requirements met as well by the Conference scheme. Under the district system there would not be preferential charges, but zonal charges.

Witness said, in reply to Mr. KENNEDY, he did not think it desirable that the plant at Stepney station should be increased by 75,000 kW.

instead of building a capital station, as the St. Mary station would not take sufficiently large units. The Great Eastern wanted their supply at Stratford. They could get that more easily from Blackwall than from Dagenham. On the other hand, the Midland Railway could be supplied more easily from Dagenham. Poplar was only seeking permissive powers for the south-eastern part of the proposed area—the Woolwich, Bexhill, Dartford & Gravesend portion.

Mr. Lacey informed Mr. Tylor that he had no objection to the proposal that railways should be represented on the district board.

Mr. MORSE was informed by Mr. Donald that the southern portion of the City of London Company's area should be left out if the Company desired it. In regard to the suggestion to link up the stations in South London, the Bexhill and the London Electric Stations were not included. In regard to Mr. Morse's remark that the South Metropolitan Company, who supplied in bulk to the West Kent Company, was included in the area but the West Kent Company's area was excluded, which might result in the West Kent Company getting no supply, Mr. Lacey said little difficulties of that kind would arise under any scheme.

THE FUNCTIONS OF DISTRICT BOARDS.

TO SIR HARRY HOWARD, Mr. Lacey said the engineers of the different district boards, assuming that there were several, should act independently with regard to operation, but any questions of general policy should be referred to the chief engineer of the Joint Authority. He had allowed 6 per cent. for interest on capital.

Mr. BOOTH remarked that Mr. Lacey's estimate of £7 000 a year for administrative expenses for each of four district boards would swallow up the amount originally estimated as the expenses of a Joint Authority. It seemed to indicate that no Joint Authority was contemplated. What matters was it expected that the Joint Authority should attend to?

Mr. LACEY said his idea was that it would deal with broad questions of policy and with finance.

Replying to Mr. PAGE: The £3 000 allowed for skilled technical staff of the district board would probably be sufficient, as the staff would have the assistance of the engineers at the stations in regard to tests. Cost of plant after 1926 was put at £24 per kilowatt, compared with £20 per kilowatt before that date, because more would be spent on buildings.

SIR JOHN SNELL, on the suggestion of Mr. Craig Henderson, asked Mr. Donald to call a witness who would give details of the proposed constitution of the district board for East London. Sir John said this was rendered necessary by the fact that Poplar's original scheme for a separate Joint Authority for East London had been in effect withdrawn, and all it could ask for was the appointment of a district board under the jurisdiction of the Joint Authority for the larger area.

Mr. DONALD said he would call such a witness. He thought the constitution he had outlined might stand for the district board.

CAPITAL EXPENDITURE AT £25 PER KILOWATT.

TO MR. LACKIE, Mr. Lacey said for the completed station the capital expenditure was estimated at about £25 a kilowatt. The difference between that and the £40 a kilowatt under the L.C.C. scheme was accounted for by the fact that it would be a smaller station, and that from £200 000 to £300 000 would be saved by the jetties being already constructed. 1-228d. was the average cost of generation in the district dealt with, and he put that forward as a price they would be entitled to get as an authority.

Replying to questions by Sir JOHN SNELL, Mr. Lacey admitted that the undertaking of the Commonwealth Edison Company at Chicago was a very large and successful organisation, but the conditions differed from London in that the load was mainly power. He thought it would be over-centralisation to place the whole of the engineering control of the London organisation under one man. The Yorkshire Electric Power Company supplied a large area, but its stations were not comparable to those proposed in the London schemes.

SIR JOHN SNELL suggested that if broad principles were laid down to work on which would lead to one goal that was more likely to attain the desired object than working from, say, four centres, and that instead of appointing an advisory committee for the early stage, and a chief engineer for the subsequent stages, it would be better to appoint a chief engineer at the outset in order that the whole of the work should go on throughout on certain defined lines. This question had been under consideration since 1905, and considerable delay had taken place in devising a well-considered scheme. Would not the appointment of an advisory board of engineers lead to further postponement of any settled system?

Mr. LACEY said, on the contrary, it was hoped that with the proposed organisation they would be able to go forward in East London at once. He thought the delay in the past had been due to the fact that London had always been considered as a whole, and no particular part had been examined to see whether it was ripe for development.

BORROWING AT 6 PER CENT.

MR. P. J. SUTTON, (C.A.), said he had been engaged in connection with the drawing up of the proposed scheme for the East London scheme. He thought it was reasonable to assume that by 1926 money could be borrowed at 6 per cent. Dealing with the costs estimated under the East London scheme, these would amount to 0-3996d. in 1926, and would be reduced to 0-3412d. in 1931, more or less, and 0-474d. operating costs 0-153d., including transmission and administration; capital charges 0-279d., and working capital 0-0057d. Under the Conference scheme, the items for the same period would be 0-414d.

Mr. DONALD said he had produced the resolutions passed by Poplar Council authorising the presentation of their scheme, and he claimed that the L.C.C. and the Conference Local Authorities should also put

in the resolutions passed by their respective authorities in regard to their schemes.

SIR JOHN SNELL read an extract of the resolution passed by Poplar Council on March 22, 1921, to the effect that an objection be entered to the area delimited by the Commissioners, and that an alternative proposal be submitted for the formation of a separate electricity district for the east and south-east portions of Greater London, &c.

Mr. DONALD said he would be content for the Commissioners to leave the East London area to be dealt with by a joint committee under the 1909 Act or that a district committee should be formed under the Joint Authority for the whole of London and in either case to leave it to the Commissioners to decide as to the representation on the committee. The main point was the decision as to what powers should be compulsorily delegated to the district committee.

Mr. FRED TAIT, assistant manager of the Poplar electricity undertaking, gave evidence as to powers which Poplar Council suggested should be in the hands of the Joint Authority and in those of the district committee or committees, and as to the constitution of the district committees. He said it was suggested that the Joint Authority should approve the erection of generating stations and the extension of stations, the laying of mains between the districts and into areas exterior thereto, and order other works so as to assure the most economical supply in the whole area, and that the district committee should appoint an advisory committee of engineers, prescribe running hours of stations and regulate operation in other ways in the district, and submit recommendations to the Joint Authority. So far as the work inside the area was concerned, that was a matter for the district committee.

Mr. DONALD said he asked that if the local authorities came forward to join with Poplar they should have a sufficient period allowed to form a joint authority under the Act of 1909.

THE DISTRICT COMMITTEES' FUNCTIONS.

Replying to Mr. HENDERSON, Mr. Tait said the Joint Authority would deal with the allocation of cost of interlinking mains between the areas of district committees. The cost of interlinking within the district, provided the linking was approved by the Joint Authority, would be allocated by the district committee. There would be no revenue for the district committee until the capital station was erected. It was proposed that the district committee should raise a loan for the capital station on the security of the rates of the local authorities in the district. Another alternative suggested was the Joint Authority should raise loans for a district committee on the security of the rates of the whole of London. At present the L.C.C. raised loans on the security of the rates of the whole of London and lent money to the local authorities.

TO MR. TURNER, witness said the district committee should be appointed by the Joint Authority, but not necessarily from among its own members. Its choice as to members should be limited to representatives from the district committee's area. The members would be representative of electricity undertakers in the area and local authorities in the district not owning undertakings. The question of the constitution of a district committee within a Joint Authority had not been considered officially.

TO SIR HARRY HOWARD, he said the object of having an autonomous district was not in order to secure to that district any profit made in that area, but to get the cheapest supply. There should be no profit nor loss. The rates of the whole of the larger area should be behind all the loans.

TERMS OF TRANSFER OF COMPANIES' STATIONS.

Mr. TURNER said a meeting of the Conference of Local Authorities was held on the previous Thursday and passed resolutions to the effect that the Conference proposed at this stage that only the acquisition of the companies' generating stations should be considered and not the distribution business. There should be no connection between the acquisition of the generating stations and main transmission mains and the distributing business, and if a company received its supply of electricity from the Joint Authority at a price not greater than the company had incurred in generating their electricity, the company was not injured by the generating station being taken over by the Authority on the basis of cost price, less depreciation. These resolutions had been considered by a meeting of representatives of the Conference, of the L.C.C. and of the companies. The companies' representatives were unwilling to consider the question of acquisition, apart from an extension of the distribution rights beyond 1931, and in that view the L.C.C. acquiesced.

SIR JOHN SNELL said there was no power to compel the companies to come into this scheme. Could they be expected to give something for nothing?

Mr. TURNER said the view of the Conference Executive was that the companies would be compensated by getting the cost of their stations, less depreciation, together with a guarantee of current in future at a rate not more than that at which it had hitherto been generated.

SIR JOHN SNELL said the purchase of the companies' undertakings under the terms of the 1888 Act would involve payment of a larger sum than that proposed by the Conference resolutions. Could they be expected to accept the Conference proposal without some *quid pro quo*?

Mr. TURNER said the Conference had a measure of support from a separate conference of local authorities which did not own undertakings and which were purchasing authorities. The Conference could not assent to the extension of the distributing powers without consulting the full body of its constituents, and a meeting had been convened to ascertain their views.

SIR JOHN SNELL thought there was a prospect of all the authorities

concerned coming to a unanimous agreement, and it would be a pity for such a golden opportunity to be missed.

THE RAILWAY COMPANIES' SCHEMES.

Mr. TAYLOR then opened the case for the London, Brighton & South Coast and Great Eastern Railway Companies' schemes. He said that the companies had no feeling as to whether they obtained their supply from their own station or from any other source. Their primary need was a cheap and reliable supply of electricity. They could not put forward a detailed scheme which they could substantiate by detailed evidence. The schemes put forward were frankly for their own purposes, but the companies would be willing if they established stations to supply any surplus to a joint authority. They could not at present undertake to take a definite quantity of current from a Joint Authority. It was intended, when the difficult questions now agitating the railways were settled, to go into the details and approach the Commissioners under Sect. 11 of the 1919 Act with schemes which would be adequate for securing a supply for railway purposes. In the meantime he asked for leave to withdraw the schemes.

This leave was given, although Sir JOHN SNELL said he regretted that railway witnesses had not been called, as it might have obviated the necessity for a fresh inquiry when the railways were ready with their full proposals.

THE OPPOSITION OPENED.

Mr. A. W. TAIT, Chairman of the Metropolitan Electric Supply Company, examined by Mr. Moseley, said the Company gave bulk supplies to the Uxbridge District and the Brentford Electric Supply Company, and to the North Metropolitan Electric Power Company for traction purposes, and a small quantity to Heston and Isleworth. The Metropolitan Company was willing to find any capital that might be required for extending its undertaking, but disturbance of its existing powers would prejudice the raising of new capital. The Company's issued and paid-up capital was £1 380 605 and loan capital issued and outstanding £1 324 300. The Company objected to having its bulk supply area outside London included in the Joint Authority's area, but they did not mind their rights inside London being included.

To Mr. HENDERSON, witness said extensions were now being carried out in the Company's area. They already had mains to Beaconsfield, and an extension to High Wycombe was being discussed. He did not know that it would be an advantage to his Company if the Commissioners gave him authority to become a distributor in districts in which the Company now had only bulk supply powers. He would prefer somebody else to lay the distributing mains.

Mr. J. S. HIGHFIELD said by the autumn of this year there would be a direct cable from Willesden to Uxbridge, duplicated so far as Southall. In the Uxbridge area the system was mainly single-phase, but a good part of it had been changed to three-phase. Three-phase, 50 cycles was used in the remainder of the area, except Acton, which was two-phase. The Taylor's lane station of the North Metropolitan Company was not more than a mile from Willesden and a main was to be laid between those stations.

Replying to Sir John SNELL, he said reduction in coal consumption was expected from linking up that with the Uxbridge station and the North Metropolitan Company. It was estimated that the Company's load would be 43 000 kW in 1930. He thought that the capital charges at present day on the proposed Chiswick station would wipe out any advantages obtained by using modern plant. The price at which the Company was offering 12 000 kW to Ealing worked out at about 1.08d. which was lower than the average estimate of the Conference scheme, 1.326d. at 25% load factor. In reply to a question whether the Metropolitan and North Metropolitan Companies' areas could be supplied more cheaply by being connected up with the more densely populated parts of London than they were supplied under the present systems, witness said he thought the cost of the mains alone from Chiswick to supply that area would lead to an increase in the cost.

THE NORTH METROPOLITAN COMPANY'S CASE.

Sir JAMES DEVONSHIRE gave particulars of the powers and obligations of the North Metropolitan Electric Power Company. He said Stoke Newington was now in the Company's area and a supply was also given to Hackney. The Company had already, practically, power to link up with any other undertaking through contiguous systems. There was no legal limitation as to the amount of current that could be supplied to Hackney, and it was no concern of the Company as to what Hackney did with it afterwards. The Company had obtained and had acted upon powers to acquire electric lighting orders. Under those orders they supplied for all purposes in premises supplied with power. In a certain special district they had also authority to supply electric energy for all purposes without any limitation, with the consent of the authorised undertakers, if any. This district included East Barnet Valley, Edgware, Wembley and Willesden. Parliament had authorised the Metropolitan and the L. & N. W. Railway Companies to give supplies to the Power Company. The Company's extended powers were in perpetuity, but it was provided that applications could be made by other bodies or persons for provisional orders to supply in competition. He was responsible for the first attempt to establish a power company, in 1898. The bill was defeated by a narrow majority, but it led to Lord Cross' Committee coming to the conclusion in 1900 that the time for generation and distribution on a large scale had arrived, and the Company's first Act was then passed. In 1903 the supply to the North Metropolitan Electric Tramways was commenced. Since 1904 only one generating station other than those of the Power Company had been erected in the Company's area, viz.: that of the Tottenham Gas Company. It was esti-

mated to cost 25,000 acre-feet. The Company's area was not being by the Power Company. Its generating stations were at Brimsdown, Willesden, Hertford and St. Albans. The capital expenditure was over £1 200 000. Net revenue was £84 604 in 1920, after meeting loan and mortgage interest. In the last two years gross revenue had increased considerably because a coal clause had been agreed to by many large consumers. Units sold last year were 62 773 000. The sales this year up to date were nearly as great as those of last year, in spite of the trade slump and the restrictions of supply to tramways during the coal strike. The Company objected to the inclusion of any part of its area in the London and Home Counties Electricity District. The Joint Electricity Authority could not, in his opinion, render any assistance to the Company, but the Company would be most anxious to co-operate with the authority in regard to mutual assistance. That policy had been carried out with Hackney and the Underground Railway. He was advised that the price at which the engineers for the schemes estimated that current could be supplied, after everything had been done, was higher than that at which the Power Company gave supplies to-day with coal at a much higher price. He submitted there was no case made out for duplication. It was the Company's money the promoters wanted, apparently. The Company's sales were about 10 per cent. of the supplies given to the whole of the delimited area, which would mean that the Company would have to contribute about £2 500 a year to the expenses of the Joint Authority. He would be quite content to be under the direct control of the Electricity Commissioners, and he did not want anything substituted for them. The Company's recent issue of capital was very successful, because the feeling in the City of London was that what Parliament had given only Parliament could take away.

To Mr. HENDERSON, witness said it was very desirable that linking up in the central area should be increased. Better organisation was wanted, but he did not know that a Joint Authority was necessary. There were no large stations in the Company's area excepting its own. Therefore the stations which the Joint Authority could acquire were only small ones. He did not want those small stations, which might take supplies from the Company to be filched away by the Joint Authority. If the Joint Authority got into the Company's area and made the small stations into substations the Authority would have a strong inducement to undercut the Company's rates.

To Sir HARRY HAWARD: The Company's dividend was limited to 8 per cent. They had never been anywhere near their maximum price. As the price of current was reduced the dividend permitted was increased.

To Mr. LACKIE: He agreed that the local authorities in London supplied more cheaply than the companies. Probably that was because the local authorities had the industrial areas.

To Sir JOHN SNELL, witness said when the Metropolitan Company's change over to three-phase 50 periods was completed, and the connections were made between the two companies, no connection with the Central Authority's system would, in his opinion, lead to a cheaper or more efficient supply in the areas of the two companies.

Mr. E. T. RUTHVEN-MURRAY, constructional engineer to the North Metropolitan Company, said there were altogether eight power stations in the Company's area, four of which were owned by the Company. Brimsdown and Willesden were connected by e.h.t. mains. The capacity of the Company's four stations was 32 810 kW, and the maximum demand in 1920 was 36 838 kW. In the other four stations the plant capacity was 10 250 kW. Thirty-seven substations were supplied by the Company on extra high pressure, and 53 on high pressure. The Brimsdown plant could be extended by 50 000 kW, making the total plant 73 000 kW. In the whole of the Company's power stations the plant installed and on order was 42 650 kW, and the possible extensions of 67 000 kW would make the total 109 650 kW. With coal at 33s. 9d. the Conference scheme particulars gave the cost per unit generated as 0.705d. and per unit sent out as 0.741d. The actual cost at the Company's Willesden station was 0.487d. per unit generated, and 0.531d. per unit sent out. The Conference figure for coal consumption was 2.986 lb. per unit sent out. In the Company's main stations the figure was 2.94 lb. The load factor at Willesden was 30.5, and at Brimsdown (which was frequently shut down) 20.3. At Willesden the thermal efficiency was 27.200 per unit generated and the efficiency 12.51. The efficiencies of other stations in the area were Brimsdown 10.86, Walthamstow 11.68, Hornsey 5.68, Finchley 3.72 and Tottenham 16.47. The Joint Authority's average price was estimated as 1.326d. per unit. The North Metropolitan Company could not afford to pay that price.

Sir JOHN SNELL pointed out that that according to the Act the Joint Authority could not charge the Company more than their present cost.

Mr. RUTHVEN-MURRAY said further improvements in generating plant, such as the mercury vapour turbine, might enable small stations to generate at such a low cost that the capital expenditure on the capital stations might not be warranted. It was desirable that the Walthamstow station and the Finchley and Hornsey stations be connected to the Company's system, and the gas company's station at Wood Green could readily be converted to a substation. With coal at 36s. 1d. (3 per cent. above that of 35s. given in the supplementary particulars) the average price obtained by the Company in 1919 was 1.225d. from authorised distributors, from power consumers 1.58s. and for traction 1.179d.=total average 1.284d. The corresponding figures for 1920 with coal at 45s. 8d. (or 30 per cent. above the supplementary particulars figure) were: From authorised distributors 1.47d., power consumers 1.639d., traction 1.434d.=total 1.471d.

To Sir JOHN SNELL: The residential development of the area was going on steadily until two years ago, and Wembley was developing as an industrial area.

To Mr. HENDERSON: If his company outside the Joint Authority

area were supplying to stations inside the area, his company would not be getting all the benefit; the receiving authorities would benefit by it, as Hackney did now. If the railways could supply the Power Company at a lower rate than the present cost the Power Company would be pleased to take it.

To Mr. PAGE, witness said he was not pessimistic about capital stations, but he did not think a sufficiently strong case was made out for securing a sufficiently high load-factor and thermal efficiency to justify the proposition at present. As Sir Alexander Kennedy had said, remarkably good results could be got in small stations with suitable sized units and expert supervision. Excellent results were obtained at Walthamstow, where a special type of turbine was used, and also at his company's Wileston station.

To Sir JOHN SNELL, he said he thought a body of 20 or 30 persons would be much too large to manage an electricity undertaking. Probably the maximum number to work satisfactorily would be three. He agreed that from an engineering point of view an improvement could be made in the Metropolitan and North Metropolitan Companies' power areas by the inclusion of portions of the County of London. In his opinion the two companies working together in one area and the Joint Authority working in another would result in the cheapest and best class of electricity supply in both areas.

THE PROPOSED BARKING STATION.

Replying to Sir John Snell, Mr. MORSE said the County of London Company did not propose to call witnesses.

Sir JOHN SNELL said it was true that Mr. Sparks, for whom he had the greatest respect, had stated at the October inquiry that the demand in the Company's County of London area was expected to increase to 42 000 kW, and that in the Romford area to 10 000 kW, but he would have liked witnesses to have attended the present inquiry to give evidence on the subject with a view to their cross-examination upon it. At the October inquiry, in view of the Company's statement that it would require another Act of Parliament to enable them to construct the Barking station, Counsel only devoted themselves to securing a postponement of the scheme. It could not prejudice the Company's position to give the Commissioners this information. When Mr. Merz put in the estimates at the October inquiry they were based on the then cost of plant, which had since been reduced by some 15 per cent., and the correction in them might have been put before the Commissioners. The gist of the schemes now before the Commissioners was that the erection of capital stations should be postponed because of the high cost of money, and it should be fought out there as to which was the more correct estimate of what should be done, whether capital stations should be built at present, as the Company suggested, or whether they should be postponed.

Subsequently Mr. PEARMAN and Mr. JOHNSON were recalled on the financial aspect of the schemes. Evidence was given in opposition on behalf of Hertfordshire County Council, and counsel for the Port of London Authority and Middlesex County Council addressed the Commissioners.

On Tuesday, Mr. C. H. MERZ was examined in regard to the County of London Electric Supply Company's projected Barking station.

Technical Wireless Commission.

As announced recently in these columns, a TECHNICAL WIRELESS COMMITTEE, representing Great Britain, the United States, France, Italy and Japan has been sitting for some time in Paris for the purpose of examining questions connected with the development of wireless telegraphy and telephony. The Committee, which is presided over by Gen. Ferrié, is a sequel to the International Conference on Electrical Communications, which was held at Washington in September and October last, when certain special points were reserved for reconsideration. It is now stated that the programme includes consideration of the international rules for preventing interference, classification of the different kinds of services and of the general technical principles to be adopted in different cases. The rules are to be framed in such a spirit that their application may not impede the progress of the science of wireless telegraphy. Among the questions for consideration are:—

Classification of the different waves in accordance with their technical characteristics and definition of the uses reserved for each kind. Distribution of wave lengths among the various services, such as naval and aerial services, point-to-point communications of all distances, wireless telephony, &c. Direction finding and meteorological services; definitions of range and radiation, &c.

The names of the delegates attending are:—

Great Britain.—Colonel Blandy (President), Colonel Gardiner, Mr. Shagnessy, Mr. Lee, Captain Echevarri.

United States.—Major-General Guhier (President), Admiral Magruder, Captain Evans, Profs. Austin, Cohen, Dellinger and Kennelly, Major Mauborgne, Commandants Loftin and Craven, Mr. Goethrie.

France.—General Ferrié (President), Inspector-General of Telegraphs Denney, Profs. Abraham and Mesny, Captain Lagorio, Commandant Noel, Captains Frankand Morcieau, Engineer Perrin. In addition, the following specialists are attached to the French Delegation in the role of experts: Colonel Fraque, Commandants Chaulard, Jullien, Suberville and Le Breton, Captains Maistre and Bureau, Messrs. P. Brenot, Brailard and Vial.

Italy.—Prof. Vallauri (President), Colonel Bardeloni, Commandants Biscia-Raineri and Gabetti, and Signor Manzoni.

Japan.—General Shuzuma, Captain Kiyokawa, Commandant Hattori and Captain Ishii.

The Ediswan House Wiring System.

Just at present there is a boom in wiring systems of all kinds, and discussion has therefore naturally broken out afresh as to the merits and demerits of the various methods that can and ought to be employed. It is a question, however, which is not likely to be satisfactorily settled by the adoption of one particular method to the exclusion of all others, as the conditions which have to be met vary so greatly with a given installation while the part which cost and workmanship will play must be given more weight than is always considered necessary. Without therefore committing ourselves to a general answer, we may truthfully remark that under present economic conditions a good deal may be said for the employment of some system of surface wiring and it may also be predicated that the essential qualities of such a system are efficiency, economy, safety, and last, but not least, simplicity.

All these characteristics are claimed to be possessed by the latest wiring system that has recently been placed on the market by the EDISON SWAN ELECTRIC COMPANY. The result is that in a given time more points can be wired by a highly skilled workman than in any other system, while the less-experienced man finds the wiring and apparatus easier to work with than is often the case with some arrangements that have the same end in view.

THE CABLE.

The parts required to install the Ediswan wiring system are few and substantial. The cable used consists of tinned copper conductors, insulated with one layer of pure and two layers of vulcanised rubber in accordance with the rules of the British Engine Ring Standards Association, the whole being covered with a sheathing of metal alloy. The finished cable has thus sufficient flexibility to enable comparatively sharp bends to be made in it without breaking the sheathing, and, at the same time, it can be secured without danger to the sheathing in the special cable fixers which we describe below. The cable is supplied either single or twin in a number of different sizes, and a special point which secures its good condition on arrival at the site is that it is despatched on small flat drums when the length exceeds 110 yds.

THE BONDING RING.

One of the most characteristic features of the Ediswan wiring system is the bonding ring illustrated in Fig. 1. The object of

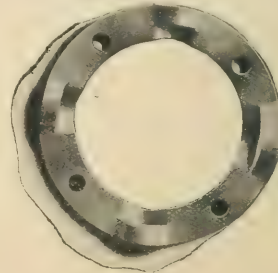


FIG. 1.

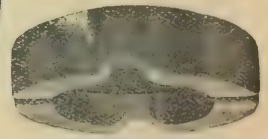


FIG. 2.

this ring is to connect together the metal sheathing of the cable at all ceiling roses, switches, or other fittings. It is made of soft tinned brass in which there are four slots, the sides of which are formed so as to allow the metal-covered cable to pass through them. The outer and inner diameters of the bonding ring are the same as the corresponding diameters of the block and the blocks are supplied with grooves to fit the bonding ring and cable. This correspondence in size allows the fact that the bonding ring has been inserted to be easily ascertained. When the block is screwed down in the ordinary manner by a central screw the cable is gripped on both sides by the bonding ring, no further fastening being required. For back entry, instead of inserting the cable itself through the slot in the ring, a wing on the lead is turned back from the cable and held in the slot in the manner described above. A plain block is then used which when screwed home presses the lead and ring together. The same size of bonding ring is used whatever the cables employed and three of the four slots are of equal width, the fourth only being slightly wider.

An interesting feature about the wood blocks (Fig. 2) employed is that they are supplied grooved to take the cable. As the bonding ring does not occupy any space in the interior of the block, there is ample room for cable slack. The blocks are supplied for either four-way, three-way or two-way working, but the first of these may be taken as standard as all the ways need not be occupied. To avoid any risk of the centre screw which secures the block

damaging the cable, it is provided with insulating bush as an additional precaution. Fig. 3 shows the relation of the block and the ring.

THE JUNCTION BOX.

The junction box (Fig. 4) used in the Ediswan wiring system is constructed as a universal four-way box, three of the ways in which are for two single or one twin cable up to 2/22 S.W.G., the fourth way being slightly larger to take 3/20 twin cable. The box consists of a heavy iron back plate, a bonding ring, a porcelain connector and a

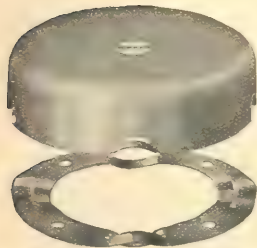


FIG. 3.

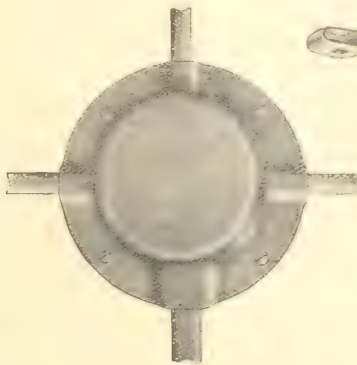


FIG. 4.

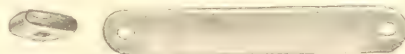


FIG. 5.



FIG. 6.

substantial stamped-iron cover. In fitting the back plate is screwed to the wall by means of a screw through the centre; cables are then passed through the bonding ring and connected as desired by means of a porcelain connector, the cover being screwed on by four round-headed iron screws provided with the box. The bonding strips for use in distribution boards are supplied in the form of an iron back plate with a thin covering tinned-brass strip.

Aspecial feature of this system is the design of the cable fixers (Figs. 5 and 6) employed, an attempt being once again made to use lead for this purpose, a metal which offers several advantages owing to being softer than the sheathing of the cable and there being no risk of corrosion due to its employment. In the Ediswan cable fixer the mechanical weakness usually associated with lead is overcome by the addition of a bronze cap which fits over the end of the lead strapping,

as shown in the illustrations, the whole being nailed or screwed to the wall or ceiling. The cable is held in this strap without any possibility of the head of the nail or screw being pressed against it and the damage to the metal covering is therefore a risk which can be looked upon as non-existent.

The system is due to Mr. F. C. Raphael, who is to be congratulated on the care and attention he has paid to its many details.

Small Transformers for Special Purposes.

The elimination of the primary battery from the domestic electric system would go far to prevent those failures of apparatus and out-breaks of temper which cast a bloom over an otherwise happy world. The British Thomson-Houston Company have therefore, we are glad to see, taken this matter in hand, and by means of the B.T.-H. bell transformers the bell system may be connected to an alternating current lighting circuit, and thus assured a constant and inexhaustible supply of electricity. The advantages of such an arrangement are obvious. All the expense and trouble of battery replacements and repairs, and the irritating possibility that the bell may fail at a particularly

two brass terminals on the secondary side, and the short primary leads connected through fuses to the two poles of the nearest lighting circuit.

The B.T.-H. toy transformer possesses fascinating possibilities for the modern boy. It gives a safe and constant supply of electricity for the operation of any electrical toy or model. This device is equipped with 6 ft. of flexible cord, and a lampholder adapter. Unlike a battery, it is always ready for use, never requires renewal, and, above all, is perfectly clean.

B.T.-H. toy transformers are made in four patterns, all of which, with the exception of the smallest, are provided with control switches on the secondary windings and alternative primary tapplings. These two adjustments permit of a wide variation of secondary voltages ranging,

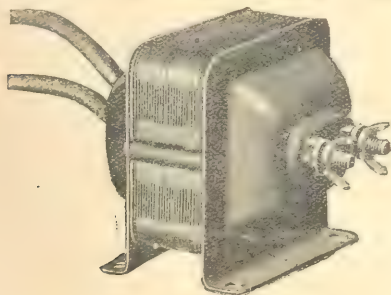


FIG. 1.—B.T.-H. BELL TRANSFORMER.



FIG. 2.—B.T.-H. TOY TRANSFORMER.

inopportune moment, are, it is claimed, entirely obviated by the use of the B.T.-H. bell transformer.

B.T.-H. bell transformers (see Fig. 1) are supplied for alternating-current circuits of 100 to 110 and 200 to 220 V, respectively. The low-voltage type has a frequency range of from 25 to 140 cycles, and the high-voltage type a frequency range of from 50 to 140 cycles. The core and coils are encased and sealed in a neat black enamelled case which effectually prevents unauthorised interference. These devices are easy to install. The existing battery wires simply require to be connected to the

in 2 V. taps, from 1 to 22—28 V. The smallest of the B.T.-H. transformers is finished in green, and may be used for working small motors, &c. The middle two are finished in red and black, and are suitable for the operation of medium-sized toys; while the largest (also finished in red and black) is intended for the operation of big toys and models.

At present B.T.-H. toy transformers are only supplied for 110 V circuits; three of them having a frequency range of from 25 to 49 cycles. Transformers for 200 V circuits, are, however, in course of design, and will shortly be available.

International Commission on Illumination.

The first technical session of this Commission was held in Paris on the 5th inst., under the presidency of Prof. Vautier, of Lyons.

The British representatives were: Major Edgumbe (president of the British National Committee on Illumination), Mr. Leon Gaster, Mr. A. P. Trotter, Mr. C. C. Paterson (honorary secretary of the Commission), and Mr. R. Watson, while the National Physical Laboratory was represented by Dr. E. H. Rayner and Mr. J. W. T. Walsh (assistant secretary of the Commission).

The other representatives were as follows: *France*: MM. Vautier, Violle, Blondin, Laporte, Janet, Rouland, Brylinski and Fabry. *United States*: Dr. E. P. Hyde (president of the Commission for the next three years). *Italy*: MM. Böhm and Bordini. *Switzerland*: M. F. H. H. *Spain*: M. Artigas. *Belgium*: M. de la Paville.

At the meeting, "The Times" Engineering Supplement that a number of interesting and instructive reports were presented to the Commission by the various National Committees. Owing to the shortness of the time available for their discussion, as well as the importance of the subjects concerned, it was deemed necessary to form small international sub-committees for the study of such subjects as photometry, nomenclature and definitions, lighting of factories and schools, regulation of motor-car headlights and the photometry of coloured lights.

The Commission, after discussion, decided on definitions of the terms "luminous flux," illumination, and "luminous intensity," or "candle-power." On the suggestion of the British Committee, it was agreed that the unit of the last-named quantity, which has been preserved since 1909 at the National Standardising Laboratories of France, the National Physical Laboratory in Great Britain and the U.S.A. Bureau of Standards should be recognised as the international unit of candle-power and should be termed the "international candle." This is the first time that international sanction has been given to this unit, although it has long been in use for national purposes by the three countries named and by many others. The subject of suitable factory lighting received special attention, and Mr. Gaster emphasised the necessity of including in future factory legislation the requirement of suitable lighting for the prevention of accidents and as a hygienic measure. Standards of illumination for various industries are to be studied by a special sub-committee.

It is expected that the next meeting of the Commission will be held in New York in 1924.

London "Toll" Exchange.

The Postmaster-General announces that in order to relieve the pressure on the London Trunk Exchange a new telephone exchange is in course of erection and is expected to be opened towards the end of the summer. The new exchange will be situated near Fleet-street and will be known as the London Toll Exchange. It is of an entirely new type and has been designed so that the telephone traffic between London and the nearer provincial towns may be handled with greater dispatch. At the date of opening, the trunk lines between London and Provincial towns which are within 25 miles radius from the City will be transferred to the Toll Exchange from the London Trunk Exchange. The area served by the new exchange will contain about 300 exchanges and rural call offices and will include the following towns:—Aylesbury, Luton, Dunstable, St. Albans, Hertford, Watford, Brentwood, Dorking, Leatherhead, Woking, Weybridge, Maidenhead, Uxbridge and Slough.

Additional trunk lines are being provided and other measures adopted so that subscribers may be enabled to effect calls with as little delay as possible. When it is desired to put a call through to any of the towns in the Toll area the public will ask for "Toll" instead of "Trunks," as at present. The local exchange will then connect the caller to the Toll exchange, where the operator will have access to all the trunk lines, or toll lines, which are connected to that exchange. If all the lines to a particular town are engaged the telephoneist will record the details of the call and ring the subscriber as soon as a connection can be given.

IN THE COURT OF THE CHIEF JUDGE OF THE COURTS OF THE REPUBLIC OF FRANCE, it is stated that it has secured from the French Government a wireless concession which will ensure the erection of a powerful receiving and sending station near Paris. The contract was signed in October, 1920, and the Compagnie Générale has been authorised to construct two sending stations (one for continental and one for transoceanic messages) and one receiving station. The concession is for thirty years, but the State reserves the right of purchase after fifteen years. Government participation in the profits will vary from 25 to 50 per cent, according to receipts. The Compagnie Générale agreed to found a subsidiary company, entirely free from foreign interests. The Compagnie Radio-France has just been formed with a capital of 50,000,000 frs. and construction has already commenced.

Parliamentary Intelligence

WIRELESS TELEPHONY.

The Postmaster-General (Mr. Kellaway) has stated, in answer to a question in the House of Commons, that experimental licences for wireless telephony are granted by the Post Office on suitable conditions as regards possible interference with Government and commercial wireless. The use of wireless telephony for ordinary business purposes within the United Kingdom would at present be impracticable by reason of the unavoidable mutual interference between the various stations. This objection, however, would not apply to the same extent to the use of wireless in place of cable telephony between this country and places abroad; and the question of issuing licences for such communication, subject to such safeguards in the interests of the State, is under consideration.

TELEPHONE DEVELOPMENTS.

On the 13th inst. the House of Commons went into Committee on the financial resolution in connection with the Telegraph (Money) Bill, authorising the payment of a sum not exceeding £5,000,000 required for the development of the telephone service.

The POSTMASTER-GENERAL (Mr. F. G. Kellaway) explained that the total expenditure out of telephone capital was £5,867,000 in 1920-21. It was proposed for the present year to spend out of capital a total sum of £9,000,000. Of that sum £2,500,000 was for trunk lines, £6,500,000 for new exchanges and subscribers' circuits and £500,000 for sites and buildings. The money was principally required for contracts already made and for work in progress. During the first five months of this year, under the new tariff the Post Office received 1,400 orders a month for telephones in London and 2,500 a month in the provinces. They had to refuse a large number of those orders, and at the end of May, 23,000 persons were waiting owing to the shortage of plant. If the telephone system was to be made thoroughly effective and useful for business, they ought to be able to provide for every person who wanted a telephone and could pay for the accommodation, but at present that could not be done. There was a great shortage of exchanges, and although new ones were springing up a great number more were wanted and the Government hoped to make considerable improvement if they got the £5,000,000 asked for. In regard to the laying of underground trunk lines, he said that the three largest roads which were now approaching completion were London to Manchester, which would be completed near the end of this calendar year; London to Bristol, Newport and Cardiff; and London to Southampton with a spur to Portsmouth. The number of rural call offices opened in 1919 was 149; in 1920 it was 383, and in the first quarter of the present year 116 had been opened and 105 were in course of construction. Arrangements were being made to open call offices at rural post offices where there was a telegraph line that could be converted to telephone purposes.

RESULT OF THE NEW TARIFF.

In regard to the new telephone tariff, Mr. Kellaway said that the number of subscribers who as the result had surrendered their telephones was 23,000, or 4.7 per cent. of the total number. During the same time they had 27,000 new subscribers and had had to refuse 23,000 applications. The bulk of the complaints were in regard to the difficulty which those who desired to have the telephone installed found in getting it installed, and that difficulty could not be got over till the Post Office was provided with the necessary plant to make up for the arrears of the past seven years.

After discussion, the resolution was carried and the Bill was subsequently introduced and read a first time.

Legal Intelligence.

Wireless Patents Action.

On July 12 Mr. Justice Eve heard a motion for judgment in the action of Marconi Wireless Telegraph Company, Ltd., v. A. W. Gamage, Ltd.

Mr. J. WHITEHEAD (for the plaintiffs) said that the action was one for an alleged infringement of two patents (Franklin No. 13636 and Round No. 28413 of 1913), the infringement being in respect of the sale and offer for sale of a certain wireless receiving set, known as the "Polaris Receiving Set."

The motion was by consent, Mr. Eric Bousfield appearing for defendants. The terms provided for an injunction restraining infringement as set out in the statement of claim, £150 agreed damages, and the destruction of infringing apparatus by dismantling and breaking up into constituent parts.

In re Bastian Co., Ltd.

In the Companies Winding-Up Court last week this matter was mentioned to Mr. Justice P. O. Lawrence upon the petition of Mr. F. N. May and another.

Dr. Dighton Pollock, K.C., said that the petition had been standing over from time to time, but the petitioners had now been paid, and the petition, subject to his lordship's sanction, would be dismissed, the company paying the petitioner's costs; but a part of the arrangement was that the petitioners should give an undertaking not to infringe the company's patent, and they would hand over some management shares.

Commercial Topics.

Import and Export of Electric Lamps.

In reply to a question in the House of Commons last week the President of the Board of Trade admitted that the registered imports of incandescent glow lamps into the United Kingdom had reached a total of nearly 1 000 000 lamps during the first four months of the present year, that the number of gas-filled lamps had increased from 87 272 in January to 224 519 in April, and that the number of vacuum lamps imported in April was 129 097. The registered exports of electric lamps for the four months in question, however, amounted to 2 426 000.

Business Houses in France.

As from the 11th inst., every French or foreign merchant or limited company engaged in commercial enterprises must be registered at the local tribune of commerce. The registration is compulsory whether the business is conducted as the head office, branch establishment or agency, and where there are branch offices registration must be made in each district where a branch exists. The registration fee is 25 to 30 frs., (plus one centime per 1 000 frs. of capital over 100 000 frs.) and the penalty for a false declaration is a heavy fine or imprisonment up to six months. Further legislation is projected in order to compel merchants to print on his letter paper and invoices the commercial court at which particulars of his business are lodged.

British Currency Policy.

Abstruse and complicated though the question of currency policy undoubtedly is, yet it has a great influence upon industry and commerce, and in view of the existing slump in trade the matter should receive the most careful examination. The present British policy is based on the report of the Cunliffe Committee, which was issued in 1918, since when there has been continued inflation and an upward trend in prices over almost the whole of Europe, thus materially altering the situation. The whole question has recently been investigated by the Credits and Currency Committee of the Federation of British Industries, which adopted a resolution urging the Government to appoint a new commission, containing representatives of industry and labour, to reconsider the currency policy in the light of recent developments. The resolution has been submitted to the Prime Minister and Chancellor of the Exchequer, and in the accompanying letter from the President of the Federation (Sir Peter Rylands) reasons are given for revising the revision of the present policy.

Argentine Commercial Position.

According to the Commercial Secretary to H.M. Legation at Buenos Aires, the commercial situation in Argentina continues to be unfavourable, but the depression and uncertainty are less severe than elsewhere, and perhaps offer a sounder basis for hopes of an earlier recovery. The financial stringency is not so acute, for, as there was no inflation, the country has not suffered from the effects of deflation; and the higher purchasing power acquired during the war remains intact. The Argentine is not a manufacturing country, and there has been no sensible increase in unemployment in non-industrial occupations.

The import trade in practically all lines is, however, stagnant. Customs warehouses are full of merchandise, almost entirely of United States origin, of which importers have refused to accept delivery. Liquidation of these accumulations is partly proceeding, at a sacrifice reaching in extreme cases 40 and 50 per cent. German goods at low prices in such lines as Germany is able to offer are being bought. Government purchasing departments have taken advantage of the break in prices to come into the market for large quantities of machinery and material urgently required for railways and public works, but in almost all cases German firms have quoted and secured contracts at prices which no British or American firm could entertain under prevailing conditions.

CAUSES OF STAGNATION.

The developments which have caused the present situation are the familiar ones: over-ordering owing to the optimism which prevailed in the post-war boom and difficulties in obtaining full deliveries if normal orders were placed; restriction of consumption, due to the refusal of consumers to purchase at high prices, and the resistance of retailers against making reductions in prices; heavy shipments on delayed orders; cancellations in anticipation of a break in prices; and rejection of goods after arrival by importers to avoid losses caused by the fall in prices and adverse movement of the exchanges. Very few commercial failures have occurred, considering the stringency of the situation, but in present circumstances it would appear advisable for British firms to confine credit shipments to substantial customers, to obtain revised reports of customers' standing, and to accept cancellations of pending orders where the alternative is the greater evil of rejection after arrival. Onslaughts on British commercial supremacy in the Argentine market—one by the Germans before the war by means of cheapness and excessive credit, and the other by Americans, who had the advantage of war-time conditions, but the British methods of trading, of reasonable credit and quality of goods have survived both ordeals, and there can be little doubt that British traders have profited most from their trading connection with the Argentina. The value of the exports from the United Kingdom to Argentina in 1913, 1919 and 1920 were respectively £22 640 943, £21 217 214 and £42 839 819, but imports into the United Kingdom from Argentina exceed those from any other country except the United States, amounting to £128 038 642 in 1920.

Electricity Supply.

MANSFELD Corporation has been authorised to borrow £2 286 for feeders and distributors in connection with the housing scheme at Mansfield-Woodhouse.

SUDBURY Town Council has asked for tenders for public lighting, partly by electricity and partly by gas, which are to be considered at next month's meeting.

The BURNLEY Electrical Engineer has reported that through industrial disputes the additional generating plant on order will not be available to meet next winter's load.

STEYNING Parish Council has accepted the offer of the Steyning Electric Lighting Company for the electric lighting of the streets at £2 19s. 6d. per lamp per annum.

CHICHESTER City Council has acquired the local electric supply works for £16 500 and an Electricity Committee has been constituted in order to carry on the undertaking.

The Minister of Transport has confirmed Special Orders made by the Electricity Commissioners in regard to the Urban Districts of BEDWAS and MORTON, PANDE and RISA.

WIMBLEDON Council has appointed Messrs. C. P. Sparks and Partners as consulting engineers in connection with the electricity undertaking, at an annual fee of 300 guineas.

WAREHAM and PRIBBECK Rural Council has decided to support the application of the Wareham Electric Supply Company, Ltd., for a Special Order to supply electricity in parts of the district.

The SEVENOAKS Rural Council has granted permission to the Sevenoaks and District Electricity Company to erect overhead lines in the district for the supply of electricity to villages in the Council's area.

The HOVE Corporation has increased the charge for electric power by a halfpenny per unit.

The Works Committee intend to introduce electric vans for refuse collection, and to destroy the stuff by means of mechanical crushers.

TEIGNMOUTH Council has assented to the application of Messrs. J. & W. Purves, of Exeter, for a Special Order to amend their electric lighting order of 1914 so as to give a supply of electricity to the town and to Shaldon.

Mr. Frank Gibbs, of Beach Shipyard, Shoreham, W. Sussex, is applying to the Electricity Commissioners for a Special Order to authorise the provision and distribution of electrical energy in SHOREHAM Urban District and the parish of LANCING.

WEYBRIDGE Urban Council has been informed by the Ministry of Transport that they had refused to allow the Urban Electric Supply Company to increase the present maximum price of 10d. per unit, but the matter would be reconsidered in six months.

HYDDERSFIELD Corporation is applying to the Electricity Commissioners for an amendment of the proposed area of supply under the Special Order (relating to extension to Kirkheaton, &c.) now before the Commissioners, by the inclusion of Marsden Urban District.

An application has been made to the Electricity Commissioners by Lord Meston, Sir Geo. Young, Mr. R. N. Caught and Mr. H. E. Cooper for a Special Order to authorise them to generate and distribute electrical energy in part of the Rural district of COOKHAM, Berkshire.

Owing to complaints of a nuisance at the Hylton-road electricity station WORCESTER Corporation has decided to install plant for the suction system of removal of flue dust and ashes from below boiler furnaces and chambers, and to construct additional soot chambers at a cost of £800.

An arrangement has been made between the BIRKENHEAD and WALLASEY Corporations for the supply of electricity from Wallasey to Birkenhead with a minimum payment by the latter authority of £3 500, and Birkenhead Council has accepted a tender for laying a feeder cable at a cost of £9 240.

The Folkestone Electricity Supply Company, Ltd., has applied to the Electricity Commissioners for a Special Order to authorise the amendment of the FOLKESTONE ELECTRIC LIGHTING ORDER, 1896, by the inclusion of Cheriton Urban District and part of Elham Rural District in the area of supply.

Two engineers of the General Electric Company waited on the LANDEVORY Council last week in regard to a proposed electric supply scheme. Three separate schemes were submitted, the cost ranging between £6 237 and £8 000. One of the members has given notice of motion for the next meeting that electric supply be introduced.

HAMPSTEAD (London) Borough Council has instructed Mr. J. S. Highfield to report on the question of abandoning the generation of electricity and of relying entirely on a bulk supply. The Council has agreed to raise a loan of £38 093 for electricity purposes, and to apply to the Electricity Commissioners for sanction to borrow £10 000 for mains.

The Woolwich Borough Council has agreed with Erith Urban Council to supply electrical energy to a large consumer in Erith. The minimum demand will be 1 500 000 units per annum, but it is anticipated that the consumer's requirements will, in the near future, increase the total output of the Woolwich station by approximately 33 per cent.

The WALSALL Electric Supply Committee has presented a report on the organisation of supply in the WEST MIDLANDS ELECTRICITY DISTRICT, into which the Electricity Commissioners will hold an inquiry on the 31st inst. The Committee has been authorised to deposit with the Commissioners their observations and objections, and to take such other steps as they deem necessary.

The total revenue of the Glasgow Corporation Electricity Department for the year ended May 31 amounted to £1,311,951, an increase of £334,465 over the previous year. The costs were £902,424, an increase of £188,973, and after providing for interest, sinking fund, and depreciation (£409,374) there is a surplus of £151, contrasted with a deficit last year of £54,614. The Electricity Committee states that in view of the adverse circumstances, due to shortage of plant (which was accentuated by the breakdown of new generators at Dalmeirck works in December last), and the drop in the consumption caused by the dispute in the mining industry, the result of the year's operations is more favourable than might have been expected.

The dispute between DOVER Corporation and the Electrical Power Engineers' Association has been settled amicably. As a result of negotiations between the officials of the E.P.E.A. and members of the Dover Electricity Committee, the latter agreed to recommend the Council to continue the application to the technical staff of the electricity undertaking of the conditions of employment and schedule of salaries recommended by the National Joint Board. Certain difficulties experienced by the Corporation in the application of the schedule were also cleared up, and the salaries of two of the members concerned have been adjusted in accordance with it.

The SWANSEA Corporation electricity department made a profit of £3,876 in the year ended March last. In making this announcement at a meeting of the committee last week, the chairman (Col. A. Sinclair) observed that, as they were the only undertaking that had advanced their charges only 50 per cent., that coal had been scarce, and that they had temporarily lost some of their customers, he regarded the result as splendid. The total expenses, exclusive of loan charges, were £80,549, compared with £56,251 last year, and the total income £106,413, compared with £77,390. Loan charges amounted to £22,035, against £16,780. A vote of thanks was accorded to the borough electrical engineer (Mr. J. W. Burr), to the chairman, vice-chairman and staff.

The report on the working of the LEEDS ELECTRICITY DEPARTMENT for the year ended March 31 last states that consumers increased by 2,636 (13.32 per cent.), but trade depression during the latter part of the year caused the units sold for power purposes to remain practically stationary. Units sold for all purposes were 63,921,813, an increase of 898,311. Heating consumers increased from 2,140 to 2,605 and their apparatus from 5,077 kW to 6,543 kW. The branch of the business showing the highest increase was that of residential bulk supplies (at 4d. per unit plus a charge based on the rateable value of premises). The number of consumers on this system increased from 596 to 793 and their consumption from 712,800 to 998,409 units. The maximum load on the works was 29,000 kW, compared with 29,210 kW. The capacity of the station remains at 51,000 kW, but contracts have been let for a 12,000 kW turbo alternator with boilers, switchgear, &c. Revenue was £519,021 (compared with £468,718), gross profit was £205,966 (£230,895) and net profit £30,269 (£44,409).

Electric Traction.

DARFLORED Urban Council has applied for a loan of £2,000 for capital expenditure on the tramways, and £10,000 for the repair of the track.

At the recent conference of the INSTITUTE OF CLEANSING SUPERINTENDENTS, Mr. J. A. Arden, of Rochdale, read a Paper on "Technical Cleansing Work," and on the question of haulage in connection with cleansing work, he expressed himself in favour of the steam wagon, but for the shorter distance work of refuse collection he considered the electric was the ideal vehicle. A properly managed utilisation refuse plant should first of all produce from house refuse the power and light required for its own works or depot, and save those materials which paid for the process.

The BIRMINGHAM City Council are recommended to promote a Bill for the purpose of authorising various public works, including general powers to run trackless trams on any route in the city. The Tramways committee propose to run trackless cars on the Nechells route, and the Ministry of Transport has agreed to the change in view of the fact that a rail service has been in existence over the route for some time. The Ministry, however, suggest that in the next Bill the Corporation promote they shall take comprehensive powers for the extension of the system if it is so desired. The committee point out that the cost of reconstructing the permanent way would be £90,000 and that of installing the new system £54,000. There would be an estimated saving in capital expenditure of £54,000 and an estimated profit on working the railless vehicles of £3,122 per annum after paying interest and sinking fund on the new capital required, as against a loss of £3,340 in the case of a tramway.

The accounts of GLASGOW TRAMWAYS DEPARTMENT for the year ended May 31 show total revenue £2,392,854, compared with £1,721,578 in previous year, working expenses £1,937,644 (£1,558,161), including payment to employees' dependents. Interest required £6,925 (£3,891), sinking fund £2,624 (£1,711) and property and income tax £70,813 (£81,295), and after providing for rents for leased tramways, parliamentary expenses, depreciation allowance, &c., there was a net profit of £105,796 (against a deficit of £108,531). Total revenue per car-mile was 21.347d. (15.616d.), and working expenses including payments to dependents, were 17.286d. (14.134d.). Passengers carried were 447,601,811 (509,339,886) and car-miles run 26,902,874 (26,459,015). Total capital expenditure amounts to £4,054,892, and the total amount of sinking fund is £3,839,546, general reserve £23,727 and depreciation and renewals fund £470,804. A 10,000 kW turbine set has been ordered for Pinkston power station. Average cost of coal for Pinkston power station was £1 17s. 5½d. (£1 9s. 10½d.). There are 926 cars in stock (an increase of 29), of which 894 are in operation.

Imperial and Foreign Notes.

For the extension of the MAURITIUS TELEPHONE SYSTEM orders for new switchboards and other telephone material have been placed in this country.

Several important subjects were considered on Monday by the Special Committee of the Imperial Conference. On the question of WIRELESS TELEPHONY, statements were made by the Postmaster General, by Sir Henry Norman and by Prof. W. H. Eccles, and a resolution was passed recommending that the developments in wireless telephony, whether by Governmental or by private enterprise, should be investigated and technical reports furnished to the Governments of the Dominions and of India.

In regard to the subject of an EMPIRE PATENT a resolution was passed recommending that a conference of representatives of the Patent Offices of the Dominions should be held in London at an early date to consider the practicability of instituting a system of granting patents which should be valid throughout the British Empire.

The Committee also considered the recent representations made on behalf of the Empire Press Union and the Newspaper Proprietors' Association. The Committee endorsed the resolution passed at the second Imperial Press Conference, held at Ottawa in 1920, that any assistance given by the Governments of the Empire towards the reduction of rates for Press services by wireless and cable should appear specifically in the estimates of public expenditure, and should be so directed as not to affect the quality of the news service supplied or the freedom of the newspapers so served. The Committee sympathised with the object of reducing rates for Press messages and recommended the most favourable examination by the Governments concerned of any practicable proposals to this end.

It is stated by the Berlin "Lokal-Anzeiger" that negotiations are proceeding between the German postal authorities and representatives of the Mackay Company regarding the laying of a direct SUBMARINE CABLE between GERMANY and the UNITED STATES. A similar concession is being requested by the Western Union Telegraph Company, and there are also conversations as to the erection of radio-telegraph stations.

H.M. Consul at Liège (Mr. J. Pyke) announces that a contract has been awarded to a Belgian firm for the construction of a h.t. line of about 60 kilometres (40 miles), Genck-Hasselt-St. Trond, in connection with the proposed electrification scheme in the Province of Limburg. British firms desirous of supplying material to the successful contractor should communicate with H.M. Consul, British Consulate, Liège, forwarding copies in duplicate of their catalogues, &c.

The British Vice-Consul at Granada notifies that the "Sociedad Anonima Fuerzas Motrices del Valle de Lecrin" has been formed at Granada with a capital of five million pesetas, for the purpose of erecting and working HYDRO-ELECTRIC POWER-STATIONS in the VALLE DE LECRIN, SPAIN. The first station will be on the river Durcal, where 4,000 h.p. will be utilised. In addition to the capital mentioned, the bulk of which has been subscribed by the "Banco Hispano-Suizo para Empresas Electricas," it is intended to issue 6 per cent. preference shares for a further one million pesetas.

British business methods are reported to be making most gratifying improvements in the PERUVIAN POSTAL AND TELEGRAPHIC SERVICES. Delays of from two to three days in the delivery of internal telegrams were common when on May Day Sir William Slingo, acting for the Marconi Company, took over these Departments from the State. So great has been the change that, on three successive days before the last mail left Lima, not a single telegram was left undelivered overnight in any part of the Republic, and the staff are being given strictly eight-hour duties.

Institution Notes.

At the last meeting of the Committee of the ASSOCIATION OF CONSULTING ENGINEERS, Mr. W. Vaux Graham, 5, Queen Anne's Gate, Westminster, S.W.1, was unanimously elected Chairman for the ensuing year.

The ELECTRICAL TRADES BENEVOLENT INSTITUTION have received a cheque for £76 4s. 2d. from the Cardiff Local Advisory Committee, this sum being the proceeds of a whistle drive and dance recently organised by the local branch of the Electrical Contractors' Association.

A notice appears in the "Gazette" that a petition of the INSTITUTION OF ELECTRICAL ENGINEERS, praying for the grant of a charter of incorporation, has been presented to the Privy Council, and petitions for or against the grant should be sent to the Privy Council Office, Whitehall, on or before Aug. 1.

It is proposed if a sufficient number of candidates make application to hold an examination for ASSOCIATE MEMBERSHIP of the Institution of Electrical Engineers in London and at other places (at home and abroad) in October, 1921. Entry forms and full particulars may be obtained on application to the Secretary of the Institution, Savoy Place, Victoria Embankment, London, W.C.2.

The annual autumn meeting of the INSTITUTE OF METALS will be held in Birmingham from Sept. 21 to 23. A number of Papers will be presented, among them being one by Mr. F. Adcock on "Electrolytic Etching of Metals," and another by Mr. S. Beckinsale on "Electrons" (the high magnesium alloy). The meetings will be held in the mornings of the days mentioned, the afternoons being devoted to visits to works and the evenings to social events. Since the inaugural autumn meeting of the Institute was held in Birmingham in 1908 the membership has increased from 200 to over 1,300.

Miscellaneous.

On Saturday the Postmaster-General (Mr. F. G. Kellaway) unveiled a MEMORIAL at the G.P.O. (London) to the 89 men of the Central Telegraph Office who fell during the war.

Mr. R. A. Bartram, a Sunderland shipbuilder, has given 10 000 guineas to the SUNDERLAND TECHNICAL COLLEGE. Of this sum, £5 600 will be used to provide an endowment fund for four scholarships in naval architecture, £4 500 for building a drawing office for naval architecture, and £400 will be devoted to the equipment of the office.

The Secretary for Mines has appointed a MIXING DANGERS' RESEARCH BOARD to direct generally the work of research of the Mines Department into the causes of mining dangers, and to undertake the reorganisation of the arrangements for carrying out such work at the Mines Department Experimental Station. The members of the Board are:—Mr. W. Walker, director of the Health and Safety Division Mines Department (chairman), Mr. T. H. Mottram (chief inspector of mines), Sir R. A. S. Redmayne, Mr. Thomas Richards and Prof. R. V. Wheeler (director of the Mines Department Experimental Station).

An interesting conference of well-known employers and Trade Union representatives is to take place this week-end at the residence of Sir Samuel Waring, Footscray, Kent, at which the subject to be considered is "FOREIGN EXCHANGES AND THEIR INFLUENCE ON INDUSTRY." The gathering is one of the series of week-end Conferences which have been arranged under the auspices of the INDUSTRIAL LEAGUE AND COUNCIL, and, through the generosity of prominent personages in the Commercial and Industrial world, are being held at their country residences. This is by no means the first occasion that Sir Samuel Waring has officiated as host and presided over such a gathering, and he, like many other large employers, fully recognises the value of such conferences at which difficult industrial problems can be discussed from all standpoints. The Conference is to be opened by Mr. H. G. Williams, M.Sc., M.Eng., A.M.I.C.E.

Catalogues, Price Lists, &c.

THE STANTON IRONWORKS COMPANY has issued its monthly stock list of c. pipes for July.

Particulars and prices of "AUTO" ELECTRIC FLASHERS for electric signs, &c., are given in a leaflet which is being circulated by the Attracta Electrical Company, 11, Hanway-place, Oxford-street, W.1.

THE VINCENT SWITCHGEAR MANUFACTURING COMPANY, Vincent Parade, Balsall Heath, Birmingham, have issued a well-illustrated price list of switchgear manufactured by them. Particulars of the design and construction of several types of "Vincent" switches, fuses, distribution boards, &c., are given. The company's manufactures comply with Home Office requirements and are of sound construction.

THE G. E. C. STUDIO ARC LAMP is the subject of an illustrated pamphlet (E. 2 351) issued by the General Electric Company, Ltd., Magnet House, Kingsway, W.C. 2. The lamp, which has been specially designed for photographic and studio work, possesses several distinctive features. It is of the semi-enclosed type and the high voltage long arc produced yields the highest possible actinic values, giving much better results than those obtained with an open type arc lamp. The mechanism ensures excellent control, there is a total absence of daylight shadow, all parts are accessible and simple in construction; it is easily trimmed and adjusted on the stand, &c.

An illustrated four-page pamphlet on the "CROYDON" ELECTRIC SUCTOR AND BLOWER has been issued by Messrs. Scholey & Company, Ltd., 56, Victoria-street, S.W.1. The suction is used for a variety of industrial purposes, including the removal of dust from machinery, motor cars, &c. Weighing only 6 lb., the machine is made for all voltages from 25 to 250 and the motors are designed for either a.c. or d.c. circuits. The machine is also supplied as a blower to be carried by hand or furnished with a special stand. Another pamphlet, giving particulars and prices of SCHOLEY FRACTIONAL H.P. MOTORS is also being circulated by the company.

An illustrated pamphlet of 16 pages on "Improvements in Insulating Materials," which is being circulated by Messrs. HIGHTENSITE, LTD., Custom House, E., gives particulars of the "hightensite" and ebomite insulators manufactured by them. Owing to the withdrawal from the market in 1915 of "Stabilit," a German manufacture, the present company was formed, and shortly after "hightensite" was placed on the market here and has proved increasingly popular. It resists abrasion to the same degree as brass, and it is recommended for insulating purposes where a hard rubber dielectric is required, for intricate composite mouldings, &c. The pamphlet gives a long list of electrical and telegraph uses to which it is applied, and the report of the National Physical Laboratory on the insulating and physical properties of the material is also being circulated.

A new catalogue of PRESCOT PAPER INSULATED CABLES has been issued by the British Insulated and Helsby Cables, Ltd., of Prescott, Lancs and London. The cables listed are manufactured in strict accordance with the specification of the British Engineering Standards Association and their distinctive points are briefly outlined in the pamphlet. The company supplies cables for all electrical, telegraph and telephone purposes, and tables are given of the dimensions, weights, resistance, &c., of the various classes of l.t. single, twin, concentric, three- and four-core cables for pressures up to 660 V, h.t. concentric three-core three phase cables for pressures up to 2 200 V, e.h.t. concentric and three-core three phase cables for 3 300 V, e.h.t. three-core three phase cables for pressures up to 6 000 and 11 000 V respectively. Specifications and technical details are included.

Business Items, &c.

MR. SIDNEY G. JONES, electrical and mechanical engineer, importer and exporter, has removed to 72-74, Victoria-street, London, S.W. 1. Telegraphic address: Jonofied Sowest London; telephone: Victoria 3650.

THE ALTON BATTERY COMPANY, LTD., has opened a branch office at 90/91, Queen-street, Cheapside, London, E.C. 4, under the management of Mr. D. Mackay Robertson, who will deal with the sales of A.B.C. accumulators, in London and Home Counties. Telephone, Central 8112.

Herbert Geo. Cayless and Percival Fras. Geo. Potter trading as CAYLESS & POTTER, electrical and general engineers, Gladstone-mews, Wood Green, Middlesex, have dissolved partnership so far as concerns Mr. Potter, who retires from the firm. Debts by Mr. Cayless, who continues the business under the old style.

It is refreshing, in these days of almost universal depression, to find an electric firm spending money on extensions. This, however, is the happy occupation of the BRITISH THOMSON-HOUSTON COMPANY, who have recently secured additional premises at National Buildings, St. Mary's Parsonage, Manchester, to take care of their increasing business in that district in connection with the sale of Mazda lamps, fittings and accessories, and to provide greater storage accommodation. A part of the extension has been tastefully decorated and furnished as a fittings showroom, where are exhibited a varied assortment of the many novel and effective lighting appliances of the B.T.H. Company, including, amongst others, "Eye-Rest" indirect fittings, semi-indirect fittings, Mazdalux industrial reflectors, X-Ray window lighting reflectors, street lighting and other lanterns, &c. Members of the industry in Manchester and neighbourhood are cordially invited by the B.T.H. Company to visit the showroom, and, when occasion demands, to avail themselves of the advisory services of the engineering staff.

Bankruptcies, Liquidations, &c.

G. H. GEE, electrician, 10, Front-street, Annfield Plain, Co. Durham, has been adjudicated bankrupt.

CHAS. ATG. CARPENTER, electrical engineer, 4-5, Mason's-avenue, London, E.C., has been adjudicated bankrupt.

BERTRAM THOS. DALE, electrical engineer, Erick-street, Newcastle-on-Tyne, has been adjudicated bankrupt.

Meetings of creditors and contributories of the STOLS ELECTROPHONE COMPANY (1914), LTD., will be held on July 26 at 33, Carey-street, London, W.C. 2.

The discharge of Geo. Sutcliffe, trading as GEORGE SUTCLIFFE & CO., electrical engineer, 22, Church-street, Abertillery, is suspended for two years from May 25 last.

A meeting to receive an account of the winding up of the SIGNAL ELECTRIC COMPANY, LTD., will be held at 4, Charterhouse-square London, E.C. 1, on Aug. 28.

THE ELECTRICAL MAINTENANCE COMPANY (LIVERPOOL), LTD., is being wound up voluntarily, and Mr. J. Airey, 8, Victoria-street, Liverpool, has been appointed liquidator.

Claims against BERNARD ESMOND THOMAS, electrical engineer, 12, Castle-meadow, Norwich, are to be sent by July 30 to Mr. H. P. Gould, 8, Upper King-street, Norwich.

MR. H. J. de C. MOORE, 2, Gresham-buildings, London, E.C. 2, has been appointed trustee in the bankruptcy of JOHN HENRY TOMS, electrical engineer, 13, Gray's Inn-road, London, W.C.

A supplementary dividend (19s. 6½d.) is payable at 14, Figtree-lane, Sheffield, to creditors of WM. HY. PEARSE, electrical engineer, lately trading at Royal Hotel Shops, Scarborough, and 19 & 20, Baxter-gate, Doncaster.

THE UNITED ELECTRIC CAR COMPANY, LTD., is being wound up voluntarily, and Mr. G. R. Freeman, 66, Coleman-street, London, E.C. 2, has been appointed liquidator. Claims are to be sent to Mr. Freeman by Aug. 31. The above notice is formal, and all debts will be paid in full in due course.

Personal and Appointments.

RHYL Council have appointed Mr. E. P. Wright to be electrical engineer to the end of the financial year, at a salary of £312, in succession to his brother, Mr. E. H. Wright, who has had to relinquish the duties owing to ill-health. The members of the Council expressed the hope that Mr. Wright's health would soon be restored, and described him as a most conscientious officer.

Presentations have been made to Mr. A. J. STUBBS, assistant engineer-in-chief to the Post Office, and to Mr. Alex. Moir, superintendent engineer for the London district, who are retiring from the service on pension at the end of the month. The presentations were made by Sir Wm. Noble, who mentioned that Mr. Stubbs had served under seven engineers-in-chief, while he described Mr. Moir as the father of the engineering department.

SIR WILLIAM J. LARKE, K.B.E., M.I.E.E., who was knighted by the King at Buckingham Palace on Tuesday, did much special work for the Ministry of Munitions during the war. He is a member of the Disposal Board, and the sales of metals, chemicals and explosives for which he has been responsible run into many millions sterling. His training in engineering was received at the works of Messrs. H. F. Joel & Co. and Messrs. Siemens Bros. & Co. In 1898 he joined the British Thomson-Houston Company at Rugby, becoming manager of their power and mining department, and from 1912 to 1915 he was executive engineer and assistant to the engineering director of the Company. Sir William J. Larke received the O.B.E. in 1917 and the C.B.E. in 1920.

Tenders Invited.

Newport Corporation invite tenders for the supply of a 750 kW rotary converter, transformers and switchgear. Specifications from the Borough electrical and tramways engineer, and tenders by July 25 to the Town Clerk, Mr. Albert A. Newman, Town Hall, Newport, Mon.

Tenders are invited by Aug. 15 for the supply and delivery to the Postmaster-General's Department, State of TASMANIA, of switchboard material. Tenders, forms, &c., from the High Commissioner for Australia, Room E.5, Australia House, Strand, London, W.C.2.

BRISTOL Electric Committee invite tenders for the supply of a 3 000-l.w. single phase and a 6 000 kW 3 phase turbo-alternators, with condensing plant and auxiliaries. Specifications and forms of tender from the chief engineer and general manager (Mr. H. Faraday Proctor, M.I.C.E., M.I.E.E.) to whom tenders are to be sent by noon, August 15.

The Secretary of the NEW ZEALAND PUBLIC WORKS TENDER BOARD (Wellington) invites tenders (by Nov. 1) for the supply and erection of new or second-hand auxiliary plant for the Rotorua electric supply as follows:—One oil engine (200 to 250 B.H.P.) and one three-phase 50 cycle alternator of 150-kW (power factor of 0.8) with exciter and switch-gear. Specifications at Department of Overseas Trade.

The NEW ZEALAND Public Works Department are calling for fresh tenders for the supply and erection of steel pipe lines and fittings required in connection with the Mangahao power plant. While the quantities, &c., are substantially the same as those specified in the original call for tenders, some of the conditions appear to have undergone modification. The closing date for the receipt of tenders in Wellington is Nov. 1, 1921. Specifications can be inspected at the Department of Overseas Trade.

BELFAST Corporation invites tenders for the manufacture and erection of one 12 500-kW turbo-alternator with condensing plant, accessories, four water-tube boilers, with super-heaters and forced-draught fans, four fuel-economisers, two steel chimneys, with four electrically-driven suction draught fans and one electrically-driven centrifugal pump. Specifications from Messrs. Prece, Cardew & Rider, 8, Queen Anne's-gate, Westminster, S.W. 1, or the city electrical engineer, Mr. T. W. Bloxam. Tenders to the town clerk, Mr. R. Meyer, City Hall, Belfast, by Aug. 22.

Tenders are invited for the supply of the following plant and material for the Municipality of BULAWAYO (Rhodesia):—(A) two sets of gas-producing plant, (B) gas engines, (C) 3, with alternative of 4, three-phase 300-kW generators, (D) alternative steam plant, (E) main switch-board, (F) switchgear distribution and transformer houses, (G) poles and cross-arms, (H) insulators and shackles, (I) h.-d. copper wire, (J) three-core cable, (K) insulated cable, (L) lightning arresters and choke coils, (M) transformers, (N) bus-bar copper, insulators and Crosby clips, (P) stay rods, stay wires and swivels. Specifications from Messrs. Davis & Soper, 54, St. Mary Axe, London, E.C. 3, to whom tenders by Aug. 3.

THE VICTORIAN RAILWAY COMMISSIONERS invite tenders (by August 10) for 250 impedance bonds for power signalling (Contract 34 130) and 50 miles of insulated copper wire (Contract 34 131); by Aug. 17 for renewals for 3 000 sets of caustic soda primary cells (Contract 34 145); and by Aug. 24, for motor generator set, accessories and switch-gear for automatic telephone exchange (Contract No. 34 132); also (by Aug. 31) for the supply and delivery of accumulator cells and accessories (Contract No. 34 171), including (a) 100 sets, 140 Ah capacity in sets of 12, and (b) 32 sets, 200 Ah in sets of 12 cells (electrolyte not included); also for electric lighting equipment (axle generator system), including (a) 45 sets, 30 A set for passenger car, (b) 10 sets 30 A set for van, (c) 16 sets, 40 A set for special car; (d) 72 main car switches (chopper or rotary type), and an extra battery, &c. Tenders to the Commissioners, Spencer-street, Melbourne, and must be accompanied by a preliminary deposit of 1 per cent. of the total offer. Local representation is essential. Specifications at Department of Overseas Trade.

SALISBURY Council has accepted the tender of Stuart & Moore for a telephone fire alarm system at £790, plus £20 for poles.

STEPNEY (London) Electricity Supply Committee recently accepted the tender of the Universal Electrical Manufacturing Company (lowest tender) for six feeder and six sub-feeder boxes at £306 (four tenders received; highest £444); and that of J. Downton & Company at £130 (including cost of erection) for an indicating, recording and integrating steam flow meter for the new 10 000-kW turbo.

LONDON COUNTY COUNCIL Establishment Committee has accepted the following tenders: Waygood-Otis, Ltd. (lowest tender), two-passenger lifts, £5 005 (four tenders received, highest £6 328); Express Lift Company (lowest tender), goods lift, £1 191 (four tenders received, highest £1 888); Express Lift Company (lowest tender), two electric book lifts, £1 080 (five tenders received, highest £1 743); Dorman & Smith (lowest tender), main lighting switchboard at New County Hall, £840 19s. 9d. (seven tenders received, highest £1 130 16s.).

GLASGOW Corporation has accepted the following tenders: Callenders' Cable & Construction Company, Enfield Edison Cable Works, Ltd., W. T. Glover & Company and General Electric Company, 12 months' supply of cables; Edison Electric Company, Ferranti, Ltd., Chamberlain & Hookham and Metropolitan-Vickers Electrical Company, 12 months' supply of meters; British Thomson-Houston Company, rotary converter, £9 300; General Electric Company, converter, £9 074; Metropolitan-Vickers Electrical Company, transformers, £1 556; Johnston, Park & Company, electrical work in municipal buildings, £6 911; W. C. Martin & Company, electric wiring, &c., at Knightswood Hospital.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by MESSRS. NEWBURN, ELLIS & CO., Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.

COMBUSTION SPECIFICATIONS.

- 162 880 H. L. L. Sparking plug for internal combustion engines. (4/3/20)
- 162 880 CALVERT. Sparking plugs. (15/2/20. Cognate application, 24 675/21.)
- 162 889 BERRY (Wood Corporation). Vehicle lamps, searchlights and other lamps. (2/3/20.)
- 162 907 B. T.-H. Co., Ltd. (General Electric Co.). Tungsten alloys particularly for electric filaments. (19/4/20.)
- 162 919 RAILING, GARRARD & McCOLL. Protective apparatus for alternating current systems. (6/5/20.)
- 162 425 GILCHRIST. Glass reflecting globe for electric safety and other lamps. (13/5/20.)
- 162 926 VERITYS, LTD., & THORPE. Electric lanterns or the like. (15/5/20.)
- 162 949 SIEMENS, Bros., & Co., Ltd., & FERREIRA. Electrically-operated indicator or annunciator apparatus. (4/6/20.)
- 162 961 IORANG ELECTRIC CO., LTD. (Cutler-Hammer Manufacturing Co.). Electric distribution and power transmission systems. (21/6/20.)
- 162 965 IORANG ELECTRIC CO., LTD. (Cutler-Hammer Manufacturing Co.). Thermally-controlled electric circuit interrupters. (28/6/21.)
- 162 966 TORRANCE & TORRANCE. Electric generators. (30/6/20.)
- 162 980 HAMILTON. Electric light source fittings. (27/7/20.)
- 162 981 IORANG ELECTRIC CO., LTD. (Cutler-Hammer Mfg. Co.). Electro-magnetically operated controlling devices. (29/7/20.)
- 162 992 EDISON ACCUMULATORS, LTD., & MONROE. Means for operating constant voltage circuits for variable speed dynamos. (28/8/20.)
- 163 070 SMITH & WRIGHT. Aerial systems employed in wireless signalling. (24/12/19.)
- 163 071 BOYDELL & SONS & BOYDELL. Electric lamp casings and holders. (29/12/19.)
- 163 072 BURSILL. Improvements in variable electrical resistances by the jointless joining of the resistance wire forming same. (30/12/19.)
- 163 079 B. T.-H. Co. & TAYLOR. Ventilation of dynamo-electric machines. (8/1/20.)
- 163 083 BRITISH INSULATED & HEATSEALING CABLES & WILSON. Electric welding systems and apparatus. (10/1/20.)
- 163 090 B. T.-H. Co. (General Electric Co.). Cooling devices for electrical apparatus. (3/2/20.)
- 163 092 HANDLEY. Electric switches. (4/2/20.)
- 163 094 ENRICH & SERRANO. Electric cut-out systems. (4/2/20.)
- 163 097 B. T.-H. Co. & GLINKER. Electrical measuring instruments. (9/2/20.)
- 163 111 RANSOME, LTD. Electric cut-out systems and cut-outs used in connection with electric lighting plant employing internal-combustion engines. (11/2/20.)
- 163 113 WALSALL HARDWARE MFG. CO., COMPTON & READ. Combined electric switches and wall plugs and sockets. (11/2/20.)
- 163 117 MACROBIE, AIREY, MORRIS & SHEARING. Wireless telegraphy and telephony. (11/2/20.)
- 163 118 MACROBIE & SHEARING. Transmitters for wireless telegraphy and telephony. (11/2/20.)
- 163 129 RAILING, GARRARD & McCOLL. Protective devices for alternating-current systems. (13/2/20.)
- Relates to protective devices for alternating-current systems for three or more parallel feeders, and comprises controlling means involving either mechanically-balanced or dynamometer type relays wherein the coils of the relay are arranged for circulating current and normally carry the whole current of the circulating current system, operation being obtained by current which spills into a balance lead connecting equipotential points of the relays.
- 163 136 B. T.-H. Co. (General Electric Co.). Electric power transmission systems. (17/2/20.)
- 163 153 MOSSAY, MOSSAY & CO. & RANSOME, SIMS & JEFFERIES. Electric controllers for use in electrically-propelled vehicles and other purposes. (25/2/20.)
- 163 159 TUCKER & CO. & LINE. Electric switches. (27/2/20.)
- 163 185 E. T.-H. Co. & GARTER. High-speed electric or other locomotives. (26/3/20.)
- (Addition to 128 106.)
- 163 189 BEAVER & SUN ELECTRICAL CO. Fittings for electric gas, and like lighting. (31/3/20.)
- 163 195 TELEGRAPH CONSTRUCTION & MAINTENANCE CO. & ROKES. Electric lighting of buoys and the like. (16/4/20.)
- 163 198 PAULIN, FORTUNE & McLEOD. Telemotor apparatus. (20/4/20.)
- 163 207 BERGERY. Construction of incandescent electric lamps. (13/5/20.)
- 163 228 MYERS. Spark-plugs. (20/7/20.)

APPLICATIONS FOR PATENTS.

February 5, 1921.

- 4 238 SEYMOUR. Electric cables.
- 4 239 WOODBURN. Electric welding machines.
- 4 247 AUTOMATIC TELEPHONE MFG. CO. & ROSEBY. Electric furnaces.
- 4 249 HAMILTON, STONE & PILE. Electric measuring instruments.
- 4 257 WINTER. Switches.
- 4 261 BEYRON & EVANS. Electric signal for road transport, &c.
- 4 267 TORRANCE. Regulating current output of generators.
- 4 281 WALLACE. Electric advertising machine.
- 4 285 BURLEIGH. Electric machines.
- 4 292 VANDERVELL & MIDGLEY. Electric machines.
- 4 300 ECKERSLEY, STEWART, VAN DE VELDE & FURNIVAL. Supplying current to valve amplifiers.
- 4 301 RELAY AUTOMATIC TELEPHONE CO. & INMAN. Telephones.

February 7, 1921.

- 4 320 BROLT. Dimming device for electric lamps for motor vehicles.
- 4 321 BROLT & HOLT. Electric horns.
- 4 325 PRIESTLY. Trolley poles attachments for electric trams, &c.
- 4 329 JEFFERIES & LANCASTER. Electric indicator or movable sign.
- 4 345 KINNAIRD. Combined electric iron and curling-tongs heater.
- 4 359 HARGRAVES. Electric hair-waving apparatus.
- 4 361 THOMPSON. Switches.
- 4 377 SARVASZ. Carbon electrodes. (29/11/17, Hungary.)
- 4 381 B. T.-H. Co. (G. E. Co.). Wireless signalling.
- 4 382 B. T.-H. Co. (G. E. Co.). Electric apparatus.
- 4 390 ROBINSON. Electric kettles, &c.
- 4 394 SOC. ARON. L. Carbon brushes for collecting current for vehicles by means of carbon brushes. (15/10/20, France.)
- 4 408 SIEMENS & HALSKS A. G. Mercury vapour jet pumps with light arc. (24/4/20, Germany.)
- 4 410 DE BRUYN. Rotary converter with variable tension. (5/2/20, Belgium.)
- 4 413 BAILEY & WEIR. Stripping insulation and armour from cables, &c.
- 4 432 WAITE, CAMPBELL & GIFFORD. Electric furnaces for non-ferrous metals.

February 8, 1921.

- 4 446 BISHOP & CHADWICK. Pulleys for trolley poles, &c.
- 4 445 CREDENDA CONDUIITS, LTD., & DAVIDSON. Electric toasters, &c.
- 4 459 ATKINSON. Automatic telephone systems.
- 4 474 & 4 475 FRANCIS & DUNGLISON. Locking devices for incandescent lamps.
- 4 482 ELECTRICAL UTILITIES, LTD., DALGLEISH, SCHATTNER & PRENTICE. Electric cooking devices.
- 4 491 PICKERSGILL. Electric lock for railway coaches, &c.
- 4 495 WESTERN ELECTRIC CO. Telephone repeater monitoring system.
- 4 506 GLADSTONE. Electric lighting apparatus.
- 4 513 B. T.-H. Co. (G. E. Co.). Signalling systems.
- 4 516 METZ-JULIEN-VICKERS ELECTRICAL CO., FIELD & NEVILLE. Rotors for generators.

THE CHINESE AND HOLLAND IN THE TAIWAN STRAIT, 1624-1662

THE DIRECTORS OF THE BOCCACCIO HATS & FUR LONDON LTD. COMPANY, LTD., have declared interim dividends upon the 4½ per cent. preference and 6 per cent. second preference shares and an interim dividend on the ordinary shares at the rate of 5 per cent. per annum, less tax, and payable Aug. 15.

The net profit of the LIMA LIGHT, POWER & TRAMWAYS COMPANY for 1920 was £p.143 347. The dividends distributed absorbed £p.113 546. The sum of £p.15 000 has been allocated for cost of stores, £p.5 200 to cost of extraordinary repairs and £p.9 600 reserved for bad debts, leaving £p.95 091 to be carried forward as in 1919.

The revenue of the TRAMWAYS & LIGHT RAILWAYS ESTATES COMPANY, LTD., for 1920 was £806, and after deducting administration and general expenses and adding £319 brought forward, the available total was £865. The directors have applied £100 to reduction of goodwill, £100 to reserve, and after paying a dividend at the rate of 3 per cent for the year, £213 has been carried forward.

The profits of the HORSELEY BRIDGE AND ENGINEERING COMPANY, LTD., for the year ended March 31 last amounted to £30 784, after charging all expenses of administration, &c., and with £11 601 brought forward the amount available for distribution is £42 385. The directors have declared a dividend for the year of 8 per cent. (tax free), and £10,000 placed to reserve fund leaving to be carried forward £12 385.

The total receipts of the YORKSHIRE (WOOLLEN DISTRICT) ELECTRIC TRAMWAYS, LTD., for 1920 were £148 077, against £125 161 in 1919. After setting aside £23 000 to renewals fund, and deducting expenses, &c., the balance was £19 682, while £9 677 was brought forward. The sum of £8 000 is placed to reserve, and a dividend at the rate of 6 per cent. for the year is proposed (of which 2½ per cent. has been paid), leaving £9 357 to be carried forward.

The accounts of GREENWOOD & BATLEY, LTD., for the year ended March 31 show a profit of £23 433, and with £25 308 brought forward the total is £48 741. A sum of £6 000 has been allowed for depreciation and the interim dividends paid in February last, preference 3½ per cent. and ordinary 2½ per cent. absorbed £18 224, leaving £30 517. Final dividends are recommended for the year of 3½ per cent. on the preference and 2½ per cent. ordinary shares, absorbing £8 710, leaving to be carried forward £18 294.

The accounts of PERNAMBUCO TRAMWAYS & POWER COMPANY for 1920 show a profit (including balance brought forward, &c.) of £109 567. Deducting £51 149 for debenture interest, £10 230 transferred to capital reserve, £6 800 interest on 8 per cent. notes, £4 177 interest, discounts, &c., and £7 338 for exchange, the balance available is £29 873. The directors have placed £10 000 to renewal and general reserve and £1 500 to amortisation account, leaving £18 373 to be carried forward.

Presiding over the meeting of the CALCUTTA TRAMWAYS COMPANY, LTD., last week, Mr. J. G. B. Stone stated that the traffic receipts increased by 63 per cent. with practically the same number of miles run, the passengers carried (nearly 53½ millions) showing an increase of 10 per cent. The Indian expenditure shows an increase of 40 per cent. The gross receipts are increased by 10 per cent. and salaries, power, expenses due to increased prices paid for coal, and maintenance and repairs, due to exceptionally heavy repairs on the rolling stock and to abnormal expenditure in making good damage to the electrical equipments of 67 motor-cars caused by the floods in August last. The gross profit was £240 389 and the available balance £189 076. They were paying a final dividend on the ordinary shares of 3s. 6d. per share, making, with the dividend already paid, 7 per cent. for the year, tax free (against 10 per cent. for the previous year); £40 000 was placed to reserve for depreciation, £80 000 to taxation reserve, and after a contribution to the staff provident fund of £2 403, the balance of £42 591 was carried forward. Owing to the heavy increase in the cost of working, a new scheme of fares was under consideration and would be brought into operation as quickly as possible. The loss of revenue due to strikes, coupled with the drop in the takings for the current year from other causes, had drained the available cash resources and further capital would be required. There were signs of improved trade conditions, to which their traffic would quickly respond.

Mr. J. G. Stone presided over the meeting of the ELECTRIC SUPPLY CORPORATION, LTD., on the 14th inst. and stated that the increase in gross revenue for the past year was £22 580. Excluding the Dumbarton undertaking and the return on investments, the gross profit on the other undertakings was £6 830, an increase of £3 887 over 1919. The net revenue account showed that repairs amounted to £7 196, an increase of £3 935. The cumulative effect of the increased cost of repairs, interest charges and the reduced carry-forward was that the balance was reduced to £3 403, which was the net result for 1920. In towns other than Dumbarton they supplied 1 416 534 units in 1914 and in 1920 743 652 units; the increase in average selling price was 50 per cent.; the cost of production had risen 149 per cent.; coal which cost £5 040 in 1914 cost £17 213; stores had increased from £565 to £1 417; and wages from 44 385 to £11 960 in 1920. In regard to maximum rates, they had now got the bulk of their undertakings in a satisfactory position, having obtained revised rates without any condition. The maximum rate was now 1s. per unit in all towns except St. Andrews.

- 5442 & 5443 SAYAK, Gustav & Co. Ltd. Electrician.
5436 TAYLOR, Transmission systems.
5456 RADIO COMMUNICATION CO. & SCOTT-TAGGART. Wireless, &c., signalling systems
5454 & 5455 HIGHTON & CALVERLEY, Constructors.
5460 HIGHTFIELD & CALVERLEY, Electrical/insulating members.
5465 DAVIS, Vent plugs for accumulators, &c.
5467 GREVILLE & READ, Interrupters.
5468 & 5469 GRIFFITHS & ROWE, Electrician.
5470 EASTERN TELEGRAPH CO. & DAVIES, Electric signalling.
5491 DRENNAN, Cables or conductors.

whereas in 1901, Dumbarton Rd., Exchange St., and Hitchin Rd. In Dumbarton and Hitchin they were excluded from getting the proper increase owing to the form in which they carried on those undertakings. The new Electricity Bill, if passed, would relieve them from that incubus. Apart from repairs, their position was considerably improved, and they had reason to think the repairs charge would be materially reduced when they got over the arrears. The high-water mark in wages had been reached, the cost of living was falling, but coal prices were higher than they had ever been. There was still an active demand for electricity.

Presiding over the meeting of Messrs. CROMPTON & COMPANY, LTD., last week the chairman (Mr. A. A. C. Swinton, F.R.S.) said the actual profits earned on trading during the past year were exceedingly good, but from their trading position they had needed a large sum necessary to write down their stocks to a safe figure. The expansion of their foreign and export trade had been very noticeable. Profits in Australia and India particularly were very encouraging, but the fall in the value of the rupee had sadly depleted their Calcutta profits. The profit shown was after making provision for excess-profits duty, corporation tax and income tax. Dealing with the heavy burden of taxation, Mr. Swinton pointed out that on every £1,000 they earned over and above the standard the Government took £734, leaving them with £266. It was with a considerable amount of satisfaction that notwithstanding the many and varied drains on the profits the board were able to show a net available balance of £66,291, against £52,878 last year. The directors proposed to carry to reserve £19,500, bringing the reserve up to £75,000, and to pay, with the interim preference dividend, a dividend on both preference and ordinary shares at the rate of 10 per cent, per annum, which was the same as last year, and to carry forward £18,370. At the corresponding period of the year the directors were in the fortunate position of having to turn away business, but the position had entirely altered. It was true that they finished off the year at March 31 with a considerable amount of work in hand, but in the present condition of trade new business was difficult to get. There were plenty of inquiries, but orders were not being placed. However, the settlement of the coal strike would undoubtedly relieve the position, and they were told that there was going to be a very distinct revival in trade.

New Companies.

ACCUMULATOR TRUST, LTD. (175 551).—Reg. July 5, capital £100 in £1 shares, to carry on business of manufacturers' agents, &c. Reg. office, 21, St. James's-st., S.W. Private company.

GAUNT & WILKINSON, LTD. (175 555).—Reg. July 5, capital £500 in £1 shares, to carry on business of mechanical and electrical engineers, steel manufacturers, &c. Directors, T. Gaunt, J. A. Wilkinson and S. Berrioford. Reg. office, Pilot Works, Corporation-st., Sheffield. Private company.

OLSEN ENGINE SYNDICATE, LTD. (175 524).—Reg. July 2, capital £24 in 1s. shares, to carry on business of ironfounders, mechanical and electrical engineers. Reg. office, 2, Sable Inn, W.C.1. Private company.

S. ROWLAND & COMPANY, LTD. (175 599).—Reg. July 7, capital £3,000 in £1 shares, to carry on business of coverers of wire with all materials. Directors, L. Maister, M. Cooper, A. Simon and S. Rowland. Qualification of directors, 1 share. Remuneration of directors to be voted by the company. Reg. office, 8, Strye-st., Middlesex-st., E.1. Private company.

THERMAL ELECTRIC WORKS (HACKBRIDGE) LTD. (175 513).—Reg. July 1, capital £2,000 in £1 shares, to carry on business of mechanical and electrical engineers. Directors, M. N. Kearney, E. Swainson and W. Makin. Reg. office, Hackbridge, Surrey. Private company.

Books Received.

[Copies of the undermentioned works can be had from THE ELECTRICIAN Offices on receipt of published price, plus postage.]

"Die Asynchronen Drehstrommotoren Induktions und Kommutatormotoren." By Prof. Dr. G. Benischke. (Braunschweig: F. Vieweg & Sohn.) Pp. viii.+232. M. 24.
"Electrical Rates." By Dr. G. P. Watkins. (New York: D. Van Nostrand Co.) Pp. 228. \$3.
"The Steam Turbo-Alternator." By L. C. Grant, A.M.I.E.E. (London: Sir Isaac Pitman & Sons.) Pp. xvi.+260. 15s. net.
"Theory of the Induction Coil." By E. Taylor Jones, D.Sc., F.Inst.P. (London: Sir Isaac Pitman & Sons.) Pp. xi.+217. 12s. 6d. net.

The Editorial, Advertisement and Publishing Offices of "THE ELECTRICIAN" are at 8, Boulevard Street, London, E.C.4. Telegrams: Benbratic, Fleet, London. Telephone: City 9852 (5 lines).

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Forty Years Ago.

(THE ELECTRICIAN, JULY 23, 1881.)

IRELAND.—Mr. Sanger, the Postal Telegraph Engineer for Ireland, is suffering from an illness occasioned by exposure to the sun.

KING KALAKUA.—The King of the Sandwich Islands visited the works of the Telegraph Construction & Maintenance Company on Thursday last, accompanied by Mr. John Pender, M.P.

THE RESERVE SQUADRON.—On the occasion of the recent visit of the reserve squadron to Kiel, in Germany, a grand garden fete was given in honour of our officers. The garden at the Bellevue was illuminated by the Siemens electric light.

SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.—The *Journal* for June (No. 37, Vol. X.) is now published. It contains, amongst other things, Papers by Mr. Fox Pitt on the "Application of Electricity to Lighting"; Mr. Preece on "Radiophony"; Mr. Luke on the "Field Telegraph in Afghanistan"; also original communications and abstracts of Papers.

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"Chemical Age": Merchant Shippers' Number: "Trade Opinions on the Future of Overseas Trade"; "Catalytic Reduction of Ethylenic and Acetylenic Bonds," by A. A. Pollett, M.Sc.

"Cabinet Maker": "The Decoration of Furniture"; "Dinner to Mr. Ernest J. P. Benn"; and "Kensington Argyll Amateur Athletic Association Annual Sports Meeting."

"The Fruit Grower": "Among the Norfolk Growers"; "Commercial Carnation Growing"; and "Cultural Hints."

"Farm and Home": "The Government and the Farmer"; "Drought and the Need for Forage Crops"; and "Birds and the Crops."

"Gardening Illustrated": "Early Potatoes"; "Tufted Pansies and the Drought"; and "Annals in the Garden."

"The Gas World": "Experiences of the Gas Industry during the Coal Stoppage"; "Work of the Chief Alkali Inspector for the Industry"; "Extracts from Annual Report."

"Hardware Trade Journal": "The Manufacture of Hollow-ware, ILL"; "Spinning"; "Seaside Hardware Shops"; and "Trade Developments in Greece."

Arrangements for the Week.

FRIDAY, July 22nd (to-day).

INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

10.15 a.m. At the Institution of Mechanical Engineers, Storey's Gate, London, S.W. Annual General Meeting.

ELECTRICAL POWER ENGINEERS' ASSOCIATION.

7 p.m. At Central Hall, Westminster, London, S.W. Lecture on "Boiler Design: Latest Developments," by Mr. J. Cauthery.

Prices of Metals, Chemicals, &c.

		Price.	TUESDAY, July 19.	
			Inc.	Dec.
Copper—	Best selected.....	per ton	£71 5 0	—
	Electro Wirebars ...	"	£75 10 0	—
	H.C. wire, basis	per lb.	0s. 11½d.	—
	Sheet	"	0s. 11½d.	—
Phosphor Bronze Wire (Telephone)—				
Phosphor-bronze				
wire, basis				
" ..				
Brass 60/40—				
Rod, basis				
" ..				
Sheet, basis				
" ..				
Wire, basis				
Pig Iron—				
Cleveland Warrants .		per ton	£6 15 0	5s. 0d.
Galvanised steel				
wire, basis 8 SWG ..				
Lead Pig—				
English				
Foreign or Colonial ...				
Tin—				
Ingot				
Wire, basis				

Salammoniac.—Per cwt. 75s. 70s.

Sulphur (Flowers).—Ton £15.

" (Roll-Brimstone).—Per ton £15.

Sulphuric Acid (Pyrites, 16%).—Per ton, £9 17s. 6d.

Rubber.—Para fine, 10½d.; plantation lat latex, 8½d. lb.

The metal prices are supplied by British Insulated & Helsby Cables, and the rubber prices by W. T. Henley Telegraph Co., Ltd.

Copper Sulphate.—Per ton £36.

Boric Acid (Crystals).—Per ton £89.

Sodium Bichromate.—Per lb. 7½d.

Sodium Chlorate.—Per lb. 4d.

THE ELECTRICIAN

THE OLDEST WEEKLY ILLUSTRATED JOURNAL OF

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Notes.

Some Lessons of the Coal Strike.

THE coal strike has taught electricity supply engineers a lot, as was evident by the trend of the discussions at the I.M.E.A. Convention last week. Commercially, it has taught them that it is possible to pass more quickly than was pleasant from a state, when they did not know where the next unit was coming from to supply all the demands, to a condition where a large portion of their plant was standing idle. Technically, it has taught them that coal is not the only fuel with which they can generate sufficient steam to carry on and that the substitutes for coal, interesting though they may be, cannot be obtained with the same ease, at the same cost, nor do they operate at the same efficiency as that much maligned commodity. Psychologically it has raised in them a state of indignation that, as Mr. FEDDEN expresses it, they should have to pay for dirt as coal and a determination to investigate, and, if necessary, to force on the coal owners methods which shall ensure that the coal delivered is clean and has a certain definite thermal value. As both Mr. WOODHOUSE and Mr. SELVEY pointed out, however, a fixed thermal value is not easy to obtain. Coal is not a material of fixed composition and it is not possible to lay down that large quantities of it should conform to sample. The best that can be done is to obtain guarantees as to size and amount of ash and to ensure that the fuel supplied is from a specified seam.

The Cleaning of Coal.

As regards cleaning, Mr. ROBERT NELSON at the recent Engineering Conference showed that there are no technical difficulties to prevent this being efficiently done, and with the present industrial conditions, therefore, it should only require that force which the consumer can well bring to bear to make the mine owners take adequate steps towards improvement. As we recently showed, the question is one of importance not

only to electricity supply engineers but also to those who are concerned with transport. To carry material which is useless, even when paid for as coal, is not economically sound. When, however, we have got proper coal in our generating stations there are still a number of interesting problems to be solved. These were widely dealt with in the discussion on Messrs. WILSON and MILES' Papers last week and we are glad to see so great an interest being taken on the matters by supply engineers no less than by manufacturers.

The Pros and Cons of Pulverised Fuel.

PERHAPS one of the most interesting of the problems is that contained in the suggestion that pulverised fuel is a solution of many of our boiler house difficulties. Upon this, however, there is evidently a good deal of difference of opinion and many station engineers are against rather than for its wider employment. On the other hand, the discussion at the recent summer meeting of the Institution of Mechanical Engineers showed that a large number of technical and commercial experts are in its favour and that a good many excellent results can be obtained by its use. One of the points which have doubtless influenced station engineers against pulverised fuel lies in the necessity for the installation of auxiliary machinery for its preparation, or, in other words, the allocation of space where space is hard to find and capital expenditure which is not justified by the results obtained. It is therefore interesting to see that recent experiments in America have shown that the grinding and drying of the coal need not be carried to such a high degree as has so far been considered necessary. In a Paper by Mr. HENRY KREISIGER and Mr. JOHN BLIZARD recently read before the American Society of Mechanical Engineers it was pointed out that completeness of combustion seems to be more a matter of proper furnace and burner design and of air supply than of the fineness of coal, while tests made with undried coal gave equally good combustion as when coal from which the moisture had been excluded was employed. Boiler capacity, when this coal is used, depends

entirely upon the shape and size of the furnace. This may explain some of the bad results which have been obtained over here, especially where just recently attempts have been made to use all sorts of fuel in furnaces of shapes which render efficient results problematical. But while it is very desirable that the advantages and disadvantages of various types of fuel and various types of boiler and other boiler house apparatus should be closely explored it must be pointed out, as Mr. CHATTOCK rightly said, that changes in our present boiler house practice are not necessarily desirable.

The I.M.E.A. and the N.J.I.C.

WE hope that the plea for support made by Alderman W. WALKER at the annual dinner of the Incorporated Municipal Electrical Association last week on behalf of the decisions of the National Joint Industrial Council and the Joint Boards will be heeded by all members of the Association, especially the Committee members. For while it is true that a very large majority of the electricity undertakings of the country have loyally abided by the awards made by the District Boards and National Councils, there remains a small recalcitrant minority who have not yet accepted these decisions and so spoil the unity of the whole. There also exists an unfortunate tendency among certain of those who have accepted the awards to cause further friction by attempts to revert to an individual policy. To do this not only strikes deep at the root of combined bargaining, but must inevitably lead to failure and to a consequent loss of prestige, which is bad not only for particular undertakings, but for the employers as a whole. It is now generally realised by those concerned that wages must fall, but if this fall is to take place without disturbance it must be diplomatically engineered by all parties. This can most easily be effected through bodies such as the Joint Industrial Council which, as Alderman WALKER rightly pointed out, has the further advantage of relieving individual undertakings from the work and responsibilities which would naturally be attendant on individual wage adjustments.

Disbandment of the Industrial Joint Committee.

WE have always whole-heartedly supported the ideas crystallised in the Whitley Report and, at the same time, have pointed out the great obstacles to trade development which must arise from any form of Government control, direct or indirect. The news that the Joint Committee of the National Joint Industrial Council which was set up in April, 1919, has been dissolved is not, therefore, unpleasant. For it is really the sequel to a series of attempts on the part of the Council to deal with evils of unemployment and generally to investigate industrial problems relating to employment, hours of labour and wages. The wholesale resignations which have taken place seem to have been caused by non-acceptance of their report in favour of the eight-hours day and the fixing of a minimum wage. This non-acceptance is a sign of sanity we are glad to record. The eight-hour day has its good points and the minimum wage, at least, is some guarantee against sweating. But whatever advantages these much-vaunted panaceas may bring to the settlement of industrial unrest, the disadvantages which accrue from their adoption are much more profound, as has been amply shown during the last few months. To allow the Joint Committee to dabble with these problems could only have meant further interference with trade, while the good that they might have achieved is already being voluntarily and much more efficiently achieved by the Whitley movement, which we are glad to see is growing in both strength and influence. This is not surprising, for it is obvious that no

body can be more competent to regulate hours of labour or establish a minimum wage scheme in any industry or to consider all the points of difference which may arise in that industry than a Joint Industrial Council, representative both of the workmen engaged in that industry and their employers

Mr. Hugo Hirst on the Future.

THE speeches made by Mr. HUGO HIRST at the annual meetings of the General Electric Company are always interesting, and his remarks at the ordinary general meeting of the Company last week are more interesting than usual. Notwithstanding the many difficulties that have had to be faced during the past year Mr. HIRST was in the happy position of being able to announce a record profit, an undiminished ordinary dividend and an increase in the amount carried forward of nearly £97 000. A good deal of Mr. HIRST's address was naturally devoted to an exposition of the development and projected extension of the activities of the Company and its various subsidiary undertakings. He was able to announce that these were now equipped to deal with all demands that might be made upon them and in regard to the future his tone was very optimistic. Whether we turn to electric light, to power, to hydro-electric projects, to railway electrification, to mines, to steelworks, to telephony, to wireless or to the domestic field we see no end to potential electrical development and for that reason we share Mr. HIRST's optimism regarding the future of the General Electric Company and of the electrical industry as a whole.

Magnet House.

EXTREME pressure on our space prevents us from making more than a passing reference this week to the latest enterprise of the General Electric Company, namely, the inauguration of their new headquarters, Magnet House, in Kingsway. Magnet House was open to the inspection of both shareholders of the Company and the Press on the occasion of the annual general meeting on Thursday in last week. It marks an interesting step in the progress of the Company, a progress which, like the course of Empire, is westward, from the old buildings in Queen Victoria-street, which have been occupied for over 32 years. These buildings, though of historical interest, some years ago became inconvenient and had it not been for the war, that great destroyer of many an enterprise, Magnet House would long ere this have been occupied by that busy throng whose daily business is to develop the affairs of the General Electric Company. Such a change from a site where they have been established for many years to an entirely fresh situation can only be justified by the urgent need for increased space and more modern accommodation. That it has been made shows that it is justified and is in itself an indication of the progress made by the Company.

Follies Electric!

AS usual, the Annual Report of Mr. G. SCOTT RAM, H.M. Electrical Inspector of Factories, is mainly devoted to a recital of accidents, the majority of which could have been avoided by ordinary care and prudence, and to an exposure of defects in workmanship and of faults in the design of electrical plant and apparatus which were discovered in the course of his official duties. We have set out in another column some of the most glaring instances of these shortcomings in the hope that they will serve as a warning to all engineers engaged in the erection or supervision of electrical plant. During the past year there were 394 accidents, of which 23 were fatal, and though this is about the same as that for 1919, it is very

much higher than it need be. Where the human element is involved mistakes will never be eliminated; but when we read of five cases of cleaning being done on station switchboards close to unscreened conductors known to be alive we think it is time the Department's regulations were strengthened by making that kind of folly penal. Several cases of poor and slovenly work were discovered and one instance is given where a large Scottish engineering works with over 200 electric motors of various sizes up to 40 H.P. on a 440 V three-phase supply was without an electrical engineer. It is not surprising that Mr. RAM found an accident at the works to be due to the want of skilled supervision.

Loan Repayments a la Ecosse.

WE had always thought that whatever Scotchmen did in their own country they always agreed with each other in foreign climes. The direct contradiction by Mr. ALEXANDER KENNEDY of Mr. BAILLIE SMITH's remarks about loan repayments at the meeting of the Incorporated Municipal Electrical Association last week therefore came as a rude shock which was not in the least tempered by our entire agreement with Mr. KENNEDY and our entire disagreement with Mr. BAILLIE SMITH. BAILLIE SMITH's argument was that municipal undertakings were at a grave disadvantage compared with company owned undertakings because they must pay off their loans by rigid rules, which ought to be made more flexible. It is true these rules press heavily in certain cases, especially in the earlier years of an undertaking's history, but were flexibility introduced, we fear with Alderman BEAUMONT that the loans would not be repaid at all, and that the financial position of many of our municipal electricity undertakings with regard to sinking and reserve funds would be a great deal worse than it is at present. Many English customs have been "caledonianised" in a way in which we fear it is too late to mend, but we hope that process is not going to be applied to loan repayment.

The Cost of Industrial Disease.

THE statistics of sickness and disablement benefit given in the Annual Report of the Chief Medical Officer of the Ministry of Health are worthy of careful study not only by employers, but by all who take an interest in the welfare of industrial workers. Here are some of the figures. In 1920 the sum paid for sickness benefit to men and women employees was £5 335 173, an increase of £900 000 over the previous year, while the disablement benefit amounted to £1 734 511, an increase of over £300 000. Men lost 6 217 048 weeks by sickness and 2 699 405 weeks by disablement, while the corresponding figures for women were 3 771 405 and 1 378 536 hours respectively. It is therefore estimated that at least 14 000 000 weeks' work is lost in this country every year through sickness, though indirectly, of course, the loss is very much greater. These figures are, in fact, sufficient to show the urgent need for better organisation on the part of employers and employees to reduce this enormous waste of time and money. We are aware that many progressive engineering employers, recognising that prevention is better than cure, have established welfare centres where medical attention is provided, but there is evidently ample room for their extension. Sickness and disablement can, of course, never be eradicated altogether, and it would therefore pay every employer to establish, either alone or in conjunction with neighbouring firms, some place where workers could obtain periodical medical attention. Such a course would be cheaper than the present wasteful system which represents a loss of about £2 000 000 a year to employers alone in insurance, lost time and diminished efficiency.

"Industrial" Week Ends.

NAPOLEON, among generals, and MACAULAY, among writers, have dogmatised on the valuelessness of Councils of War and Committees as a means of getting things done. This stigma has remained to the present day; and rather unjustly it is forgotten that conversations between those of different opinions are of the very greatest use, not perhaps as a preliminary to immediate action, but as an unrivalled method of clarifying ideas and obtaining that appreciation of the other point of view which is so necessary for the proper investigation of any problem. For this reason we see in the week-end conferences which are now a component part of the work of the Industrial League and Council the very greatest use. At the most recent of these held at the house of Sir SAMUEL WARING an exhaustive consideration was given to the subject of the "State of Foreign Exchanges and Their Influence on Industry"—a dull subject it may be thought and one hardly suited for either the country or the week-end. But in that dual mood of receptivity and expansiveness which is engendered by such a time and place there lies a great chance of sowing new seed and every prospect of its bearing abundant fruit. Our own experience leads us to believe that in such conferences the informal conversations are as important as the set debates. This cannot fail to be the case at the Industrial League and Council's week-ends. For informal no less than formal reasons this body is therefore to be congratulated on these meetings, while thanks must also be accorded to those whose hospitality makes them possible.

The Creation of an Organism.

THE guiding thread of Major RICHARDSON's presidential address to the Incorporated Municipal Electrical Association last week is the need for the self-inoculation of the electrical industry with the vaccine of mutual assistance. George III. said that if WOLFE were mad he hoped he would bite the other English generals, and for our part we should like to see the electrical industry generally imbued with Major RICHARDSON's sanity. For if we examine each part of the industry in turn we find in each partial organism certain phases, peculiar to that organism, which operate for its own good and are unaffected by other influences, internal or external. But we find other phases whose actions are definitely antagonistic to the actions and tendencies in other sections of the industry, and to which other sections of the industry are similarly antagonistic. We also find that the well-being of each section could be increased by assistance from the other groups and that this combination of effort would be beneficial, not only to electrical industry itself, but to its relations with other industries and the general public. Unfortunately, it does not require a close examination to find that this community of interests is almost non-existent, nor that the well-being of the electrical industry as a whole is forcibly kept below its proper level by petty mutual jealousies.

DIAGNOSIS AND REMEDY.

Diagnosis of any disease is a first step to its remedy. We have made the diagnosis, we will now attempt the remedy. The disease which permeates the electrical industry cannot be removed by drugs. The only chance lies in a general change in the mode of living of the patient so that bodily health may be built up, the mental outlook cleared and the system rejuvenated. In this way only will be possible the accomplishment of tasks which are now beyond its strength.

We have long held the opinion that one step towards improved health would be the bringing of the numerous individuals working in various branches of the electrical industry into closer communion with each other. For electrical engineers do not know each other well enough. The electricity supply engineer never hears the opinions of the manufacturer in a non-business atmosphere. The contractor is equally ignorant that the telegraph or telephone engineer is a human being like himself. False social distinctions have helped this unfortunate state of affairs and the seclusion of classes of members into watertight compartments is rapidly approaching. This is likely to be disastrous. For such ignorance of each other unconsciously breeds friction, friction breeds distrust and distrust sectionalism. At present the electrical industry is not a healthy living organism at all. It would be much better described as an uncomfortable congerie of warring elements. Can it be wondered at that it is not so efficient as it should be?

BRINGING TOGETHER THE ELEMENTS.

One remedy for the present state of affairs is, therefore, to bring together representatives of various sections of the industry under conditions which will render easy and painless the removal of sharp corners and the building up of a more friendly spirit. Such architecture is not the least of the objects of the "All-Electric" Convention whose inauguration under the auspices of the Institution of Electrical Engineers Major RICHARDSON suggests. Both politically and technically the Convention would have great uses, as we have often pointed out, but to a large extent the great future we see for it would depend on the opportunities it would afford for free social intercourse among all sections of the electrical profession and industry. At the "All-Electric" Convention all would be equal. The only qualification for attendance would be a desire for the development of the electric idea. Such development is urgently needed and we hope that by this time next year the holding of a British "All-Electric" Convention will be an actual fact.

CLEARING THE GROUND.

We are glad to find that the idea of holding such a convention has been generally well received in the industry. Naturally there has been some criticism. One objection made by Mr. DYKES in our last issue is that there are already more than enough conventions, and that to add to their number would be a mistake. We agree. But it is not so much the number of the conferences that we object to, though that, of course, is a drawback, owing to the distribution of effort that it involves where concentration is needed, but their character. During the winter months full opportunity is given in the meetings of the numerous engineering societies to discuss technical questions unhampered by the glare of publicity. At the "All Electric" Convention publicity should be the main object, and discussions on technical matters, if held at all, should be kept severely in the background. For this reason we think that the Institution of Electrical Engineers is not the proper body to manage such a gathering. In its laudable endeavours to promote the good of the electrical engineering profession, the Institution's duties are becoming every day more onerous. Quite naturally, moreover, it would not fail to look at this Convention from the professional standpoint. And that in this instance would be the wrong standpoint.

A SPECIAL BODY NEEDED.

It is, therefore, our considered opinion that the "All Electric" Convention could be best organised by a special *ad hoc* committee composed not only of representatives of every electrical association taking part, but of prominent public men well known in the district where the Convention is to be held. Within this committee, which to be sufficiently representative would have to be large, would be a small executive

charged with the actual arrangements. The place of meeting should be selected with care on lines we have already laid down and municipal hospitality should be solicited. On the other hand, we agree with Mr. WORDINGHAM that a comprehensive engineering conference dealing only with professional matters is required. The success of the recent Engineering Conference is sufficient to show that. But this conference should be kept entirely separate from the Convention with which we are now dealing.

DOING SOMETHING NEW.

Mr. DYKES' letter in our last issue makes it necessary that we should reiterate that the object of the "All Electric" Convention is to do something new—something which urgently requires doing, and not to take the place of any society which in its own way is assisting in the education and promoting the well-being of its members. Such a gathering would save time and money rather than waste it, and would give better value for what is spent than is the case at present.

Technically it is obvious that, if rightly arranged, such a convention would be useful and instructive in the broadest sense. Politically, it could not fail to be less so. For reasons to which we have drawn attention above, the work of electrical engineers and the benefits conferred by them on civilisation remain largely unrecognised. To the uninitiated, which in this case is 95 per cent. of the population, the electrical engineer is some one who cannot repair an electrical bell, and who occupies the time he can spare from this absorbing occupation in signalling to Mars. Such a state of ignorance is largely our own fault and we suffer for it. An "All-Electric" Convention would quickly change all that, for the potentialities of success are present.

The Pros and Cons of Electric Propulsion.

THE MARINE ISSUE of THE ELECTRICIAN, published this week, is an attempt to cover the whole range of the application of electricity to driving machinery on board, to ship lighting and to the methods of communication between ship and ship and ship and shore. It is not outside its scope to deal with quayside equipment designed for the easy and economic loading and unloading of cargoes or with devices for controlling a vessel on its course to the port or through fog or crowded fairways. Marine electrical engineering is at once a general and a special subject. For much of the practice that has been successfully followed in land work is equally applicable on ship board. Where it differs often the differences are not great, and the majority of the special problems that have arisen have now been successfully overcome both in the Navy and the Mercantile Marine.

ONE OUTSTANDING PROBLEM.

But there remains to be solved one outstanding marine electrical problem. It is a large problem made up of a variety of interesting and novel features besides being of a magnitude which is not generally appreciated. Were, in fact, its magnitude better realised, many of the glib statements that are made about it would remain unspoken. This problem is most easily described by the term electrical propulsion.

The importance of electrical propulsion at the present time renders it instructive to examine what obstacles are retarding its progress in the British Navy and Mercantile Marine and what the conditions are that lead to the special difficulties to its development which undoubtedly exist. This examination is the more opportune as there exists a feeling that we are being left behind in a race in which, being a maritime nation, it is essential we should be first.

NAVAL AND MERCANTILE CONDITIONS.

Distinction must first be drawn between the conditions that exist in the Navy and in the Mercantile Marine. In the latter service the vessel usually performs long voyages from port to port at a particular uniform speed, *i.e.*, it is most economical to design its propelling machinery for one speed and practically to neglect its efficiency at other speeds. The object of such ships, as Mr. BUTLER points out in the article we publish on another page of this issue, is mainly to carry cargo, and the location of the propelling machinery in the most convenient place is, therefore easily possible. It is obvious, moreover, that these conditions in the present state of our knowledge of the working of electric propelling machinery more generally favour the direct or geared drive by steam turbine than the electric drive. An exception to this statement is found in some of the smaller merchant vessels where the Diesel or other similar engines offer advantage. Apart from the reasons we have mentioned above, the increased space occupied, the added weight, the extra complications and the necessity of employing more skilled engine room staff than is now available all mitigate against the general use of the electric drive in the Mercantile Marine, though it has been and will be successfully used in a number of special cases. For the moment, then, we must look to the other great field of marine endeavour, the Navy, as our first objective from the electrical point of view.

NAVAL CONDITIONS AND THE ELECTRIC DRIVE.

It is soon evident that conditions in the Navy are much more favourable to the electric drive than those in the Mercantile Marine, principally because a warship must be designed to operate as efficiently as possible at a number of varying speeds. And while for the same boiler power the electric drive may not give the same maximum horse power and overall efficiency at full speed, and that full speed will be probably lower than the figure that can be obtained with the steam turbine at other speeds it is distinctly more economical, while its greater flexibility of arrangement, operation and manoeuvring are advantages which are worth some sacrifice of mere full speed efficiency to obtain. The electric drive has the further valuable asset that in cases of breakdown arrangements can easily be made for using all the propellers at a reduced speed, while in the case of the steam turbine the only progress possible is that proverbially associated with a lame duck.

THE BEST FIELD FOR THE ELECTRIC DRIVE.

It follows from what we have said that for the moment the battleship, the cruiser and the larger types of warship generally offer the best field for discovering the merits of the electric drive and every opportunity must, therefore, be seized for assisting this development. This is the bright side of the picture. But the other side must also be examined critically the more so as claims have been made for the electric drive which may almost be described as preposterous, and, at any rate, have been instrumental in providing those who, for a variety of reasons, are opposed to its adoption with some sharp and telling tools for pointing their arguments.

THE TECHNICALITIES OF THE ELECTRIC DRIVE.

What, then, is the present position with regard to the technical side of the electric drive? There are some interesting problems to be solved without a doubt. One of these in its broadest aspect may be likened to the old task of introducing a quart into a pint pot. And here it is as well to sound a note of warning. Those who talk easily of the wholesale introduction of electric propulsion as an easy matter forget that a modern battleship requires propelling machinery to the tune of some 200 000 H.P., apart from the hundreds, if not thousands, of additional horse-power needed for driving gun mountings, hoists, fans and other auxiliary plant. One phase of the problem is,

therefore, to erect a super-station under conditions very far removed from those we usually envisage as part of a super-station's economy. For space, even on a battleship, is cramped and of queer shape. Ample ventilation is necessary and difficult to obtain. Salt spray has to be reckoned with. Lubrication has its special problems. Fire is also a danger. The interchangeability of personnel necessary in a fighting force introduces difficulties of quite a special kind in training and practice and, above all, necessitates that the equipment shall be reliable and easily operated. In all these ways, then, there is ample room for much hard work and experiment and we are therefore glad to learn that the Admiralty are closely considering the variety of problems involved.

A WEIGHT OF PREJUDICE.

But when all these technical difficulties have been overcome the progress of electric propulsion is not freed from obstacles. There remains a weight of prejudice to be removed before it can really come to its own. This prejudice is of two kinds, the legitimate, which can be removed by argument or example, and the second kind, which depends in this country on the magnitude of vested interests in other forms of propulsion. We call attention to this difficulty because its presence must be dealt with, but not as something whose influence cannot be overcome. In other fields the electric drive has vanquished some doughty opponents. There is no reason why it also should not do so in the field of electric propulsion.

THE FIGHTING MACHINE.

We have said above that steaming conditions in the Mercantile Marine do not at present favour the use of the electric drive and that its advantages in the Navy are mainly due to the greater flexibility it possesses when compared with other systems. But this argument may be enunciated in another way. For the battleship is first and foremost a fighting machine and, as was recently well said by an American writer, nothing in its design "should govern but fighting qualities—difficulties of accomplishment, cost, appearance, convenience, efficiency, cost of operation are all of secondary consideration and should be sacrificed willingly and completely if by so doing the fighting quality is enhanced." With this statement there will be general agreement and that being so, the question must be approached with an open mind, to discover without prejudice the effect of its employment on the fighting power of the ships.

NO DOUBT OF THE RESULT.

For ourselves, we have no doubt what the result of this investigation will be, and recent experiences in the United States Navy where conditions of the kind we have mentioned have been more favourable to the electric drive than in this country confirm that view.

But for that state of things to be brought about electrical manufacturers must apply themselves more closely than they have done up to the present to working in a "blue water" atmosphere. Marine engineering in the present sense of the term is closely identified with shipbuilding. Although some electrical engineering firms in this country are closely dealing with the problem, that *liaison* between electrical engineering of the kind that will be necessary for large ship propulsion and shipbuilding exists only to small extent. That must be changed. For it is not too much to say that in this country at present the electric drive is only accepted if nothing else will be found to do, while, in the United States, electrical propulsion is considered in shipbuilding circles on an equal, if not preferential footing, with other forms of drive. A great step towards this end will be made by the adoption of a more enthusiastic attitude by British electrical engineers, a state of mind which, as Mr. BUTLER points out in his article, is exceptional. This is a pity.

Electric Ship Propulsion.

The Situation as it Stands To-day.

By R. J. BUTLER, M.I.N.A.

IN attempting a survey of recent advances in electric propulsion of ships, it would, of course, be idle to evade the fact that interest has not been sustained in this country to anything like the same extent as on the Continent and in America. Nevertheless, whilst progress in actual building may lack tangibility, yet the opportunities of profiting by the experience of our neighbours have been by no means neglected; and it may be asserted with every confidence that when a revival follows the present slump in ship-building, electrically propelled ships, second to none in design and construction, will be well represented in the programme of new work. Whilst building is thus in a dormant state there are distinct signs reflected in the engineering societies and the technical press, that there is a great recrudescence of interest, not only amongst builders but by shipowners, and a general feeling that the whole subject should be re-investigated. This attitude has undoubtedly been caused by the success of foreign vessels equipped with the system. That Great Britain is sadly in arrears is fairly well known, and it will require long and strenuous efforts to reduce the lead already gained by our competitors. Whether this method of propulsion will leap into meteoric fame like the geared turbine is doubtful, but, once established, it will certainly remain as a sound commercial proposition in its own field, and its intrinsic merits will gradually oust most of the present-day forms of transmission, except, perhaps, the slow-running direct-connected Diesel engine which has its own sphere of activity, limited, at present, to comparatively small powers.

ADVANTAGES AND DISADVANTAGES OF THE ELECTRIC DRIVE.

The advantages and disadvantages of the electric drive have been reiterated so often that they will not be enumerated here, though reference to certain of them will appear subsequently. In spite of the state of coma at present existing, many designs have, as stated above, been prepared and are in readiness to be put into the shops when the opportune moment arrives, and it will, perhaps, be of interest to examine some of the problems involved and the methods of obtaining successful technical and commercial solutions to them. Little of British origin has been published as compared with the large amount of data available from American sources; but the quantities are probably proportional to the volume of actual work accomplished and being done in the two countries. A list of principal home contributions is added for reference as an appendix to this article.

Turning now to the before-mentioned problems, it must be borne in mind that marine requirements fall broadly into two absolutely distinct branches, the naval and the mercantile, each of which differs vitally from the other. The war vessel is designed for short periods at full speed and long runs at fractional powers, whilst the passenger or cargo steamer will be at full power for her whole running life, save when manoeuvring in narrow waters to her terminal or other ports of call. Maximum economy must, therefore, be obtained in the two cases under totally different conditions, and it will be seen later how this end has been achieved.

PROGRESS IN THE UNITED STATES.

In both classes the larger and faster the vessel, the more favourably can electrical transmission be applied, although for small cargo ships of 10 knots the system has met with much success, particularly in Scandinavia. In high-powered liners, the method of drive has not, so far, been installed, but the American decision to fit nothing else in their capital ships, after considerable experience with high power units, shows that no fear need be entertained, particularly as mercantile requirements are far more easily met than naval ones. That these ships, thirteen in number, of a total of 1 500 000 H.P., are all electrically driven—six of them are 180 000 H.P. each—shows that the U.S. Navy Depart-

ment is convinced of its superiority for large ships. For destroyers and light craft in general the weight of the machinery as compared with geared turbines would be prohibitive, but for all other classes of ships there is little to choose between the two rivals on this score. From published figures the "Lexington" class get 2 H.P. per ton more than the "Hood," our latest capital ship, and the "Indiana" class nearly 6 H.P. per ton more than the "Royal Sovereigns" (the latter are, of course, direct connected turbines, none of our battleships being geared, except, so far as cruising turbines are concerned).

A table showing the leading machinery particulars as far as available of electrically propelled ships, built and building, is appended, although there are several others, of Swedish origin chiefly, of which data are not to hand, mostly repeats of some of the smaller ones shown.

TECHNICAL PROBLEMS.

The technical problems which arise in the application of electricity to main propelling purposes on shipboard fall into three main classes:—

1. Those in connection with the main generators and motors.
2. Those in connection with the auxiliary equipment.
3. Those in connection with the switch and control gear with their cables, measuring and recording instruments and their accessories.

The first two classes are quite separate and distinct in their requirements, but must have an intimate relationship and be intelligently co-ordinated in a well-balanced installation.

Taking the first division, the primary difference between land and marine work is that in ship propulsion the propeller revolutions alter with the load, that is, with change in the ship's speed, this—assuming polyphase alternating current is installed—being a condition totally at variance with the constant speed generators and motors associated with land practice. This variation could, of course, be easily legislated for were it possible universally to employ direct-current generators and motors for these units. These latter, are, however, in the present state of the art, confined to small units, owing to the restriction of weight and space available in ships, and to the same limits as apply to land work, viz., commutator and brush troubles, which accrue if high current intensities and voltages are employed. In all modern installations, except in the case of a few very small plants and battery-driven submarines, alternating-current sets are at present universal. Of course, the direct-current drive would be very much more preferable if the voltage could be made high enough so that generators, cables, motors and instruments could be made of small enough dimensions to make the outfit a commercial proposition, and the risks of flashing over at the commutator from some defect could be eliminated; also regulation of speed would be much facilitated and control gear simplified.

SPEED REGULATION.

Until this can be done, however, alternators—inherently high-speed machines and suitable for direct coupling to steam turbines—must be employed; and the problem of regulating the revolutions of the propelling motors, to suit the required ship's speed, must be accomplished by means of external resistance, special motor windings and alteration to frequency by cutting down steam supply to the turbines. A combination of the first and third methods is the one most usually employed, although the double squirrel-cage winding, as fitted in the "New Mexico," appears to have given satisfaction.

Fortunately, the efficiency curve of modern turbines is fairly flat for a considerable range of load, so that a moderate reduction of revolutions is not accompanied by a serious increase in fuel per unit generated. In mercantile vessels, moreover, as pointed out above, the greater portion of the running period is at full power, and the comparative loss of economy is not vital. In warships where economy at cruising speed is essential, it is usual to provide two alternative pole

windings on the motors, thereby altering the normal revolutions corresponding thereto, and leaving further regulation to be done by liquid resistances or alteration of voltage and of turbine speed. This is, of course, practically equivalent to fitting a two-speed gear. A further essential difference between land and marine turbines is the necessity in the latter case for being able to develop a high overload for short periods, this being required to provide means for quickly reversing the propellers to full astern with the ship going full ahead, and with the existing way tending to rotate the propellers in the ahead direction. This overload is most easily legislated for by increasing the field excitation by means of a booster; this overload state can be maintained without detriment, provided that it is not long continued. A very complete analysis of the conditions obtaining in the "New Mexico" was published in the "General Electric Review," Vol. XXII., April, 1919, to which

as some 5 to 6 per cent. of the total energy is dissipated as heat, it will be seen that means to deal adequately with this is of very great moment, particularly in closed machinery spaces.

In January of last year, Mr. J. Sheppard read a Paper before the Institution of Electrical Engineers*, suggesting development of turbo-alternators along water-cooled lines, instead of the customary air cooling. Whilst considerable criticism of detail was directed to these proposals, it is undoubtedly the method of attack of the problem which shows the greatest promise. It must be remembered that ventilation troubles are accentuated when the ship has to be battened down in rough weather. Moreover, the cooling air may be warm, moist and salt, none of which conditions are conducive to improvement of the windings. An alternative is to arrange a closed system, employing a substantially constant volume of air, this air being

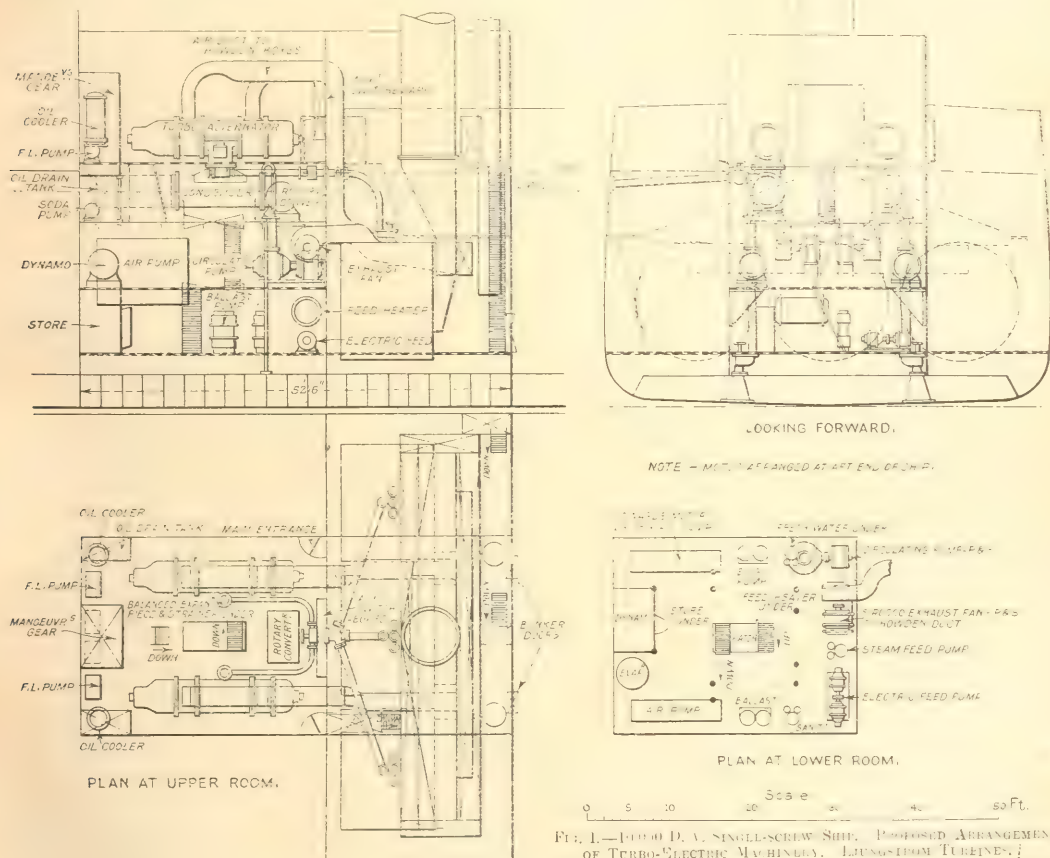


FIG. 1.—10000 D.V. SINGLE-SCREW SHIP. PROPOSED ARRANGEMENT OF TURBO-ELECTRIC MACHINERY. (LOOKING FROM TURBINE.)

those interested are referred, space not permitting more than a brief mention of this peculiarity of marine propulsion. It may be noted that this overload condition also occurs when helm is given to the vessel, it being, particularly in twin screw ships, necessary to apply a higher power to one shaft to maintain constant revolutions than when on a straight course.

THE COOLING QUESTION.

The question of cooling the generators and motors is one of the most important difficulties to be overcome, and it cannot be said that there is unanimity of opinion as to the best methods to be adopted. Obviously where space is of such enormous value, large air trunks are exceedingly difficult to arrange;

circulated through a heat interchanger, with sea water as the cooling medium.

This method is being adopted in some American vessels, but whilst better than straight air cooling, it is a cumbersome alternative to the direct water-cooling plan, which will carry all before it if constructional difficulties can be surmounted. Furthermore, if fresh water be employed for this purpose, the heat absorbed from the machines can in part be returned to the boilers; in other words, the generators function also as feed heaters. This method of cooling would also eliminate fire risk, as with the present system a flash over is fed by a

* See THE ELECTRICIAN, Vol. LXXXIV., p. 61.

PARTICULARS OF

Name of Ship.	Type.	Builders of Machinery.	Date.	S.H.P.	Speed	Full Power Propeller Revolutions.	Water Rate Propelling Machinery.	Steam Pressure.	Super-Heat
"JOSEPH MEDLEY" and "GRAMP STEWART"	Cargo	—	1908	—	—	—	—	—	—
"ELECTRIC AIR"	Experimental Launch	Mayo & Coulson	1911	25	8.3	400	—	—	—
"TANINGONG"	Cargo	Mayo & Coulson	1912	500	9	80	—	—	6 cylinder petrol engine 800 r.p.m. 6 cylinder Mirlees Diesel engines 400 r.p.m.
"JUPITER"	U.S. Collier	G.E.C.	1912	5 500	11	110	12	190	Nil.
"MOONER"	Cargo	Swedish Ljungstrom	1912	950	11.5	90	—	218	190
"WULSTY CASTLE"	Cargo	Brush Co.	1918	1 500	10.0	76	10.25	180	200
"NEW MEXICO"	U.S. Battleship	G.E.C.	1918	Normal 28 000 Max. 36 500	21 21.98	175	11.9 all purposes	250	50'
"CONSTITUTION" CLASS	U.S. Battle Cruiser	G.E.C. Westinghouse	1924	180 000	33½	331	—	—	—
"TENNESSEE"	U.S. Battleship	Westinghouse	1920	Normal 28 000 Max. 33 500	21	180	12.0	—	—
"AQUILA," & C.	Cargo	Swedish Ljungstrom	1918-19	1 200 (I.H.P.)	10½	70	9.4 all purposes	220	240'
"ECLIPSE"	Cargo	G.E.C.	1919	3 000	—	100	—	210	200'
"CUBA"	Passenger	G.E.C.	1920	3 000	17.28	100	—	190	200'
"INDIANA" CLASS	U.S. Battleship	G.E.C. Westinghouse	1924	60 000	23	223	—	265	50'
—	United Fruit Co.	B.T.H. & Workman Clark	—	3 000	—	—	—	—	—
—	White Star Liner	Harland & Wolff	—	4 000	—	—	—	—	—
"MARINER"	American Trawler	New London S. & E. Co.	1920	400	10½	200	—	—	2 8-cylinder 4 cycle, Diesel engines, 240 B.H.P. each, 350 r.p.m. eng. 9-in. bore and 12½-in. stroke 1 115-B.H.P. 6-cylinder Winton Diesel engine, 7½-in. bore & 11 stroke 425 r.p.m.
"ELFAY"	American Yacht	Winton Westinghouse	1920	90	8½	350	—	—	2 6-cylinder Winton Diesel 350 B.H.P. each, 225 r.p.m.
"GUINEVERE"	Ditto.	Ditto.	1921	550	11½	220	—	—	—
"INVINCIBLE"	Cargo	G.E.C.	1921	2 860	11	100	—	195	160'
"FORDONIAN"	Cargo	G.E.C.	1921	850	—	120	2 cycle Diesel engines	—	—

forced draft of cooling air and special precautions must be taken to cut this off immediately, in the event of such a contingency. The practice in some cases is to lead the heated air through ducts to the boiler furnaces, but this is only possible in relatively small installations, and only in such are the additional complication and air trunking warranted by the accruing gain in economy.

ROBUSTNESS AN ESSENTIAL.

It is, of course, vital that the machines, both generators and motors, be of an extremely robust character, in that they must withstand abuse from warm salt air, moisture, possibly coal dust, and operators only partially trained in electrical work, and not cognisant of its peculiarities. The machines must have their parts accessible, and yet be free from displacements by short circuits, readily capable of being dismantled for repair and built to standard as far as possible, so that renewal of parts does not require lifting the whole outfit from the ship and returning to the factory.

One aspect of the electric drive which is apt to be overlooked in making comparisons with other systems, is the ability to utilise otherwise unoccupied spaces by suitably laying out the

plant. Particularly is this the case with large open hatchways, usually more or less vacant. The turbo-alternators can in some cases be readily arranged in these hatchways with their condensers below, more or less on the lines of a power station, and, with the auxiliary plant situated in the normal engine room and the propelling motors aft in a space of little value, so far as cargo or other stowage is concerned, a very compact yet accessible scheme can be devised. A design for a 3 000-s.h.p. 10 000 ton deadweight ship is shown in accompanying illustration embodying this principle, from which it will be seen that practically no space is utilised. Incidentally the ventilation of the generators is facilitated. A further saving could be made were one generating unit only adopted; in this drawing two 1 500-kW Ljungström machines are shown. In these early days two generators are strongly to be preferred, since if one fails the vessel can still make a port, and, although the failure were due to a minor defect, yet it is difficult to dislodge a bad impression once formed, and the average shipowner does not discriminate. The first modern ship in this country suffered from some minor troubles, totally unconnected with the electrical propulsion system, with the result that the ship

ELECTRICALLY PROPELLED SHIPS.

No. of Generators and Type.	No. of Motors and Type.	Voltage and Period.	Fuel Consumption.	Current to Auxiliary Machinery.	No. of Shafts	Weight of Propelling Machinery.	Remarks.
2 D.C.	2 D.C.	—	—	D.C.	2	—	—
1 3-phase double wound	1 3-phase 4 and 6 poles	20 & 30	—	—	1	—	Double windings on generator to give frequency of 20 and 30 periods.
2 3-phase 235 kW	30 & 40 pole	500 20 & 26.6	—	Steam	1	—	Double windings on motor, generators wound for different frequencies.
1 3-phase Bipolar	2 3-6 pole direct coupled	2 200	—	Steam	2	156	—
2 3-phase 400 kW	2 induction geared	500 120	—	A.C. 500 V	1	55	—
2 3-phase 625 kW	2 induction geared	650 60	coal 1-05	A.C. 650 V	1	179	—
2 2-phase bipolar	squirrel cage 4 24 & 36 pole windings direct coupled	42.42 & 35.5 3000	oil 0.98 f.p. 1.07 at 17 knots	D.C.	4	590	Curtis turbines 1 2-stage and 9 single-stage wheels. Motors 12 ft. 6 in. diameter and 11 ft. long. Reversal 7.9 secs. Speeds up to 17 knots on one generator only.
4 3-phase 40 000 kVA 1835 r.p.m.	8 2 per shaft 23 000 s.h.p. 22 poles	5000	—	Electric D.C.	4	Electric 1800 total 6172	16 boilers, 198 000 sq. ft. H.S., 18 000 sq. ft. superheater.
2 3-phase bipolar	4 24 & 36 pole windings direct coupled	36.5 37.9	—	D.C. 240 V	4	—	Westinghouse impulse and reaction turbines. Change over speed 1 500 revs. per min. from 24 pole to 36 pole. 15 knots, 2 270 revs. per min. 36 poles, 10-15 knots, 1 generator, 36 poles, 15-17 1 generator, 24 poles, 17-21 knots, both generators, each supplying on 2 motors P. and S. independent, 123 revs. per min. Propellers=15 knots.
2 Ljungstrom 5400 r.p.m.	2 3-phase geared	450 -90	coal 1-08	A.C. 450	1	—	1 Curtis turbo-generator, 3 000 revs. per min. Motor, slip-ring type. 2 35-kW exciters, 125 V.
1 3-phase bipolar 2300 kW	1 3-phase 60 pole direct coupled	2300 50	—	steam	1	—	1 Curtis turbo-generator, 3 000 revs. per min. 2 auxiliary generators, 150 kW, 250 V.
1 3-phase 2350 kW 3000 r.p.m.	1 3-phase direct coupled	1100 50	—	D.C. 250 V and steam	1	—	1 Curtis turbo-generator, 3 000 revs. per min. 2 auxiliary generators, 150 kW, 250 V.
2 2-phase 28 000 kVA 1 800 r.p.m.	4 15 000 s.h.p. 16 poles	5000	—	D.C. 8 500 kW 240 V	4	2778	Motors 3 600 B.H.P. each, 24 poles, 150 revs. per min.
1	1 direct coupled	—	—	—	1	—	Electrical gear by B. T.-H. Co.
—	—	—	—	—	2	—	Ljungstrom generators.
D.C. 165 kW 125 V	1 direct coupled 400 B.H.P.	125	30 gall. per hour	D.C. 1-10 kW generator oil driven 125 V	1	—	—
D.C. 75 kW Westingh'se 125 V	1 direct coupled	125	7½ gall. per hour	D.C. 125 V	1	—	—
2 225-kW Westingh'se 125 V	1 direct coupled	250	—	D.C.	1	—	—
1 A.C. 3 000 r.p.m. 2 300 kW 2 240 kW D.C. 250 V	1 direct coupled 3 000 h.p. 1 direct coupled	2300 50 250	—	—	1	—	—

was condemned in some quarters as a failure, whereas she has made several regular successful voyages without a hitch, and with excellent fuel economy. She is now amongst hundreds of others awaiting cargo due to the slump in trade. It is true that certain items would be arranged to better advantage in a replace ship, but the same could be said of any pioneer design, and the alterations would not be of a fundamental character so far as the main propelling units are concerned.

THE CASE FOR DIESEL ELECTRIC PROPULSION.

The case for Diesel electric propulsion may be briefly referred to. It is undoubtedly attractive at first glance as a consumption of half-a-pound of fuel oil per brake-horse-power cannot be approached by steam. The maximum power at present available and the speed of revolution permissible of Diesel engines limits this equipment to small vessels, unless a large number of independent units is provided; 500 revs. per min., the highest figure yet attained in comparatively high-power engines, is more suitable for direct-current generation so that, in this respect, direct-current generators and Diesel engines approach (when directly coupled together) their maximum speed and power together. It is doubtful if such engines will prove

to be sufficiently reliable at sea. Fast running engines of this type in submarines require much tuning up and nursing, and if the revolutions are cut down to improve the running characteristics of the Diesel engine, then the only inducements for insertion of electrical transmission and not coupling direct to the propeller shaft are the abolition of reversing and manœuvring troubles, and the ability to install more generating units than there are propeller shafts. It will be seen that the Diesel electric drive has not the attraction of the turbo-electric drive where both turbine and alternator are high-speed machines, and the former can only be favourably considered for small vessels such as yachts, trawlers and special craft. The second phase of the subject, i.e., the auxiliary machinery is quite as important as the main drive, but has scarcely received in the past the amount of attention which it deserves.

THE TYPE OF CURRENT.

The chief problems involved are the determination of the type of current to be employed in this subsidiary plant, and also the source of supply thereof.

These questions should be decided for individual ships, as there are some cases—e.g., tank steamers—where there are

factors which limit the choice of type. In this instance, where petrol or other inflammable liquid is carried in bulk, sparking at the commutator of a direct-current machine might have dangerous possibilities, and alternating-current motors are in such cases preferred in spite of certain disabilities. Totally-enclosed pipe-ventilated direct-current motors would overcome this difficulty. Where no such restriction occurs the balance of favour for marine purposes lies with direct-current machines, except, perhaps, for large constant speed motors, such as are required by refrigerating machines.

The various units absorbing power are, for the most part, of small or moderate rating, 5 to 50 B.H.P. covering probably 95 per cent. of the sizes for all vessels. It may be conceded that special attention must be given to keep the commutators and brush gear in an efficient condition, yet the advantages of greater flexibility, ease of replacement from stock, and ability to utilise shore current (almost invariably direct current) direct, outweigh the cost of extra care and maintenance.

Moreover, if designed—as it is strongly insisted that they should be—for standard voltages, lamps, starters, instruments, &c., can be obtained in almost any port, whereas special fittings to suit alternating current, of an odd frequency, must be specially made, if repairs or replacements are required.

DIRECT CURRENT SUPPLY NECESSARY.

A supply of direct current, must, in any case, be provided for field excitation of the main propelling generators, and it is undoubtedly preferable to fit a small direct current turbine driven set, exhausting to a feed heater, for this and auxiliary purposes. Where this is not installed and the auxiliaries derive their power from the main generators direct, these generators carrying a self-contained exciting unit, it is necessary to start up on the atmosphere, no current being available for the air and circulating pumps to produce a vacuum. This has been the arrangement in certain ships, but is most undesirable. Independent auxiliary sets are therefore to be preferred, except, perhaps, for very small units, where it would pay to run a main generator in harbour for winches, lights, &c. In this case a small direct-current machine, driven by an alternating-current electric motor, or, alternatively, by a small steam engine, or an internal combustion driven set, can be conveniently used, the former being employed at sea and the latter in harbour. Of course, unless the voltage is low, transformers must be employed to step down the voltage to a suitable figure for small alternating-current motors, which even then are not easy to build and maintain in good condition with polyphase current. If it be decided to take the supply from the main generators, then static transformers and/or rotary converters meet the case.

THE USE OF MERCURY RECTIFIERS.

In this connection the possibility of employing mercury arc rectifiers appears to have some advantages, but, as far as at present known, these have not been used in sea-going plants. Considering every phase of the question the simplest and best arrangement, though not the cheapest is undoubtedly the provision of separately driven direct-current auxiliary sets, preferably generating at 440 V and distributing current at that voltage to large motors and at 220 V to small motors and lights through a three-wire system.

OPERATING VOLTAGES.

There has been a gradual growth, as in land work, of the voltage of the transmission line, but the distance over which this has to be passed being very small, never exceeding 500 ft., no step-up and down transformers are justified. The operating pressure is therefore determined by the highest which the motor can commercially take, subject always to the requirements of safety and reliability. It is essential continually to bear in mind that a ship's resources are strictly limited, and there are no repair shops in mid-ocean. The latest vessels show a figure of 5000 V for this transmission, but there seems to be no valid reason why the standard 6600 V should not be adopted, insulation being as vital in one case as the other, and almost as readily secured. The reduction in cost of the transmitting

cables would more than compensate for the increased insulation necessary. The controlling consideration should, however, be the figure most suitable for a robust and efficient arrangement of the motor and generator windings, and the limitations imposed by the switch and control gear. The question of voltage for auxiliary circuits has already been touched upon. Finally, the whole equipment, particularly the control gear, cables and instruments must be arranged to be accessible and at the same time out of reach of unauthorised tampering with; care must be taken to keep out moist salt air and coal dust; adequate means must be provided for frequent inspection, and simplicity, "fool proofness" and reliability are absolute essentials. The main motors and any auxiliary pumps, where placed aft in a separate compartment, should be arranged to be controlled locally, and also at the starting platforms, suitable indicators being fitted to show the engineer on watch whether or not such motors are running.

PARALLELING PROBLEMS.

There are, of course, many other problems in the successful design and operation of electrically propelled ships, for instance, the paralleling of alternators if two or more are fitted, the automatic control if one machine loses its vacuum by any chance and thereby gets out of step, the necessity of arranging that alteration of the direct-current supply voltage for excitation does not affect the running of auxiliaries coupled to the same source, but space does not permit entering into a large amount of detail.

The leading features of the subject have only been sketched, and a broad survey of the technical problems which have been surmounted and those which lie ahead has been attempted in this short article. Probably enough has been said to show that the work of pioneers in this field has not been an easy one, but that it has borne fruit will be gathered from the attached table, which should convince that technical and commercial success has been attained, and it cannot be doubted that this method of ship propulsion gives every promise of great extension in the better times of trade revival which all look forward to with such high anticipation.

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Design and Manufacture of Electrical Auxiliary Machinery for Ships.

By S. E. GLENNING, M.I.E.E.

It is not necessary to start by apologising for the presence of electrical machinery on shipboard. The courage and confidence of the pioneers of thirty years or so ago have been amply justified by experience, and there are few auxiliary services for which the shipbuilder now considers any method of power transmission but the electrical. It speaks well for the convenience and reliability of electrical apparatus that both shipbuilders and sailors have, in so comparatively short a time, come to regard its use as a matter of course.

In this article it is intended to express the designer's point of view for the benefit of the user, and to help the marine engineer interested in electrotechnical matters to appreciate what is done to meet his special requirements. It is by understanding the difficulties that have been foreseen (or stumbled against) in the past that the highest degree of reliability can be maintained in the future—so if undue stress seems to be laid on possible faults, this must be regarded only as a warning against "cheap" and unsuitably designed apparatus.

SYSTEMS OF SUPPLY.

Direct current supply at 220 V so far holds the field that it can be regarded as almost standard practice at the present time, and most of the notes following apply mainly to this system.

From the designer's point of view the chief advantages of direct current over an alternating current system are the great flexibility with which the d.c. motor can be adapted to the special requirements on shipboard and the ease with which it can be controlled by relay contactors. The latter are worked by solenoids or magnets for which direct current has obvious advantages, the alternating magnet being both cumbersome and inefficient. In alternating circuits, too, the lead and return currents must be exactly balanced in concentric cable to prevent outside disturbance in neighbouring ironwork, and this seriously cramps the designer in his lay-out of both the main and operating circuits.

THE VOLTAGE QUESTION.

Considering now the various voltages of direct current in use—100 V, once the usual standard, is still retained by some shipping lines, while 440 is being tried out on others. As regards the electrical design of motors and dynamos, 220 V has the advantage, as good windings can be got out for the whole range of outputs usually required, *i.e.*, from 1 to 100 h.p. and from 50 to 200 kW at the usual speeds for direct motor drives and reciprocating engines. Below 220 V the larger units present difficulties, as it is not easy to get a winding which has enough commutator segments, and the commutators are too long to be good practice, either electrically or mechanically. Also a modern machine with carbon brushes is not so efficient at 100 V as at 220 V. Above 220 V, small motors become less reliable, on account of the fine gauge wires used (which in case of corrosion will give out sooner than thicker wires) and also on account of the difficulty of finding space for the insulation, more particularly in the slots, crowded as they must be with small conductors.

The actual thickness of insulation used does not, in modern practice, vary much with the voltage between 100 V and 440 V, but surface leakage when the air is damp and salt-laden, is much more serious at the latter pressure, and often necessitates special methods of insulating that are not wanted at 220 V.

FLASH-OVER AND SHOCK.

Flash-over between brushes of opposite polarity under adverse commutating conditions is unknown at 100 V, very rare at 220 V, but has to be considered seriously at 440 V. In small motors, where the brush-lines are generally only a

few inches apart, a flash-over may be started by sparking, if the commutator and brush-gear have been allowed to get into bad condition. Of course this ought not to happen, but if it should, one does not want more serious trouble to occur before there is time to rectify the smaller fault. The risk of flash-over also limits the tricks the designer can play with the commutation of variable-speed motors, or motors subjected to sudden heavy overloads such as winch equipments. As regards risk of shock, a 440 V system with a middle-wire "earth" should normally give 220 V only above or below earth, but most men who have to work on steel decks in boots wet with salt water would probably have more confidence in a system which has no more than 220 V at disposal.

So far, it looks as if the balance of argument was in favour of 100 V as against 440 V, but when one considers the size of the cables required for, say, a 50-h.p. motor at 100 V, the massive terminals necessary, and the abnormal length of commutator already referred to, it will be seen that there are strong arguments for the present usual voltage of 220 V.

GENERAL CONSIDERATIONS OF DESIGN.

More thought and care have to be devoted to the insulation of motors and switchgear for marine work than to any other feature of their design and construction, as is only natural when one considers the conditions under which they have to work, in salt-laden air, in extremes of heat and cold, and often in very inaccessible positions. Of course, electrical gear built for ship or dockyard work is quite suitable for ordinary commercial purposes (except that it is not "cheap"), but it by no means follows that machines that have quite a good name in factory or workshop will be any use at sea—and the same applies even more strongly to switchgear.

In the first place, it is fatal to use any hygroscopic material, even where the insulation is not supposed to depend on it. Sheet mica and micanite are the materials on which ultimate reliance must be placed, though some non-hygroscopic materials like "Leatheroid," may be used in conjunction with them for mechanical protection. This limitation affects the design considerably.

In motors, especially small machines of 2 h.p. or 3 h.p. and under, a relatively large proportion of room in the slots has to be reserved for insulation, and the space available for copper on the field coils is similarly restricted. In no case should there be less than one thickness (unbroken) of 5 to 10 mil micanite between live parts and earth, or between live parts at any considerable voltage difference.

The mounting of brush-gear and the arrangement of terminals is largely influenced by the necessity for clamped mica insulation, all bushed holes, washers and little bits of insulation being eliminated.

The design of switchgear, too, is fundamentally influenced by the type of insulation employed. For naval work no slate or similar material is used at all, and though some shipping lines retain slate for the main switchboards, &c., most of the control gear is insulated entirely with sheet micanite moulded over bar iron supports on which the live parts are clamped.

VENTILATION AND TEMPERATURE RATING.

Where a motor has to be placed in an exposed position on deck, a totally-enclosed machine must be used, but for all ordinary purposes a semi-enclosed and preferably drip-proof design is best. The internal condensation in a totally-enclosed motor under varying temperature conditions is often serious, and there is less trouble with insulation on ventilated machines even in a damp climate, provided they do not catch direct spray and are protected from drips of condensed moisture from the deckbeams above. The latter may be effected

either by designing the frame of the machine with hoods over the openings, or (as is usual with open-type generators) by fixing a curved sheet-metal canopy on the top of the magnet frame or to the underside of the deck above. Very strong fans for aiding ventilation are undesirable, as they may make a draught strong enough to suck in spray.

Ratings must be conservative, on account of the tropical heat to which most vessels are subjected at some time or other. A temperature rise of 81°F. is generally allowed at the end of a continuous run the length of which depends on the duty of the machine. For a machine which will be running on ordinary work continuously a test of 6 hours is generally near enough to the truth, though generators of the sizes used on shipboard and the larger motors will take longer, and the small motors less time, to reach their maximum temperature. For intermittently loaded motors, such as reversing motors for winches, a short, continuous run is specified which is roughly equivalent to an all-day run at the normal intermittency, taking into account not only the time running but also the load, which is generally light on alternate motions. A half-hour run at full load usually covers the heaviest duty for a reversing motor, though for motors of exceptionally heavy intermittency an hour's run is sometimes specified. For very intermittent work a quarter-hour run is a good enough equivalent, provided the motors are suitably designed as regards commutation and distribution of internal heat losses.

Special ratings for motors exposed to the direct rays of the tropical sun and to boiler-room temperatures, are referred to below.

MECHANICAL DESIGN.

Owing largely to the desirability of saving weight, especially on the upper decks, motors are often designed for a heavier output from a given carcass than would be usual or economical for motors "sold over the counter" for ordinary shore work. This may be effected by crowding on the copper, or by the use of over-run windings protected by the method of control. In either case this means that the shafts and bearings must be relatively large, corresponding roughly to the sizes usual in the next larger carcass. If oil-ring bearings are used—as has been usual till recent years—it is important that the covers should fit well so as to keep out splashing water, though easy access for oiling must be provided through a screw plug or otherwise. Allowance must be made for pitching, both in the design of oil wells and the provision of end-thrusts. Rolling need not be taken into account, as motors are not generally placed with their axes athwart-ship.

Ball bearings, long regarded with suspicion, are now being more used, and the manufacture is now so perfect that (if they can be kept from rusting) they run silently enough even for fan and lift motors where the trunks magnify and convey every small noise given out by the motor. With a well-designed housing there is no chance of spray working in, and it is only necessary to see that the interior is well filled up with grease and that no drops of salt water are accidentally introduced with fresh grease when filling up the Stauffer lubricator cups. Mechanically, they are reliable, and need very little attention. Their use enables the designer to shorten up a motor in an axial direction by several inches—often a consideration in cramped positions.

DESIGN OF GENERATING PLANT

The outputs generally required from generators (50 kW to 200 kW) are convenient from a designer's point of view for 220V direct-current windings at the speeds usually given by the makers of reciprocating engines. At the speeds necessary for direct coupling to steam turbines the electrical design at this voltage is not so favourable, and (in the larger sizes at any rate) a higher voltage would give a more suitable number of commutator segments and core slots. It is very doubtful if a ship is the right place anyway for a turbo-generator, but if it is decided to go in for such sets the speed should be kept as low as is consistent with reasonable economy at the steam end. It is worth taking a lot of trouble to keep below the critical speed, which causes more anxiety on shipboard than on shore

where the foundations are generally heavier and less resilient. This necessitates an expensive shaft of large diameter, and also in consequence of the size of the shaft the commutator has to be of rather large diameter and heavy construction. Still it is worth some expense to keep below the critical speed, as there is then no risk of the rotor straining itself and throwing out of balance.

Whether Diesel or steam reciprocating engines or steam turbines are used, the parallel running of the sets is of first importance. This depends chiefly on the regularity of the turning moment and the stability of the governing. The governor must be sensitive to small changes, but not inclined to hunt. There seems no advantage in the very close governing that some engine makers are able to get on their test-plate, and a speed drop of 3 per cent. or so from no load to full load is better, from an electrical point of view, than 1½ per cent.

Given the best that the engine maker can do, it remains for the electrical designer to see that his machines are stable in voltage (*i.e.*, that they are working beyond the bend in the magnetisation curve and not on the straight). Interpoles should not be allowed to influence the design too much, as they tend to make the voltage highest at half load if they are unduly strong, and generally affect adversely the paralleling qualities of the sets. The same requirements apply to shore jobs, but on a ship the loads are very fluctuating, and the services to be maintained are vital to the safety of the vessel, so that a sound and well-designed generating plant is of prime importance.

ENGINE AND BOILER-ROOM AUXILIARIES.

Motors running in the comparatively cool engine-room of a Diesel-driven vessel call for no special comment, except that a compact arrangement, often combined with starter or controller, is required. On a steam vessel, however, motors intended for very hot situations should be specially rated so as to keep the total temperature (atmosphere plus rise) down to a figure at which insulation will not char—generally about 200°F. It is not enough simply to reduce the load on a standard-wound motor, an expedient that would reduce the armature copper losses but leave the iron and excitation losses as an undue proportion of the whole. A small increase in the number of turns on the armature, and consequent decrease of magnetic field, will improve the distribution of the losses, and it may also be advisable to effect a further reduction of iron losses by the use of armature plates of special steel, of low hysteresis and eddy losses. In any case the reduction of the magnetic field must not be carried so far as to endanger the commutation, even at the reduced horse-power at which the motor will be rated.

FAN REQUIREMENTS.

In a passenger ship a certain number of ventilating fans are generally placed in exposed positions where they get the full heat of a tropical sun, and in such cases the same remarks, as regards rating, apply as in the instances referred to above, *i.e.*, the motors should not be lightly loaded only, but should be specially got out for a uniformly low temperature rise.

Most of the centrifugal ventilating fans are placed rather high up in the ship's structure, and as there may be 40 or more in a liner, it is important that the design should be as light as possible, consistent with economical speed control. A variable speed motor is necessarily larger than a constant speed motor for the same top output, but in driving a fan the field windings can be over-run somewhat to get the slowest speeds, as the armature is then taking such a small current that the machine does not overheat as a whole.

A centrifugal fan has a rapidly rising speed-load curve, and also takes an increased load as the outlet is opened more freely. It is best served by a series-wound motor, which will slow down a little and prevent overload if the fan outlet is opened rather more widely than usual. Speed control is obtained by using a series field winding of many turns of fine wire, and either diverting it, or regrouping the coils in series-parallel, or cutting out sections, to get the higher speeds—or by a combination of these methods. Coils which

are intended for cutting out in sections are wound with different gauges of wire, the sections used only for the slowest speeds being finer and of more turns than the sections left in at the top speed.

If the speed range is large, it would mean too big a motor to do it all on field control, and it is usual to get the lowest speed by a resistance in the controller, which does not waste much, as the total power then taken is so small.

Fans must be silent, and attention must be paid in the design to the number of slots (which must not be too few), to the shape of the pole-tips, the tightness of the laminated core and pole caps, as well as to the mechanical details of bearings and brush gear.

STEERING GEAR.

Every system of steering gear has its own virtues and defects, and as the defects of steam gear are familiar to the nautical man, and those of electrical systems are still something of a mystery to him, he shows a preference for the former. Sailors of the younger generation are, however, much more familiar with electrical engineering than are those brought up in "stick and string" traditions, and as time goes on electrical systems will no doubt be judged on their merits. Meanwhile much pioneer work has been done, both in purely electrical and electrically-driven hydraulic control, and more gears are in use than many people realise. A consideration of the design of these apparatus is really a subject in itself, but the general ideas to be borne in mind, in order of importance, are—reliability, suitability of the system for distant control, economy of running and upkeep, and simplicity.

WINCHES.

Electrically-driven deck winches form a very large part of the auxiliary equipment of a modern ship. This is particularly the case in the large Diesel cargo vessels which, with their 10 or 12 cargo winches, are quite independent of wharf cranes, and can in fact discharge their own cargo or load up from lighters at anchor.

In some instances a continuous running motor is used driving through clutches two or more drums, but when the control gear is designed in conjunction with the motor a separate motor for each winch with a reversing controller is the most efficient and handiest arrangement. Heavy series field windings are in circuit on the first steps of the controller, so as to get full torque economically at slow speeds on the rope, and these field windings are diverted on the later steps to get top speed. In this connection the Scott-Bentley load discriminator is a device for permitting more diversion and therefore higher speeds on light loads than can be allowed on heavy loads. This means that movements with loads up to about half load are automatically carried out faster than they would be if one relied only on the natural speed-load curve of a series motor and the general speed of operation of the winch is considerably increased.

It should be borne in mind that coolies and other unskilled labourers who generally work cargo winches are very fond of using the foot brake for all purposes, and this should be interlocked electrically with the controller so no harm can be done. When a relay controller is used, as is customary for large winches, it can be arranged so that the motor starts up again as soon as the foot brake is released, so that all the stopping and restarting generally necessary during a lift out of the hold can be done on the foot brake only.

WINDLASSES AND CAPSTANS.

Warping and anchor gear is generally worked by more skilled labour, but otherwise the same remarks apply as to deck winches. A steady pull may be wanted for quite long periods when warping, so it is important to design the motor with plenty of field range, so as to get steady control and reduce rheostatic loss. When housing an anchor a slow, steady motion is wanted as the hause-pipe is nearly reached, and the resistance inserted by the controller on this step must be such that the anchor can be brought right home without shock or strain on the cable.

GENERAL NOTES ON MANUFACTURE OR REPAIR.

As regards insulation nothing should be sent on to a ship that will not stand 2 000 V alternating. This is a more important test than that with the Megger, though a low reading on the latter is often a warning, that should not be disregarded, of internal dampness. In manufacture, and when possible in repair, all windings must be impregnated by the vacuum process and well stoved, and finally varnished hot to protect them externally from oil and damp. If coils under repair are treated with insulating enamel on internal layers, it should be well dried out as the work progresses, so as to avoid enclosing moisture.

Most faults in armatures occur at the top of the slot unless the insulation is carefully folded over and kept down with a wood or fibre slat. If the wooden slat is arranged as a wedge, so that wire binders can be dispensed with on the core, it is worth a little additional time and trouble in the winding shop.

Sheet micanite used for clamped insulation on switchgear, &c., must be moulded into shape in hot formers, so as to avoid cracking at the corners. The ends must project not less than $\frac{3}{8}$ in. beyond live metal, to give an adequate leakage path.

It is more important to get exact balance of rotating parts for marine work than for corresponding shore jobs. Balance of armatures should be carefully checked at each stage of manufacture, and finally adjusted when the windings are completed.

PREVENTION OF CORROSION.

A great deal of attention must be paid in the shops to painting and enamelling the interior of the magnet frame, the empty slots, and all other parts of a motor that cannot be got at afterward.

Aluminium must not be used at all, on account of the effect salt water has on it. Gunmetal and brass are best for fittings that have to unscrew or come adrift, but on ships where coolies are employed it does not do to have any loose parts of these materials. The difficulty can often be got over by fitting steel nuts to gunmetal studs, and bushing the holes in iron covers with thin brass liners, the whole being painted to look like iron.

CARE AND MAINTENANCE.

The best design and manufacture avail nothing if the gear is treated unsympathetically in use. A steam plant is not expected to run without the occasional tightening of a gland, nor (to go further back) an old "wind-jammer" to sail without ever a rope-end being whipped—and electrical gear is not meant to be boxed up and never looked at till actual trouble is evident. The ideal electrician is one who rectifies trouble before it occurs, just as a good mechanic on a steam engine will tell (by sound, sight or instinct) just when a bearing is going to run hot. Fortunately most shipping lines, are realising that the electrician is not a man who puts up bells that won't work, but a very specialised engineer, and the improvement in his status is a great assistance to the electrical manufacturer.

The "Tennessee's" Generators.

According to the "Electric Journal," there are two generators on the "Tennessee," each having a nominal rating of 13 250 kVA, three-phase, 34.6 cycles, 3 270 V at 83.4 per cent. power factor, and 2 maximum rating of 14 850 kVA, three phase, at 2 195 revs. per min. The generators are arranged to drive two motors each over a speed range of 1 548 to 2 195 revs. per min., corresponding to a variation in ship speed from 16.1 to 21.8 knots. One generator will handle four motors between 15 and 16.1 knots, with a change in speed varying between 1 435 and 1 548 revs. per min., the motors being operated with 24 poles. For lower speeds of the ship between 10 and 15 knots, one generator handles four motors, operating with 36-pole connection. The speed range of the generator under this condition is between the limits of 1 430 and 2 175 revs. per min.

Systems of Direction Finding by Wireless.

By J. J. BENNETT.

METHODS of using wireless telegraphy for direction-finding purposes have been devised for both shipping and aircraft, as the outcome of much experimenting, and are now being generally employed. The subject is an extremely interesting one, and it would be impossible to deal with all phases of it in the limits of a short article. We will, therefore, confine ourselves to describing briefly some of the ways in which it is applied to the assistance of vessels at sea. A ship either in open water or when approaching port in thick weather can now obtain bearings by means of direction-finding wireless, and thus make sure that she is in a safe position, or the opposite, and whether she is shaping a right course or a wrong one. The value of such guidance is so obvious that it needs no emphasising. It goes far towards eliminating risk, and it also prevents a ship from having to hang about in foggy weather until she can ascertain her position definitely enough to proceed on her voyage.

THE NECESSARY APPARATUS.

In order that a ship may be able to avail herself of any direction-finding system it is necessary that she should be fitted with wireless telegraphy, or with special direction-finding

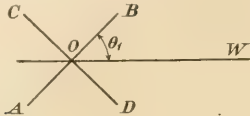


FIG. 1.

apparatus, such as that of the Marconi Bellini-Tosi type, so that she is able to call up the stations ashore and ask her whereabouts. A ship possessing a wireless telegraphy installation alone can only obtain the information she needs from a shore station that is equipped with a direction-finding plant as well as a wireless transmitting installation. The usual practice is to group stations together for this work, one of them acting as the controlling unit. Stations may, however, be self-contained. In this case the station gives the ship her bearing and position, too, if required. But there is a risk of "jamming" if more than one ship is asking for information at the same time. When a ship carries direction-finding apparatus she is responsible for using the information obtained from the station to fix her own bearing and position, and no "jamming" arises if

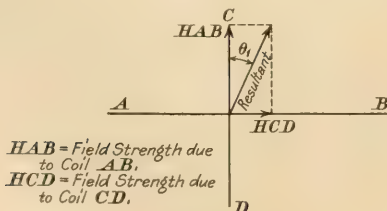


FIG. 2.

more than one ship is "speaking" the station at the same time. By another method the shore station rotates a directional wireless beam, which has a sharply defined zero passing through north and south at a given time. A watch, the face of which is marked in degrees, is used on the ship's bridge for timing the passage of the beam, and in this way the bearing of the station is determined, the ship being responsible for fixing it correctly. A specially constructed station is required by this system, and the ship using it must likewise carry special charts and tables of correction, as the bearings obtained are the great circle bearings of the station ashore. If due care be observed in maintaining the apparatus and the operators at the stations are practised in the work, errors in wireless

direction finding are negligible when bearings are obtained by day. At night the liability of error is greater, but over short distances even night bearings obtained by direction-finding wireless are approximately accurate.

In equipping a ship for using wireless direction finding two aerials crossed mutually at right angles is the commonest form of loop aerial now used in direction finding. By way of explaining the theory of this arrangement let us consider *AOB* and *COD*, Fig. 1, to be the plan view of two such aerials, and assume that they are receiving from the direction *OW*, making an angle θ with aerial *AOB*. If the lengths of the receiving aerials are small compared with their distance from the transmitting station it may be assumed that the waves pass the aerial without any diminution of intensity; also, that they are proceeding parallel to themselves. Take the

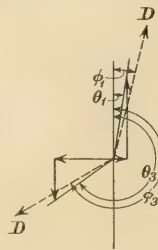


FIG. 3.

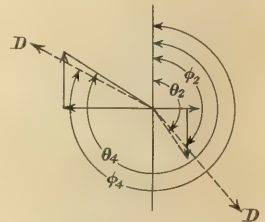


FIG. 4.

point *O* in the figure on the path of the waves from *W*, which we will assume to be sinusoidal waves set up by continuous oscillations in the transmitting aerial. Let φ be the wave intensity, measured by one of the field strengths, either electrostatic or electro-magnetic. Then at *O* φ varies sinusoidally with time. At any instant φ also varies sinusoidally with distance from *O*. Measuring time from an instant at which φ is zero, the variation of φ at *O* is given by

$$\varphi = \Phi \sin p \cdot t,$$

where $p = 2\pi$ times the frequency and Φ is the maximum value of the wave intensity. At any point *Q*, distant *x* from *O*, φ will have a value different from its value at *O* at the same instant.

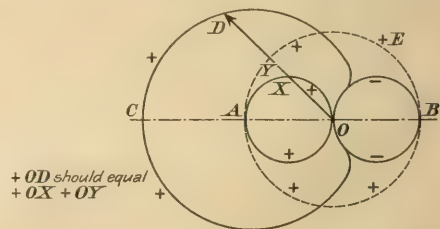


FIG. 5.

The state of the wave at *Q* at any instant will move along towards *O*, and after a certain interval of time will reach *O*. Where *U* is the velocity of the wave—that is the velocity of light—then the interval of time is x/u . Thus at *Q* the value of φ is always that which it has at *O* after an interval of x/u seconds,

$$\text{i.e., } \varphi = \Phi \sin p(t + x/u).$$

If at a distance *x* from *O* we have a vertical wire E.M.F.s will be induced in it which are directly proportional to the wave intensity; that is, $E = K\Phi \sin p(t + x/u)$, where *K* is some constant depending on the height of the wire. Applying this formula to the two vertical sides of the loop aerial *AB*, let *D* be the horizontal lengths of the aerials; then in aerial *AOB*:

the distance from O to the vertical sides measured along the direction in which the wave is progressing is $d/2 \cos \theta$. The E.M.F.s in the two vertical sides will, therefore, be found by putting $x = +d/2 \cos \theta$ and $x = -d/2 \cos \theta$ in the above equation. In all practical cases the total effective E.M.F. in the loop will be the difference of these two. (Where d is greater than a half wave-length and less than one wave the total E.M.F. would be the sum of these.)

$$EAB = K\Phi \left\{ \sin p \left(t + \frac{d \cos \theta}{2u} \right) - \sin p \left(t - \frac{d \cos \theta}{2u} \right) \right\}$$

$$= 2K\Phi \cos p \cdot t \sin \frac{pd \cos \theta}{2u}$$

Now $p = 2\pi \times \text{frequency} = \frac{2\pi}{\tau}$,

τ being the time for one complete cycle in the transmitting aerial.

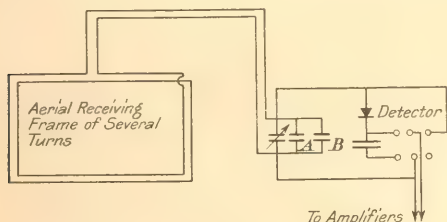


FIG. 6

Substituting this value for p

$$\sin \frac{pd \cos \theta}{2u} = \sin \frac{2\pi d \cos \theta}{2u\tau} = \sin \frac{\pi d \cos \theta}{\lambda}$$

λ being the wave-length.

The E.M.F. in aerial AB is therefore

$$EAB = 2K\Phi \cos p \cdot t \sin \frac{\pi d \cos \theta}{\lambda}$$

For aerial CD the values of x are $+d/2 \sin \theta$ and $-d/2 \sin \theta$. The effective E.M.F. is then

$$ECD = 2K\Phi \cos pt \sin \frac{\pi d \sin \theta}{\lambda}$$

If both aerial circuits are tuned exactly then these effective E.M.F.s produce currents which are limited by the resistance

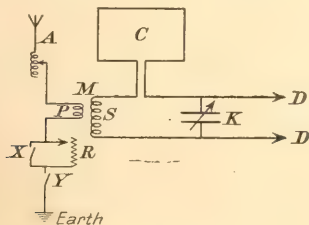


FIG. 7.

of the aerial circuits. Assuming the aerials AB and CD are identical the resistances will be the same and if R is this resistance the currents will be

$$CAB = \frac{2K\Phi}{R} \cos pt \sin \frac{\pi d \cos \theta}{\lambda}$$

and

$$CCD = \frac{2K\Phi}{R} \cos pt \sin \frac{\pi d \sin \theta}{\lambda}$$

Therefore, these are the currents in the two coils of the coupling transformer for tuned aerials. With untuned aerials the currents in them are of the form

$$\frac{Ka \sin \dots}{pL_a} \quad \text{and} \quad \frac{Kb \sin \dots}{pL_b}$$

and hence the resulting current is limited by inductance.

The magnetic fields they produce will be dependent on the size and number of turns in the coupling coils. The fields and the currents producing them will be related by some constant, K , which again is the same for each circuit. The two field strengths may, therefore, be written

$$H_{ab} = \frac{2KK_1\Phi}{R} \cos pt \sin \frac{\pi d \cos \theta}{\lambda}$$

and

$$H_{cd} = \frac{2KK_1\Phi}{R} \cos pt \sin \frac{\pi d \sin \theta}{\lambda}$$

These two fields being in phase, in time and at right angles in space will combine to give a resultant sinusoidal field. Let AOB , COD represent the centre lines, in plan, of the two

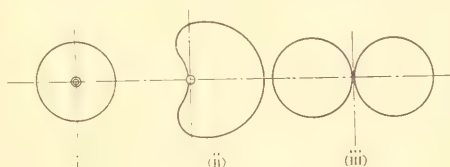


FIG. 8.

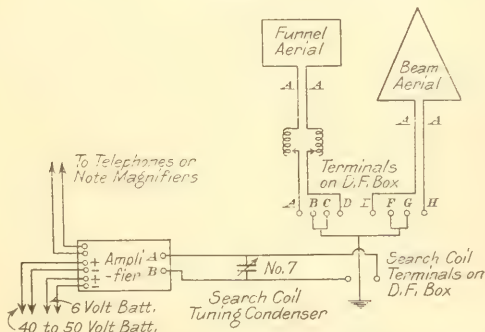


FIG. 9.—SIMPLE CIRCUIT FOR APERIODIC AERIAL AND SPARK RECEPTION.

direction-finder transformer coupling coils. Let θ be the direction of the resultant field, being measured from COD . θ' is then given by

$$\tan \theta' \frac{HCD}{HAB} = \frac{\sin \frac{\pi d \sin \theta}{\lambda}}{\sin \frac{\pi d \cos \theta}{\lambda}} \quad (\text{See Fig. 2.})$$

In the case in which the angles $\frac{\pi d \sin \theta}{\lambda}$ and $\frac{\pi d \cos \theta}{\lambda}$ are small, that is, when d , the horizontal dimension of the aerial loop, is small compared with λ

$$\sin \frac{\pi d \sin \theta}{\lambda} = \frac{\pi d \sin \theta}{\lambda}$$

and

$$\sin \frac{\pi d \cos \theta}{\lambda} = \frac{\pi d \cos \theta}{\lambda}$$

In this case, therefore, $\tan \theta' = \frac{\sin \theta}{\cos \theta} = \tan \theta$, so that a measure of θ' , the angle of the resultant magnetic field in the direction-finding transformer, is a direct measure of θ , the angle of incidence of the received wave. Exactly the same result is

obtained if the direction of the incident waves is reversed. Thus the direction, but not the sense, is determined.

Referring to Fig. 3, in the first quadrant of which θ is between 0 deg. and 90 deg., AB represents the magnetic component of the transformer coil excited by the fore and aft aerial of a ship, and OB the same component of the transformer coil excited by the beam aerial. If the two aeriels were equally receptive the angle θ would be exactly the angle of the station sending a bearing to the ship. As it is usually the fore and aft aerial that receives too strongly the component AB will be too large. From the diagram it will be seen that this causes θ_1 to be smaller than it should be, OD making angle φ with the fore and aft aerial being the true bearing.

In the third quadrant, θ_3 , is less than the true angle φ_3 , when the fore and aft component is too strong. In the second and fourth quadrants, Fig. 4, θ_2 and θ_4 are respectively greater than the correct bearings, and the fore and aft component is assumed to be too large. If a curve of errors is plotted, as Fig. 5, giving the addition to be made to a pointer reading to obtain the true bearing of a station, the graph will be of the type shown by the full line when the fore and aft aerial is too powerful and the dotted line indicates a beam aerial receiving too strongly.

Another system of direction finding is that which employs

a single coil aerial rotatable about a vertical axis. Here the coil receives signals at a maximum strength when its plane is turned so as to include the transmitting station. The coil will receive zero signals when turned, so that the line joining the sending station to the coil is normal to the plane of the coil. Consequently, there are two zeros and two maxima, each 180 deg. apart. Fig. 6 shows the diagram of connections to this apparatus. In Fig. 7 is shown diagrammatically the method on which this system is adapted for ship's use. A represents a plain aerial from any direction. C is the rotating direction-finding aerial coil. A is coupled through the mutual M of P and S to the direction-finder receiving circuits. The strength of signal induced at DD by A is adjusted by means of a resistance, R , and also by coupling, M . Switches x and y are the switches operated when listening in. The characteristics obtainable with (i.) the plain circle, (ii.) the cardioids or single zero characteristic, (iii.) the figure of 8 diagrams, are shown in Fig. 8. A great practical objection to any form of rotating aerial loop is that the inertia of the moving parts prevents the operator making rapid comparisons of equal signal strength on either side of zero, especially if the angle from R to R signals approaches 90 deg. or more. But the single coil system has the advantage that the aerial coil is in a tuned circuit, and is therefore a fairly sensitive receiver.

Balance of High-Speed Electric Dynamos and Motors.

By H. D. WHEELER, B.Sc.

THE purpose of the following article is to indicate briefly some of the main causes of vibration in turbo-generators and similar machines, and to give a general description of methods employed to overcome it.

It is one of the first essentials for the satisfactory running of high speed machines that the balance of rotating parts should be as accurate as possible. This applies particularly to machinery for use on ships, where massive concrete foundations are inadmissible, and the springy nature of the decks and framework may tend to increase rather than diminish any existing tendency to vibration. The armature of a turbo-generator as it leaves the shops should theoretically be in perfect balance, but owing to unavoidable irregularities in the castings and the unmechanical properties of the insulating materials used in its construction this is practically never the case; and its balance must be corrected by the addition of balance weights or by other suitable means. For this purpose it is usual to provide grooves in the shrink rings, or other convenient places, into which balance weights can easily be placed and secured in any desired position. It is essential that there should be at least two such balance grooves, preferably one near each end of the armature.

A DIFFICULT PROBLEM.

The problem of completely balancing an armature is not so straightforward as may appear at first sight. What is known as "static balance" may fairly easily be obtained by the familiar method of placing the armature on horizontal knife edges or anti-friction wheels, giving it a slight rotation and allowing it to settle. A lump of putty is then stuck on the uppermost side and a fresh trial made, the putty being changed in position or amount until the armature shows no tendency to settle in one position more than another. The putty is then weighed, and either holes of appropriate size are drilled out of the winding drums on the opposite side, or a permanent weight is substituted for the putty.

But this static balance is not in itself sufficient. An armature may show perfect balance on the knife edges and yet be badly out when running. Fig. 1 illustrates such a case, where the excess centrifugal forces of the two heavy parts exert a couple which would tend to make the axis of the shaft sweep

out some such path as indicated in Fig. 2. We see therefore that for perfect running balance not only must the centre of gravity of the armature be on the axis of the shaft, but also the resultant moment of all the centrifugal forces about any point in the shaft must be zero.

THE MARTIN METHOD.

Various methods for attaining this end are in use, most of which depend on the action of the centrifugal force of the unbalanced masses when the armature is rotated. Another method recently put forward by Mr. W. H. Martin* is similar to that already mentioned for obtaining static balance in that it depends upon the gravitational moments of the unbalanced masses about the axis of the shaft. Fig. 3 (which is purely diagrammatic) illustrates the principles of this apparatus. The armature is slung at one end in an universally jointed bearing and at the other end its shaft rests on the short arm of a steelyard balance. The principle of operation is as follows:—The armature is moved round a few degrees at a time and "weighed" in each position. These readings are plotted and give a curve from which may be deduced the amount and position of the effective unbalanced weight at this end of the armature. The latter is then turned round and the process repeated for the other end. These two results give the plane and magnitude of the unbalanced moment, and balance weights of appropriate amount are fitted to compensate for it.

CENTRIFUGAL FORCE METHODS.

Of those methods which depend on the action of the centrifugal forces of the unbalanced masses, the writer proposes to describe in some detail † one of which he has made regular use with satisfactory results. The complete apparatus is shown in Fig. 4. The armature is mounted in bearings resting on horizontal rollers and constrained to a central position by buffer springs. It is driven by a vertical belt round its periphery so arranged that its freedom to vibrate in the horizontal plane is unhampered.

When the armature is rotated, if it is out of balance, it will vibrate between the buffer springs. At certain speeds, which correspond to the natural periods of vibration of the system,

* "Engineering," Vol. CX, p. 864, Dec. 24.

† Vide "Engineering," January 15, 1915.

resonance will be set up and the oscillations will become very much more pronounced, rendering the task of determining what part of the armature is "throwing out" less difficult. The speeds at which resonance will occur depend on the mass distribution of the armature and the stiffness of the springs employed, and may be given any desired value by using springs of a suitable stiffness. In general, for any given armature and set of springs, there will be two distinct resonating speeds. At the lower speed the armature will vibrate bodily, keeping

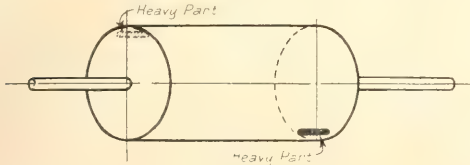


FIG. 1.

the axis of its shaft parallel to its original direction. At the higher speed the vibration will be in the form of an angular oscillation, the armature "see-sawing" in the horizontal plane. The former case indicates lack of static balance and only occurs when the armature has not been accurately balanced on the knife edges, but the latter may be due either to lack of static balance or to a centrifugal moment as indicated in Fig. 1 or to both of these causes.



FIG. 2.

THE WHEELER OPTICAL METHOD.

The problem of determining what part of the armature is "throwing out" may be tackled in several ways. The apparatus devised by the writer is shown in Fig. 4 and illustrated diagrammatically in Fig. 5.* An accurately balanced aluminium disc in which an involute slot has been cut is fixed to one end of the armature shaft. Behind this disc a straight filament lamp is placed and rays from this pass through the slot in the disc, and after being deflected from an oscillating mirror, are focussed as a bright spot on the ground glass screen

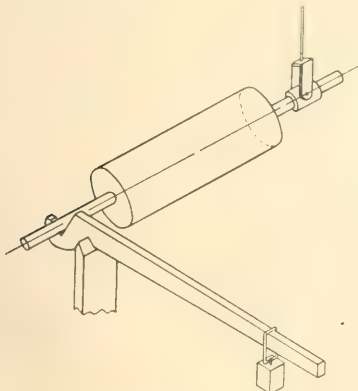


FIG. 3.

of a camera. The mirror is connected to one of the bearings of the armature by suitable linkage so that transverse movements of the bearing between the buffer springs cause an oscillation of the mirror, thereby moving the bright spot across the screen, the amplitude of movement of the bearing being magnified about 500 times.

* In the actual apparatus two fixed mirrors are introduced in order to make it more compact. These are omitted from the diagrammatic plan for the sake of simplicity.

As the armature rotates the involute slot passes in front of the lamp and the bright spot on the screen moves up or down, its position at any instant indicating what part of the aluminium disc is in front of the lamp. Thus while the armature is running the curve traced by the spot of light on the screen gives a measure of the vibrations of the bearings between the buffer springs and at the same time shows what part of the armature is "throwing out." If there is no vibration the curve will be a straight line down the middle of the screen, but if the armature is vibrating regularly the curve will be of sine form, the peaks of which correspond to the maximum displacements of the armature.

It may be noted here that the part of the armature which "throws out" lags behind the actual heavy place, the angle of lag varying considerably under different conditions of friction, speed, &c. This unknown factor is eliminated by running first in one direction and then in the other and taking the mean of the two readings. It will be noticed that as each resonating speed is approached the amplitude of vibration will increase rapidly to a maximum and then diminish, while at the same time the sine curve will advance in phase—in some cases by as much as nearly 90°—showing that the unknown angle of lag decreases as the resonating speed is approached. (This phenomenon may be compared to the case of an electric circuit where alternating current voltage corresponds to the horizontal component of the centrifugal forces, frequency to speed of rotation, induction to inertia,

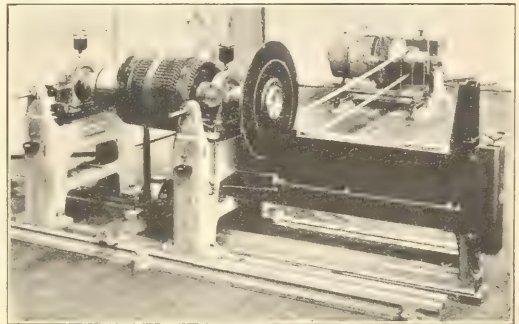


FIG. 4.

ohmic resistance to friction, and capacity to the stiffness of the springs.) It is therefore of importance that both the readings should be taken at the maximum value, when the angle of lag will be the same in each case.*

METHOD OF WORKING.

Readings are taken at each of the two resonating speeds, and the results when considered conjointly indicate the positions in which the balance weights should be put. For instance, if at the slow speed the maximum displacements occur at the points indicated by the arrows, *S.S.* (Fig. 6), a heavy part is indicated somewhere along the line, *D.D.*, while if the arrows, *H.H.*, represent the maximum displacements of the shaft at the higher speed (when the armature is "see-sawing" between the buffer springs) heavy parts are indicated at *B* or *D'*, or at both these places. Obviously then the actual position of the resultant of *akk*, the unbalanced masses of the armature must be in the neighbourhood of *D'* and balance weights should be fitted at *B'*.

A typical curve is shown in Fig. 7, the full line showing the normal curve, while the dotted line indicates an irregularity due to momentary variation in friction or some other external cause. One of the chief merits of the optical balancing apparatus lies in the fact that irregularities such as that indicated (which in practice are of frequent occurrence) may be ignored,

* Should it be necessary to attempt to improve the balance of a machine *in situ*, when it will probably be impossible to run it in both directions, an angle of lag of about 60 deg. may be assumed as a good average figure.

whereas this is not possible when scribers or mechanical feelers are relied upon for indicating what part is throwing out.

No attempt is made with this apparatus to calculate the amount of balance weights required. Their correct positions are obtained as described above and trial weights fitted. It is a very simple matter to increase or reduce these as indicated by subsequent readings until accurate balance is obtained.

ALTERING THE SENSITIVENESS.

The sensitiveness of the gear can be raised to almost any reasonable limit by increasing the stiffness of the buffer springs. This will have the effect of raising the speeds at which resonance will occur, thereby increasing the centrifugal forces of the unbalanced masses, while the friction of the roller bearings, &c., which depends on the weight of the armature, will remain unaltered. It is found, however, in practice,

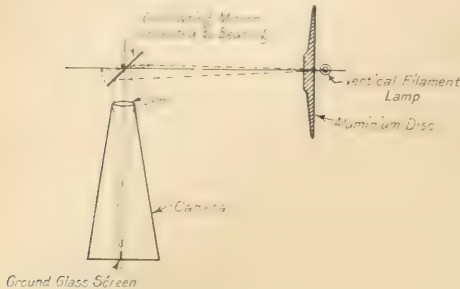


FIG. 5.

that excellent results may be obtained when balancing with weak springs at quite low speeds, and as this plan is very much more expeditious it is usually followed.

An armature balanced as described above will run without vibration at any speed, so long as it is not distorted. Unfortunately in practice distortion, though usually very slight, is almost certain to occur, and it is the business of the designer to reduce this to the minimum. In the first place, although the armature can be balanced at several stages of its manufacture, and again as a completed unit, it is obviously impossible to ensure that perfect balance is obtained at every individual transverse section, and there must be a tendency for the armature to deform slightly at high speeds, owing to this local inequality of centrifugal loading. From this point of view, therefore, the shaft should be made as stiff as possible. Again, local heating may cause distortion of the shaft. So apparently

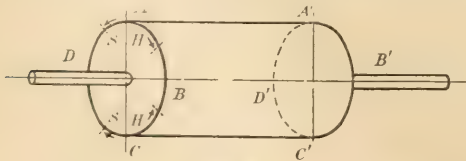


FIG. 6.

trivial a detail as an oil scraper just touching the shaft is quite enough to heat it locally, sufficiently to cause distortion and produce very considerable vibration. Unsymmetrical winding of the armature or magnet, or the use of parallel armature windings without equalising rings, may set up heavy magnetic stresses, and these also would tend to prevent smooth running of the armature; but this source of trouble is not likely to be present in modern machines.

CRITICAL SPEEDS.

Mention must also be made of "critical speeds," though a full discussion of this subject would be outside the scope of the present article. Put very briefly it may be stated that every armature has certain speeds at which it is impossible for it to run for any length of time with safety. The lowest of these speeds is generally referred to as the "critical speed,"

and it is the only one which is likely to be met in practice. As this speed is approached the deflection of the shaft, due to irregular centrifugal loading already referred to, increases very rapidly; the increased deflection in itself augmenting the centrifugal force so that a cumulative effect is obtained, until at the critical speed the shaft would tend to whirl round with ever-increasing deflection until it was destroyed.

It may be shown mathematically, and is borne out in practice, that if the critical speed can be safely passed, steady running may again be obtained, the shaft being now deflected in the opposite sense and the armature rotating more and more nearly about its mass centre as the speed is still further increased. If an armature is designed to run at a speed above the critical it is essential that it should be accelerated very rapidly through it, so that the elastic force of the shaft is unable to develop an excessive whirling before steady running again becomes possible.

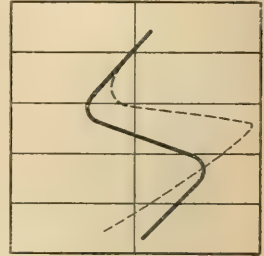


FIG. 7.

A physical conception of how this change occurs may be aided by reference to Figs. 8 and 9, which represent armatures with the shafts excentric. In Fig. 8 the shaft is supposed to be absolutely rigid, so that when the armature is accelerated by tangential forces (as in the case of a motor) its centre of gravity will be compelled to follow the dotted path indicated, and it will commence to whirl. In Fig. 9 the shaft is supposed to be perfectly flexible, and in this case the armature would simply rotate about its own centre, and the shaft would be carried round. The actual case under consideration would lie between these two extremes, and we see that if the accelerating forces are very great the shaft may be considered as being relatively

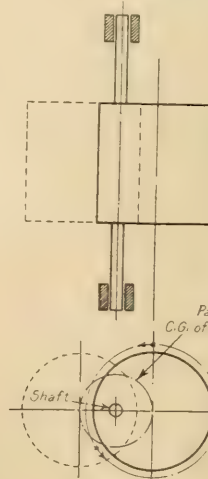


FIG. 8.

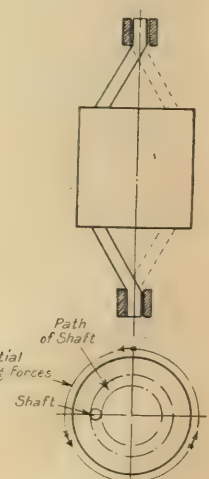


FIG. 9.

flexible, and it will only be able to impart a small whirling motion to the armature, and will itself be carried round in a bent form while the armature will rotate more or less closely about its own centre.

At speeds very much greater than the critical, rotation becomes remarkably steady, and many machines (notably D   Laval turbines) have been designed to take advantage of this. Such a course is, however, hardly to be recommended for dynamos and motors save in exceptional cases, since the composite nature of their construction renders them liable to sustain serious strains while being run up to speed or stopped.

D.C. Switchgear and Contactor Control.

By A. S. HORNE, A.M.I.E.E.

THE extended use of electric motors for driving the varied auxiliary machinery on shipboard (e.g., steering gear, cargo winches, windlasses, &c.) has required the production of improved types of switchgear to fulfil the conditions of service, which are generally of an onerous nature. The types described in this article have been evolved by the firm with which the writer is associated (MESSRS. LAURENCE, SCOTT & COMPANY, Ltd., Norwich) as the result of a lengthy experience of electrical gear for use in ships, with special application to the large Diesel-engined vessel of the present day.

REQUIREMENTS FOR MARINE WORK.

Switchgear for marine use must be of robust construction without undue weight or size; special attention must be paid to insulation and to the protection of working parts from the action of saline moisture; and general accessibility of all parts is a *sine qua non*. The duty varies from plain starting with short-rated resistances to multiple step reversing control with primary speed regulation by main resistance; the rating conforming to a fixed cycle of operations.

The starters are usually of the barrel type, with or without shunt field regulation, except in cases where they are unsuitable by reason of the heavy current to be dealt with or where automatic

BARREL STARTERS AND CONTROLLERS.

A typical example of starter is illustrated in Fig. 1. The case is of stout sheet metal with electrically-welded joints and suitable stiffeners; the interior and all metal parts, excluding contact surfaces, &c., being heavily coated with acid-resisting enamel. The polarity of "live" parts is indicated by the colouring employed. Special gunmetal glands accommodate the ingoing cables, which are generally armoured. The insulation of the square-section barrel shaft and brush-finger bar is of moulded micanite and the fingers are provided with renewable tips of heavy section. The upper shaft bearing is a self-aligning journal mounted in the cast dial plate, and the shaft carries a circular cam with notches for the engagement of a spring-supported ball or roller on the lever of the no-voltage device.

The convolute return spring is of ribbon steel contained within a light metal box mounted concentrically on the shaft. This spring is omitted in the case of controllers, and the circular cam replaced by one of starwheel pattern, movement of the handwheel being transmitted to it by a short gunmetal "driver" spindle, drilled to receive the shaft end. A spring drive, interposed between the driver and starwheel and a steel roller held in engagement with the latter, ensure a positive step-by-step motion of the barrel.

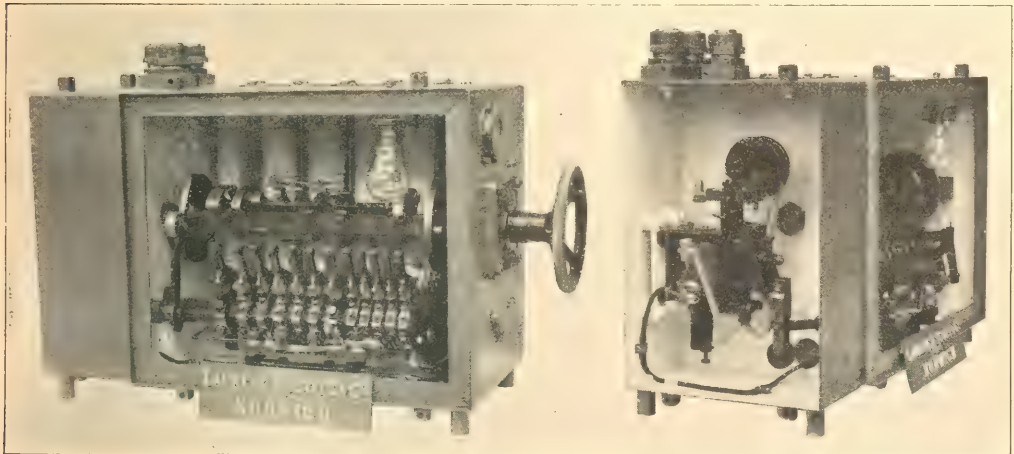


FIG. 1.—BARREL STARTER WITH OVERLOAD CUT-OUT.

END VIEW SHOWING CUT-OUT.

operation is required: in these cases some form of contactor starter is employed. Barrel type controllers with self-contained or separate resistances are used in connection with the smaller motors, while those driving deck winches, windlasses, &c., are started and controlled by apparatus of the contactor type, remote control being effected by a master switch. This permits the main controller to be housed between decks and to be of the open protected type having obvious advantages in regard to heat dissipation and accessibility. Direct mounting of the starters on motors driving engine-room auxiliaries is usually employed, with consequent economy of space and wiring.

RESISTANCE UNITS.

The resistance units used are of the "chimney-draught" type, consisting of metal tubes from 1 in. to 4 in. in diameter, covered with micanite and asbestos, on which is wound the resistance alloy in the form of wire or strip. Attachment to the case is effected by a plate integral with the upper extremity of the tube. When required, the provision of a similar plate bolted to the case over the lower projecting end, and the addition of asbestos joints, ensure watertightness. Suitable clips, with locking plates, are incorporated with the winding at the points of connection; and the connecting leads of bare copper wire or rod are either tinned or well coated with acid-resisting enamel. The units, normally mounted in a vertical position to permit free circulation of air through them, are rated for a temperature rise of 200° to 50°F.

Master controllers of this type, used in connection with deck machinery, are fitted with strong cast-iron cases and handwheels suitable to their exposed position.

The protective devices fitted as required to this switchgear include the following:—

(a) *No-Voltage Release*.—A laminated spring support to the engaging ball or roller on the lever eliminates harshness when moving over the regulating steps of the starter.

(b) *Overload Release*. This is of the usual type with series wound coil. Movement of the core raises a light pivoted arm, breaking the circuit of the no-voltage or contactor coil.

(c) *Overload Cut-out*.—A combination of (b) with an S.P. or D.P. contactor type main switch with blow-out, which is mechanically closed by a separate cam as the barrel is moved from the OFF position, and usually mounted in a separate compartment of the starter case. Operation of the overload releases the main switch by disengaging a catch. An electrically-operated contactor and separate overload replace the cut-out when applied to controllers; and in both cases the barrel must be returned to the OFF position to reset the switch.

(d) *Blow-out*.—An insulated iron rod carries a continuous coil of strip conductor on edge which is enveloped by metal cylinders separated by fireproof shields. The latter isolate adjacent brushes and form the arc chambers. End brackets, to which the coil ends are attached, are pivoted to connector blocks on the brush bar, and serve to clamp the blow-out solidly. The starter blow-out is usually of single section, embracing the main break only.

are fitted. The timing unit, which is a separate component, is shown in detail in Fig. 3. The bracket, *Z*, is supported on a telescopic extension, *H1*, of the contactor pivot pin at *I*, and is also attached to the end of the brush fixing stud, *FS*, as shown in Fig. 2. The moving contact, *MC*, is supported on a flat steel spring and fitted with an adjusting screw, *SC*, at its upper end, special low-resistance carbon being used for the contacts. *CR* is a cranked arm pivoted at *I* and having a mica inset, *Q*, pressing against the end of screw, *SC*, one extremity of the arm being attached to the air dashpot. When a contactor closes, the upper end of *CR* moves forward under the action of the tension spring, *TS*, the movement being limited by the pin, *PP*, on the contactor brush carrier, and retarded by the dashpot. The operating coil of the contactor next in order is connected across the contacts and energised upon the separation of the latter. The design of the coil circuit is such that a comparatively low potential difference exists between the open contacts. Non-corrodible metal is used for the dashpot cylinder, and the carbon plunger is fitted with a quick-return valve. The time-interval may be varied by means of the adjustable tension spring.

OPERATION OF CONTACTOR STARTERS.

Various methods are employed for the operation of the contactor starters, either locally or from a distance; and the following may be

The position of the latter determines the number of contactors to be closed, but their rate of closing is independent of the speed of rotation of the handwheel.

WINCH CONTROL.

The special application of this type of control in connection with a standard seven-ton winch motor (35 B.H.P., 220 V, 450/675 r.p.m.) is given in fuller detail, Fig. 4 being a simplified diagram of the circuits. In this instance the contactor controller, illustrated in Fig. 6, is non-reversing, the armature reversing switch being incorporated with the master controller drum. The main controller is fully ventilated and housed below deck; the master controller, fitted with pilot lamp and isolating knife switch with removable key, being mounted on the winch motor. Three control steps are provided in both HOIST and LOWER positions, and the star wheel is designed to afford a specially definite OFF position. The brushes marked *X*, *Y*, *Z* are connected by the master switch barrel on this step, and on the control steps the combinations are *X-Z-1*, *X-2* and *X-3* respectively. In the OFF position the solenoid type no-voltage release is energised through the pilot lamp and is self-maintaining. On step 1 the solenoid brake and No. 1 contactor coils are energised through a resistance, the operating circuit being completed through the contacts of the no-voltage and time overload devices. On this step

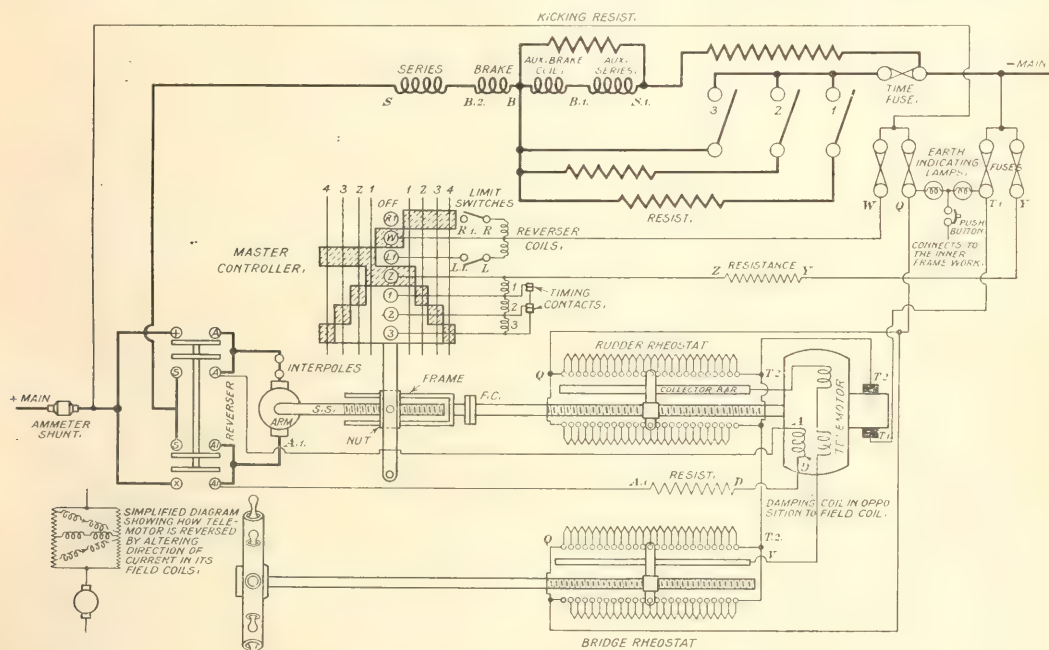


FIG. 6.—PATENT ELECTRIC STEERING GEAR CONTROL.

instanced: The starting switch in connection with a 120 B.H.P. 220 V motor driving a manœuvring compressor is operated by push buttons. The ON button operates No. 1 contactor which closes the motor circuit, and also maintains the operating circuit of the contactors through the auxiliary contact, *W* (Fig. 2), the remaining contactors automatically closing in sequence. Pressure of the OFF button short circuits the coil of No. 1 contactor.

A stokehold fan motor with shunt field regulation is remotely controlled by a master switch combined with the shunt regulator. In this case, to ensure the motor starting with full field, the last contactor supersedes the starting function of the master switch, which is opened on the regulating steps. No. 1 contactor coil is short-circuited by returning the regulator to the OFF position, when the remaining coils are diverted successively by the closing of the timing contacts, and the operating circuit opened by the last contactor.

A reversing barrel type master switch is usually supplied for the operation of contactor controllers, either the "forward" or "reverse" side of the main reversing contactor—which consists of two mechanically interlocked D.P. units—being energised according to the direction of the rotation of the master controller handwheel.

the switch interconnected with the footbrake lever is diverted, permitting the use of the footbrake as a check, the main resistance being designed to permit stalling the motor. No. 2 contactor and the brake lever switch are added to the circuit on step 2, and the timing contacts on this contactor are opened. On the last control step the third contactor is included and Nos. 4, 5, 6 and 7 thereupon close successively, the last contactor closing a diverter circuit to the series winding. The closing of this contactor is dependent upon the load on the motor, being controlled by a patent load discriminator magnet in the main circuit. The function of this device is to prevent increase of speed by series diversion if the load being lifted calls for an armature torque exceeding a predetermined value. In this case the magnet arm lifts and by short circuiting the operating coil, prevents the diverter contactor from closing and causing an overload. With lighter loads the magnet is inoperative and the winch works at the higher speed range. The motor circuit is opened by the contactors, no current being broken on the contacts of the armature reversing switch. The time taken to accelerate the motor to full speed is four seconds. The time-lag over load device has a hollow floating core inside which is fitted an air dashpot, the

cylinder of which is attached to the core, and the carbon plunger anchored, a quick-return valve being fitted. The normal lag is 15 seconds at the set current, the current/time curve being of the usual form. The copper contacts are specially designed to break an inductive circuit of several amperes.

STEERING GEAR CONTROL.

A simplified diagram of a patented system of electrical steering gear control is given by Fig. 6. A 3-step contactor controller is used in conjunction with a special controller mounted on the rudder motor. This contains a telemotor and a differential gear interconnected with a radial drum master switch. In addition a D.P. contactor reversing switch for the main motor armature and a special type of rheostat having its travelling brush in contact with a collector bar, are included. A similar rheostat is operated by the steering wheel on the bridge. The operation of the gear is as follows:—

A circular nut is rotated on a screwed spindle, *SS*, geared to the shaft of the rudder motor by a rectangular frame member, the horizontal arms of the latter engaging in transverse slots on the periphery of the nut. The frame is driven by the telemotor through a flexible coupling, *FC*, and the screwed shaft which carries the rheostat brush holder. The master switch drum is linked to a sheave encircling the nut, the sheave being prevented from rotating by a slotted lug engaging with a guide bar. It will be seen that the rheostat in the controller case and the remote rheostat on the

bridge are in parallel, the current flowing through the armature of the telemotor. The field winding of the latter is connected across the collector bars of these rheostats, the bars being normally in a state of electrical balance. Rotation of the steering wheel, and consequent movement of the bridge rheostat brush, causes a difference of potential between the bars, and a current flows through the field winding, causing the telemotor to rotate in a direction dependent upon the movement of the wheel (port or starboard). The telemotor continues to run until it has moved the brush of the rudder rheostat into a position coincident with that of the bridge rheostat, when its field current falls to zero. Meanwhile, the nut of the differential gear has been rotated along the screwed spindle, *SS*, from its mid (or zero) position, its traversing movement causing the master switch to close the armature reversing contactor corresponding to the direction of rotation of the wheel, and also to insert one or more of the regulating contactors. The rudder motor is thereby started up and continues to run until the rotation of the spindle, *SS*, has carried the nut and the interconnected master switch back to the mid position. The number of revolutions of the rudder motor is directly proportional to those of the telemotor (*i.e.*, to the amount of movement of the steering wheel), and the resultant angular movement of the rudder may be determined by the amount of travel of the rheostat brush along the collector bars, and these are suitably engraved accordingly. The function of the damping coil shown is to prevent over-running of the telemotor for large differences of helm.

Ship Lighting.

By W. J. JONES, B.Sc. (Eng.).

THE lighting of ships is a matter concerning which but little literature is available, and one which has not commanded the attention which it should receive. The writer recently opened a discussion before the Illuminating Engineering Society on this subject, on which much of the information in this article is based. It is possible that this Society will form a committee to investigate the matter, which should be able to come to some approximate conclusions concerning the requirements of ship lighting.

In the case of large vessels there is ample power available for lighting, but in small vessels the possibilities of supply become more limited, and here the lighting is necessarily more primitive. Generally speaking, all the advantages of modern land lighting can be incorporated in the lighting of vessels, with but few modifications; a ship has, however, the advantage that the area to be illuminated is relatively small, so that the cost of distribution is not so important, and the voltage may be selected largely with a view to convenience and the efficiency of the lamps used.

THE SAFETY AND HYGIENE OF ELECTRIC LIGHTING.

Apart from the improved illumination, electric lighting has been found to be safer than oil lamps, and in view of the fact that the source of light in an electric lamp is entirely enclosed, it cannot vitiate the atmosphere nor contaminate foodstuffs. These hygienic considerations are obviously of special importance when one remembers the limited amount of space that is available on board ship and the crowded conditions which must of a necessity prevail.

Hitherto the lighting of ships has not received the same systematic treatment as problems of interior illumination on land, and it is interesting to note that the U.S.A. Navy has prepared a schedule of the intensity of illumination which they consider to be suitable for various parts of a vessel. The Navy Department of the U.S.A. realised that good illumination enabled work to be more expeditiously carried out and a greater degree of proficiency attained.

FITTINGS.

Electric light fittings used on board ship must be of a strong and substantial design, and sufficiently rigid to withstand the motion of the vessel. Special ornamental fittings are used in the first-class state rooms, while in the third-class quarters and passage-ways plain brackets suffice, since utility is required rather than ornate appearance.

LIGHTING PRACTICE.

The decorative element of lighting is predominant in saloons, and the fixtures may be of almost any design, usually in keeping with the design of the compartment. It is, however, necessary to avoid glare and hard shadows. An intensity of 2 to 3 foot-candles is suggested as being adequate for this purpose. It is,

however, almost impossible to employ high candle-power units because of the small head room, and this almost invariably means the use of a number of small units in order to obtain even illumination.

Fig. 1 shows a view of the sitting room on board the White Star liner "Olympic," and it will be noted that the lighting is of a highly decorative nature and in keeping with the artistic features of the room. The head room that is available permits of a large fitting, consisting of an ornamental corona with the lighting units hanging from the periphery.

Fig. 2 shows the music room on board the P. & O. liner "Naldora." It will be noticed that the method of using a large number of small units mounted on the ceiling is here adopted.

WRITING ROOM AND LIBRARY.

There are, apparently, two general ways of lighting such rooms as the writing room and library. (1) By a general illumination of 1-2 foot-candles, supplemented by table lamps or sconces; and (2) by a much higher general illumination, which is so designed as to be thoroughly diffused, having a value of 4 foot-candles.

DINING ROOM.

In the dining-room, also, there are two methods of lighting: (1) By means of a general illumination, supplemented by table lamps; and (2) by a higher general illumination. A foot-candle intensity of 2 to 3 foot-candles is suggested as being adequate. Fig. 3 shows the illumination of a dining-room by means of a large number of small units placed in the recesses of the ceiling. A very even illumination is obtained in such a manner. Fig. 4 shows the dining-saloon on the "Olympic," which is provided with similar lighting to the reception room. It is interesting to note that there are double windows; the inner ones being of stained glass. Between these two sets of windows are provided lamps which when illuminated give a warm sunlight appearance to the room.

SMOKING ROOM.

In the smoking room the decorative element is the chief one to be considered, but adequate illumination must be provided in order that card games may be indulged in without eye strain. Two to three foot-candles should be sufficient. Fig. 5 shows the smoking room on board the "Naldora."

STATE ROOMS AND BERTHS.

Where the decorations of the rooms demand it, the electric lighting fittings should be so designed as to be in harmony. Such apartments are essentially bedrooms, but at the same time must be the lady's boudoir, the gentleman's dressing room, and not uncommonly

called upon to take the place of the hospital ward. Despite the minimum space available, passengers expect comfort, and it is here that the lack of comfort is most noticeable. A warm and cosy effect is required, but at the same time sufficient illumination is necessary for the dressing table (see Fig. 6). An illumination generally of one to two foot-candles seems necessary, supplemented by local lights.

ENGINE ROOM.

The multiplicity of overhead pipes, girders, ladders, &c., makes the engine room somewhat difficult to illuminate satisfactorily, but if the surroundings are light, and if at all possible, white, a vast improvement is obtained. In many cases it is usual to instal well-glasses with bare lamps, but if these are used in very dark surroundings, the effect of glare is apparent. It is suggested, therefore, that the engine room be lighted as far as possible with fittings provided with some means of obscuring the source of the light, and this may be accomplished by the use of shades or opalescent globes.

Fig. 7 shows the lighting obtained from well-glass fittings in an engine room where the walls have been painted white and the effect of the light surroundings and the white packing on the steam pipes is evident. The introduction of gasfilled lamps has enabled powerful sources of light to be suspended above the cylinder tops and over

that the boiler bilges on the "Olympic" have been painted white and fitted with lamps in order to immediately detect oil leakage.

PASSAGE WAYS.

Sufficient light must be provided in passage ways for the handling of material and freedom of movement. In some vessels a 2 foot candle intensity is required, particularly when the walls of the passage ways are dark, but as an instance of low illumination may be cited the working alleyways on board the "Olympic," where a reading of only 0.2 foot-candles was recorded, and yet a pleasing and satisfactory result was obtained because of the high reflecting character of the walls.

DECKS LIGHTING.

On merchant vessels it is particularly advisable to provide sufficient light for the taking on and storing of cargo, as it enables the hands to see moving objects and also permits the man in charge of the hoisting machine to have a clear vision of the working area. The ordinary cargo cluster is often used for this purpose, but the gasfilled lamp is being used extensively with suitable reflectors.

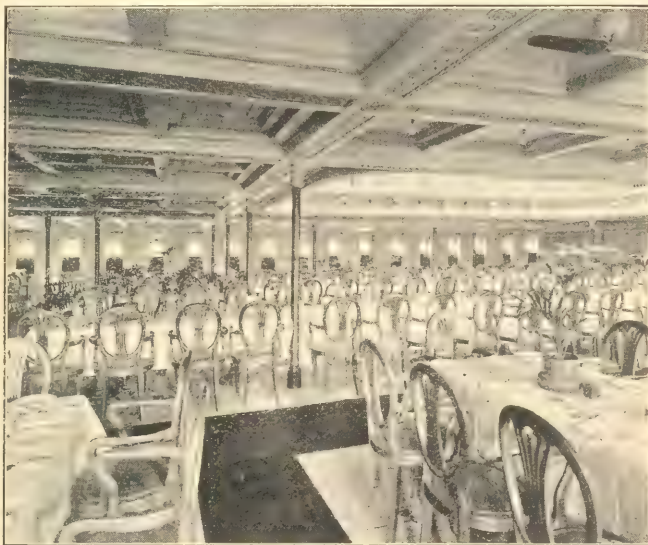
Below are given some readings of foot-candle intensities taken in various parts of the White Star liner "Olympic." The readings were taken 3 ft. above the ground except in



FIG. 1. SITTING-ROOM ON BOARD THE "OLYMPIC."



FIG. 2.—MUSIC-ROOM ON THE "NALDERA."



3.—ILLUMINATION OF A DINING-ROOM BY A NUMBER OF SMALL UNITS.

the wells with good effect. Fig. 8 shows pumping machinery in the boiler room illuminated by a 500 W lamp in an ordinary vitreous enamel focus type reflector.

An interesting description of a useful form of gauge glass light is given by Mr. Purser Fletcher in the current issue of the "Journal" of the Illuminating Engineering Society, and another method of lighting these instruments makes use of the fact that an ordinary glass tube acts as a concave lens, but when filled with transparent liquid it becomes a convex lens. If, therefore, we have a source of light placed in front of the gauge glass and a screen placed behind, the water in the tube can be made to give a focused image of the light on the screen, the height of the image varying with the position of the water in the tube.

BOILER ROOM.

The effect of glare in the boiler room is particularly noticeable, and consequently when a bare lamp is used, a distinct degree of discomfort is experienced which results in a diminution of acuity. The advent of oil fuel boilers should enable the boiler room to have more reflecting surfaces. Indeed, such a course would enable the immediate detection of the leakage of oil. It is worth recording

those instances where the readings are marked with an asterisk when they were taken on the level of the ground; in all cases they represent minimum values:—

Passenger's Quarters—First Class. Foot-Candle Intensities.

First Class Companionway	...	...	...	2.0	—3.0
First Class Alleyway (white)	...	...	...	0.45	—0.55
First Class State Rooms (local lights)	...	...	...	...	1.6
Three 30-Watt Frosted, 8 ft. 6 ft. high. Period decorations.	...	...	...	...	...
First Class Reception Room	...	...	...	...	2.2
First Class Dining Room	...	...	...	...	2.5
Ceiling Fittings, 5-light every 8 ft.					
Bath Room	...	...	...	...	1.2
Lavatory	...	...	...	...	0.7
Maid's and Valet's Saloon (Units between Girders)	...	...	...	...	1.8
Smoking Room	...	...	...	...	2.0
Swimming Bath (Frosted lamps every 4 ft. 6 in. over edge of bath)	...	...	...	...	0.5
B. Saloon Cafe	...	...	...	...	3.5
B. Deck (Bulkheads)	...	...	...	...	0.5

Passengers' Quarters—Second Class.

Second Class Companionway	...	2-7
Second Class Dining Saloon	...	2-2
Single cut pines, 6 ft.—8 ft. apart.		
Second Class Cabins	...	0-5—0-6
D Deck 6 ft.—8 ft. apart.		
Second Class Library	...	4-0
Unit between beams spaced 3 ft.—8 ft., 8 ft. high.		
Second Class Alleyway	...	0-7
Second Class Smoking Room	...	2-0

Passengers' Quarters—Third Class.

Third Class Companionway	...	0-7
Third Class Cabins	...	0-5—0-6
Dining Saloon	...	2-0
Smoking Room	...	2-0

Working Parts of Ship.

Bakery (Third Class)	...	0-58
Ovens	...	0-40
Alleyway (working)	...	0-20
Lavatory	...	0-30
Bath Room (Stewards)	...	0-30
Bath Room (Stewards)	...	0-60
Bunks (Stewards)	...	0-30
Chief Electrician's Room	...	0-6
Electricians' Quarters	...	0-6
Electricians' Shop (with local lights)	...	1-0
Ice Plant	...	0-5—1-0
Blower Room	...	0-5

Engine Room, Boiler Room, &c.—Engine Room.

Tops (30-Watt units in well-glass spaced approx. 8 ft. apart)	...	1-8
*Steps	...	1-8
Middles (with two 1 000-W G.F. lamps over top of wells)	...	1-2
Starting Platform	...	1-8
Bottom Platform (Port Pumps feed)	...	0-5
Bottom Platform (Starboard and Sanitary Pumps)	...	0-3

Boiler Room (Oil Fuel).

*Steps to Boiler Room from Engine Room (dark)	0-2
General Lighting Stokehold	0-25
Local lights on gauges and in bilges.	
Pump Room, gasfilled lamps, 500 W	4-0

Turbine Room.

General Lighting	0-4
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FIG. 4.—DINING-ROOM ON THE "OLYMPIC."

Dynamo Room.

General Lighting	0-4
Switchboard Platform	1-4
Back Switchboard Platform	1-4
Tunnels	0-25
Light over almost each bearing.	

LIGHTING REQUIREMENTS FOR SPECIAL POSITIONS.

For the purpose of steerage the Board of Trade specify that there shall be navigation lights at the foremast head and mainmast head, and that there be provided port and starboard side lights, and a stern light. The question of the visibility of such lights when seen at a distance is naturally of very great importance, and has been the subject of research at the National Physical Laboratory during recent years. The lamps for the masthead, stern light, and side lanterns are specified to consist of 32 candlepower carbon filament lamps, having two filaments each of 16 candlepower operating in parallel; the reason being that should one filament fail it is a very remote chance that the other will go out of commission at the same time. These lamps are usually subjected to a close inspection once every half-hour, but it is usually difficult, and at times impossible, to see from the bridge of the vessel whether the navigation lights are burning satisfactorily, and as it is important that the failure of

any one of the lights should be immediately known by the officer in charge, some form of indicator is therefore necessary in the wheel-house or chart-room in order to give this information. Such an indicator shows by means of luminous indications when the lamps are burning satisfactorily, and also is designed to give an audible signal when they fail and a visual warning when one of the filaments of double-filament lamps breaks.

In the event of any of the navigation lights failing, the indicating lamp corresponding to that particular light is extinguished immediately. At the same time the armature of a series coil falls away, and, in doing so, completes the circuit of the bell, which commences to ring, thus giving audible warning of the failure of the navigation light. The bell continues to ring until the switch controlling the particular circuit is opened.

In the case of navigation lamps having double-filaments, when both filaments are intact the indicating lamp burns with its full brightness. If one filament breaks the indicating lamp continues to burn, but with diminished brightness, and the bell does not ring. If the second filament should then break the indicating lamp is extinguished immediately and the bell will ring.

The lighting of compass-dials, charts, &c., also presents special problems. Naturally, the lighting should be of the concealed character, the actual sources being screened from view. In some arrangements the illumination is effected from lamps placed boxed in underneath the charts which are held stiff between sheets of glass. The device may also be equipped with a wind-screen enabling the charts to be examined in comfort.

SEARCHLIGHTS.

The advancements that have been made in the production and operation of searchlights are many and have been recently described in the journal of the Illuminating Society and in the proceedings of the Institution of Electrical Engineers, and, in view of this, it is



FIG. 5.—SMOKING-ROOM ON THE "NALDERA."

not thought necessary to dilate upon the matter further. The possible applications of searchlights in the mercantile marine, in addition to their familiar uses on war vessels, deserve attention. It has been suggested that they would sometimes be of value in locating icebergs or approaching vessels, and, in the event of an accident, for illuminating the sea and assisting boats in picking up floating survivors.

LAMPS.

With the inception of electric lighting carbon lamps were exclusively used. The introduction of metal-filament lamps has effected a considerable saving of electrical energy and are gradually replacing carbon lamps because of their high efficiency and the whiter quality of the light which is emitted. Although in modern vessels most parts of the machinery are carefully balanced and the structure

designed so as to transmit vibration as little as possible, yet the lamps still experience a considerable amount of vibration of high frequency.

HELICAL TRACTION LAMPS.

In recent years lamp manufacturers have turned their attention to the need of producing a lamp, apart from the ordinary standard, to withstand heavy vibration, and as a result of the experience gained on sea as well as on land, the best results were obtained from the helical traction lamp. These are made with a spiralsided filament, wound on a very fine mandril and mounted on springy supports. The supports are so arranged that only short lengths of filament are left unsupported and the total distance between the top and bottom support is approximately $\frac{3}{4}$ in., thus preventing crossing and consequent short-circuiting of the filament through sagging and vibration. In addition, the supports form a complete circle round the filament, and as traction lamps generally have to burn at any angle, there is no possibility of the filament dropping away or touching adjacent loops. Moreover, the construction of these lamps is such as to enable them to emit an equal intensity of light in all directions; for this reason the spherical reduction factor is higher than that of the ordinary straight filament lamp and is found to be 0.93 against 0.78 of the ordinary lamp. Such lamps bid fair to entirely replace the old carbon lamps.

Of recent years the introduction of gasfilled lamps on board ship has made considerable headway, particularly in the large sizes for the purpose of illuminating the decks and for the facilitation of

the Navy and Mercantile Marine. At the present time the various voltages and type of lamps which are asked for, even in different vessels in the same service, increases the expense of manufacturing lamps in bulk, and makes it more difficult to produce lamps of good uniform characteristics.

THE QUESTION OF STOCKS.

A further fact to be borne in mind is, that boats are often in port only two or three days, and in those few days it is necessary to obtain further supplies of lamps, and these consequently have to be despatched at very short notice. It would greatly facilitate matters if lamps for only one, or at the most two, voltages had to be stocked for marine work in order to deal with these rush orders.

Economic considerations make it necessary in the case of land installations that the maximum effect is obtained from the lamps that are used, and one of the chief things aimed at is to obtain sufficient illumination with as large a saving as possible in the fuel consumed.



FIG. 6. TYPICAL STATE ROOM ILLUMINATION.

handling goods, and in quite a number of cases these replace the old cargo clusters with six to seven 60 W ordinary lamps. From the reports which have been recently received they appear to be quite satisfactory and are giving good life.

STANDARD VOLTAGES.

It has already been pointed out that the economic feature of distribution does not call for a high voltage system on board ship because of the comparatively small area which has to be supplied with electricity compared with the amount of energy developed. In view of this fact it is, therefore, not surprising that 110 V circuits are predominant, although some of the latest vessels which have been constructed have been provided with 220 V circuits. It will be realised that lamps operating on the higher voltage are not quite so robust in view of the fact that the filament is small in cross sectional area. The strength of a filament varies approximately with the fourth power of the diameter of the filament, and hence the fragility of the high voltage lamp, particularly those of small wattage. There is a further point to be noted. In the case of gasfilled lamps the efficiency of the lower voltage lamps is 10 to 15 per cent. greater than those operating at higher voltage, i.e., for the same wattage 10 to 15 per cent. more light is obtained.

It is evident that there is a desirability that a standard voltage should be introduced on board ships, in



FIG. 7. LIGHTING IN THE ENGINE ROOM.

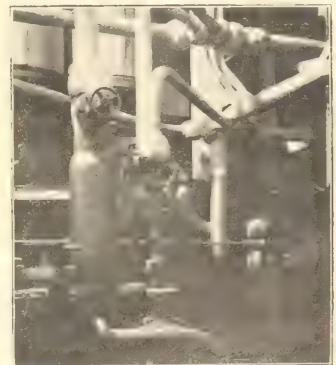


FIG. 8. ILLUMINATION OF PUMPING MACHINERY.

By careful planning in ship lighting, not only would the actual fuel consumed to generate the waste electrical energy be saved, but also additional fuel which would otherwise have been consumed in carrying such waste fuel across the ocean. For this reason it is possible that in the not distant future the steamship companies will employ illuminating engineering experts in the same way as one or two of the railway companies have already done. It has been the experience of the railway companies that increased efficiency has resulted from properly and well-planned illumination, and it is therefore not inconceivable that similar results would accrue from such a course being taken in connection with ship lighting. In any case whole-hearted co-operation between shipping companies and the manufacturers of electric lighting equipment would help materially to gain this end.

General Arrangement of Propelling Machinery of the U.S.S. "Tennessee."*

B. W. E. THAU.

(General Engineer, Westinghouse Electric and Manufacturing Company.)

Although the "Tennessee" is the second battleship to have electric-propelling machinery, it is the first to realise the full advantages of the electric system of propulsion in regard to arrangement of machinery. The ship has a displacement of approximately 33 000 tons; a length overall of 624 ft., and a breadth of 97 ft. 3.5 in. on the load water line. The normal full-load speed is 21 knots and the calculated horse-power under this condition is 28 000.

The propellers are driven by four direct-connected two-speed wound secondary induction motors, supplied with three-phase current through suitable control equipment at approximately 3 400 V and 34.6 cycles (full speed), by two direct-connected turbo-generators running at 2 075 revs. per min. A battery of eight oil-fired water-

36-pole winding. Speeds up to and including 15 knots can be obtained with the motors connected to the 36-pole winding. Fig. 2 shows the propeller performance curves.

By providing two sets of windings on the motors, it is possible to obtain more economical operation at low speeds than would be the case with a single winding. As the propeller speeds are adjusted by regulating the speed of the turbines, the two-winding arrangement permits the turbines to be operated at high speeds over the cruising range as well as the full-speed range, thus resulting in better economy.

MAIN MOTORS.

Each main propelling motor is capable of delivering a maximum of 8 375 H.P. at a speed of about 185 revs. per min. They are of the induction type and are wound for two speeds at full frequency, there being a 24-pole and a 36-pole winding. The primary or stator has two independent windings, one for each set of poles. The rotor has a three-phase two-parallel star-connected winding, having balancer connections operating as such on the 24-pole winding. The 24-pole winding is connected to three slip rings. When the stator is connected to the 36-pole winding, the balancer connections form short-circuit paths for the rotor conductors, thus forming an ordinary squirrel-cage winding having straps instead of resistance rings to connect the rotor conductors together.

In general, the design of the motors follows standard land practice. There are, however, certain features, particularly in connection with the insulation of the windings, that have been given special consideration to guard against the deleterious effect of salt and moisture conditions. The insulation is of the best-known material, and is applied and treated in accordance with thoroughly tried methods.

The mechanical construction of the motor is of the self-contained type, in which the bearings are carried by suitable brackets, which fit into recesses in the stator frame. The entire motor is supported by feet cast integral with the frame on either side. The bearing housings are adjustable radially by means of jack screws in the brackets, and after being adjusted are bolted rigidly to the bracket.

The ventilation is supplied by duplicate direct-current motor-driven exhaust blowers, each capable of delivering 12 500 cubic ft.

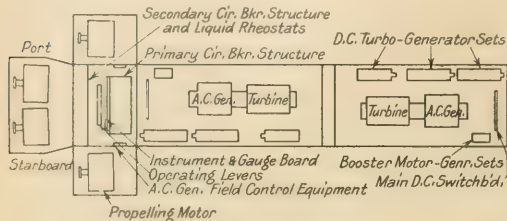


FIG. 1. SCHEMATIC PLAN OF ARRANGEMENT OF PROPPELLING MACHINERY.

tube boilers supplies steam to the turbines at 280 lb. gauge at the boilers. The generators are excited from one of the 300 kW direct-current geared turbine auxiliary sets, through a booster so designed as to vary the 240 V bus voltage in either direction to a value best suited for a given condition. All engine-room auxiliaries necessary to the main propulsion, such as the main and auxiliary condenser, circulating and condensate pumps, the lubricating and governor oil pump, oil cooler circulating pumps, and the main motor ventilating blower, are driven by direct-current motors supplied with power from the same generator which is used for excitation. One auxiliary generator in each engine room is sufficient to supply the excitation and auxiliary load just mentioned.

GENERAL ARRANGEMENT.

The power-generating machinery is located in two engine rooms, one being forward of the other, and both forward of the control room. The turbo-generators are mounted directly above the condensers. In each engine room there are two 300 kW geared turbine condensing, and one non-condensing direct-current sets of the three-wire type, supplying power at 240 and 120 V. These sets are mounted on the same flat as the main turbo-generator sets, as is also the motor-generator booster. The condenser with its auxiliaries is located in the lower machinery flat or pump room directly underneath the main generators. The switchboards for the 300 kW sets are located at the ends of the engine rooms.

The control room contains all the control equipment and other apparatus necessary for the complete control of the propelling machinery, and is located aft of the engine room and between the two outboard motor rooms. The inboard motors are in what is known as the centre motor room, located directly aft of the control room. All the main machinery is located in separate water-tight rooms, as shown in Fig. 1.

CABLES.

The cables connecting the units of the main propelling machinery are of the three-conductor lead-covered type. There are a sufficient number of these cables in parallel to carry the maximum power safely. The cable ends are provided with pot heads forming watertight seals from which the respective conductors are brought out and connected to well-insulated bus structures located over the switches in the control room, and at the motors and generators.

From maximum speed down to a speed slightly in excess of 16 knots, two generators are used, and the motors are connected to the 24-pole winding. Speeds below this are obtained with only one generator in operation, and the motors connected to either the 24 or

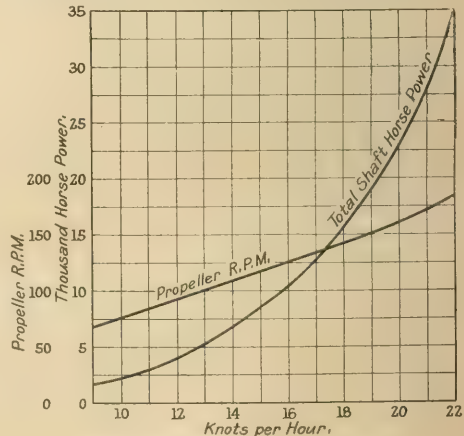


FIG. 2.—PROPELLER PERFORMANCE CURVES.

per minute maximum. In addition to these separate blowers, the rotor itself is provided with fan vanes which assist in the ventilation, and which are capable of supplying sufficient air to enable the motors to be operated for brief periods at full load in case of failure of the blowers. The blowers are mounted on the top of the motors and draw the air through the motor and discharge it through suitable ducts to the deck. The system of ventilation consists of the axial flow of air through the core and end windings, the air being drawn in through openings in the brackets and discharged through a radial duct at the middle of the core to an outlet at the top of the motor, and from there to the deck.

* Abstract of an article in the "Electric Journal."

In order to get at the motors for inspection and repair, suitable tracks and disassembling gear are provided, so that the stator can be moved to clear the rotor windings.

MAIN GENERATORS.

Each main generator is capable of delivering a maximum of 15 000 kVA at approximately 30.5 cycles. The generators are designed and constructed in accordance with standard land practice except that the rotor is of the totally enclosed type. The stator coils are insulated in the same manner as the motor coils.

The air for ventilating the generators is supplied to the machinery space by means of separate ventilating blowers. The air is drawn from the lower machinery space through an inlet at the bottom of the generator, through the end bells, entering the machine at each end of the rotor. From there it is forced through the end windings, core and air-gap axially, and discharged radially through a central opening in the core, from whence it passes through a duct to the deck.

The rotor consists of a solid steel forging having radial slots for receiving the windings. The winding consists of a series of turns of bare copper strap and the insulation is entirely mica and asbestos. After winding, the coils are very substantially braced, in order to prevent any possible movement.

The main motors and the generators are each provided with thermocouples for measuring the hot spot temperature. These thermocouples are all connected to a potentiometer board in the control room.

In order to prevent the motors and the generators from sweating when idle, heaters are provided, the motors being warmed electrically and the generators by steam coils. These coils are so located as not to cause local heating and all joints and connections to the coils are made outside of the frame of the machine to avoid the possibility of steam leaks into the machine.

TURBINES.

The turbine is of the combined impulse and reaction semi-double, flow type, allowing complete expansion of the steam in one cylinder. An exhaust connection is provided at each end of the turbine.

The speed is regulated by the governor valve only, hand valves being used merely to obtain the best economy and to prevent overloading the boilers at the various standard speeds. Briefly, the speed-control system consists of a governor driven directly from the turbine shaft through suitable gearing. The governor is essentially a dead weight governor, in which the dead weight is replaced by a hydraulic piston, resulting in a type of governor capable of functioning over a wide range of speed by varying the hydraulic pressure on the piston. The speed is adjusted hydraulically by means of a control valve in the main control room which regulates the oil pressure. A double-seated poppet valve located on the main steam inlet to the turbine is controlled through a floating lever oil pressure relay system from the main governor, and this valve controls the amount of steam as required to maintain the speed for which the system is set. The governor control valve is also operated through a suitable oil pressure relay by a separate over-speed governor secured to the end of the turbine shaft. In addition, this over-speed governor also operates the main throttle valve, in cases of necessity.

In order to limit the power input to the turbine on overload conditions to an amount which will prevent excessive overloads on the machinery and also prevent priming of the boilers, a power limit stop is provided. This is arranged to limit the travel of the governor linkage in the direction which admits more steam. The position of the stop is adjusted electrically from the main control room through a system of gearing operated by a small motor. In order that the operator may know the position of the power limit stop at any instant, an electrical position indicating system, is provided, the transmitter of which is driven by spur gearing from the power limit stop mechanism. The indicator is mounted in the control room.

OPERATING ARRANGEMENTS.

In operation, this system functions as follows: The speed of the ship is set from the control room for any given standard by means of the hydraulic speed-control system. The power limit stop is then adjusted to limit the motor speed to a few revolutions above that corresponding to the standard speed. Should an overload occur from turning or from any other cause, the speed-control governor will tend to maintain a constant speed by admitting more steam. However, as the governor linkage has only an additional limit of travel corresponding to the few revolutions increase in motor speed, the steam which can be admitted to the turbine is therefore limited, and consequently the overload has a fixed value for any given condition.

The power-limit stop may also be used for adjusting the speed of the turbine below any value for which the main speed governor system is set, and it accomplishes this in a manner similar to throttling. Since the speed is a function of the oil pressure, oil gauges

mounted in the control room give a further check on the proper functioning of the entire turbine control system. The over-speed stop may be operated from the over-speed governor, hand trip in the engine room or by wire pull from the control room.

The turbine and generator bearings have forced lubrication. Oil for the governor control system is also supplied from the same system. The oil is delivered to the governor system at 80 lbs. pressure, and to the bearings at 5 lb. to 10 lb. pressure through a reducing valve. The oil pumps for circulating this oil are of the positive displacement rotary type. Two pumps are provided in each engine room, one of which is motor driven and the other turbine driven, the latter standing by as a spare. However, upon failure of the motor-driven pump from any cause, an arrangement of pistons operated by the oil pressure will automatically cause the turbine-driven pump to be placed in operation. The turbine-driven pump is provided with a constant speed governor and an overspeed stop.

MAIN CONTROL.

As in the case of any other drive, the control for the electric drive is operated under orders from the bridge. All controlling apparatus necessary for the operation of the propelling machinery is located in the control room, and all operations for the control of the ship are effected in this room, except the actual starting of the turbines. The circuits are handled by means of manually-operated oil circuit breakers. All circuit breakers are of sufficient capacity to open the circuits under full power and voltage conditions, although in normal operation, circuit breakers are not opened or closed under load. They are manually operated from levers which are located directly in front of the control room switchboard, and arranged so that the operator faces forward. These levers are interlocked so that improper operation is impossible. The primary circuit breakers are arranged in two rows athwart ship having an aisle between them for inspection and repair, if necessary. The secondary short-circuiting breakers, and the liquid rheostats for controlling the motor secondaries, are located back of the operating aisle.

In order to disconnect any circuit completely, self-contained disconnecting devices have been provided on the reverser circuit breakers, generator circuit breakers, and tie circuit breakers. The mechanism is so arranged that the circuit breaker must be opened before it is possible to disengage the disconnecting device. This provision safeguards the men in case of improper or faulty operation, and at the same time makes it possible to inspect or repair a circuit breaker while the ship is under way.

SWITCH GENERATOR ARRANGEMENT.

The levers operate the circuit breakers and rheostat valves in pairs, and are arranged in a single row, directly aft of the circuit breaker structure. The arrangement is symmetrical so that levers on the left of the central position operate the circuit breakers in the after generator and port motor circuits, while those on the right of the central position operate the circuit breakers which control the circuits of the forward generator and starboard motors. The pedestals on which the turbine control valves are mounted and the generator field switch levers are located in the centre of the group. All the levers are mechanically interlocked so as to insure the proper sequence of operation. The scheme of interlocking is such that the field must be off and the steam control reduced to a low setting before any of the above circuit breakers can be operated.

With two generators in operation, the control of the port and of the starboard side of the ship are independent. With the tie circuit breaker closed and one generator in operation, the direction of rotation of port and starboard screws may be in the same or opposite directions, but of necessity must be at equal speeds.

All starting manoeuvring is done with the 24-pole connection. When the motors are thus connected the secondaries are controlled by liquid rheostats. There is one double rheostat for the port motors and one for the starboard motors. The rheostat consists essentially of a two-compartment tank, the lower compartment of which serves as a reservoir for the electrolyte and also as a container for the cooling coils, while the upper compartment contains the electrodes. When it is desired to use a rheostat, the valve in the upper compartment is closed by means of a lever operated from the control stand, thus allowing the liquid to rise in the upper compartment. After the maximum level has been reached, the motor secondary is completely short-circuited by means of an oil circuit breaker which is operated by a lever from the control stand.

OPERATION.

The problem involved in designing equipment for battleship propulsion is entirely special, and quite different from that encountered in designing land power plants. The generators, turbines, motors and control must be considered as a unit, and due regard given to the requirements of the propeller. The starting and running requirements under normal sea conditions are not severe, as the power required is practically steady. In a rough sea, the power

varies considerably and is unsteady. The most severe conditions however, are obtained during reversal and during turning, and if precautions are not taken to limit the power output of the turbine, it is possible to impose large overloads on the machinery during the latter condition. Fig. 3 shows the manner in which the inboard and outboard sides vary when making a turn with a 35-degree rudder. By "inboard" side of the turn is meant the side toward the centre of the circle described. The particular curve shown has been interpolated from tests made on a modern battleship making 19 knots and turning with a 35-degree right rudder. The test in this instance was made without setting the power limit stop and the turbines were allowed to take any load which may be imposed up to the maximum capacity of the machine. It will be noted that the power of the generator supplying the inboard side increases rapidly

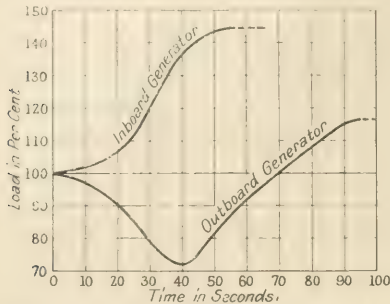


FIG. 3. LOAD ON GENERATORS WHEN TURNING WITH 35 DEG. RUDDER. POWER LIMIT NOT SET.

during the first 50 seconds, at which point it reaches the maximum output of the turbine. The power delivered by the outboard turbine, however, decreases rather rapidly during the first 40 seconds, and then begins to increase rapidly until a constant value is reached at about 90 seconds. An analysis of the curve shows that the inboard side developed an overload of approximately 45 per cent. when the maximum power of the turbine was reached and that the inboard side dropped to about 75 per cent. normal at the end of the first 40 seconds and then increased to a value corresponding to approximately 15 per cent. overload at the end of 90 seconds, when the power became constant. These conditions are common to all ships, but vary in the relative proportions of overload.

PRECAUTIONS AGAINST OVERLOAD.

It is evident that, if precautions are not taken to prevent such overloads being imposed on the machinery, it would be necessary to carry sufficient excitation on the generators continuously to take care of these overloads. At reduced loads, it would be possible to carry this additional excitation, but it would result in uneconomical operation. To provide for similar conditions at the maximum loads would necessitate an unwarranted reserve capacity in the generator fields, thus resulting in larger generators than needed. However, to overcome this condition, a form of power limit stop is provided, the function of which is to limit the amount of steam taken by the turbine to a predetermined value, which under normal operating conditions corresponds to an overload of about ten per cent. By thus limiting the amount of load that can be taken by the turbine, and consequently the generator, the field excitation can be reduced to a value just sufficient to maintain the generator voltage safely under the overload condition. The only effect of thus limiting the power is a slight and inappreciable slowing down of the ship during such manœuvres. The economy gained, however, is of considerable advantage.

The shape of the turning curves and the overload obtained varies with different ships, as also does the relative excitation to be carried on the generators. It is, therefore, necessary to conduct a series of "drop out" tests on each ship in order to determine the minimum safe field current which should be carried continuously to enable the ship to be manœuvred without liability of the motors and generators pulling apart. Ordinarily, motors of normal design have inherent torque characteristics which are sufficient to cope with these conditions, providing the generator voltage holds up, but since it is a characteristic of the generator voltage to suddenly break on abnormal loads, the condition is purely one related to the generators.

In order to provide indication of the condition of stable or unstable operation, stability indicators are arranged in the generator circuits.

As these instruments indicate the relative ratio of generator armature current and voltage, they will indicate clearly when the point of voltage collapse is being approached.

CONDITIONS DURING REVERSAL.

Another condition involving the correct performance of generator, motor and control is that which exists during reversal. The relative proportions of these curves also depend upon the ship in question, but the curves shown (Fig. 4) can be considered as typical of the backing conditions. For the sake of clearness, the reversing curve and the motor speed torque characteristics have been shown separately. A few typical speed-torque curves have been drawn for different values of secondary resistance. An inspection of Fig. 3 will show that the speed of the propellers drops to approximately 75 per cent. when the power is taken off. At this point, the motor connections are reversed, and the motors caused to produce a torque opposing the turning effort produced by the motion of the ship on the propellers. It will be noted that, as the revs. per min. of the propellers decrease, the opposing torque builds up to approximately full load value at 40 per cent. ahead revolutions and then decreases to approximately 35 per cent. when the propellers are brought to a standstill. As the propellers are reversed, the torque increases rapidly and reaches full load value at 40 per cent. revs. per min. in the backing direction. The above discussion is based on maintaining full speed of the ship. Under actual conditions, however, the ship slows down considerably in the time taken to reach 40 per cent. revs. per min. in a backing direction and therefore higher rotational speeds of the propellers in the backing direction can be obtained before reaching full-load torque.

The most vital part of the curve is that at about 40 per cent. of full load speed when bringing the propellers to a stop condition. In the case of wound-rotor motors, this condition presents no difficulties, as it is possible to obtain torques considerably in excess of normal full-load torque at any speed by simply adjusting the external resistance. The generators, however, must have sufficient field capacity to furnish the voltage required to maintain the torque under

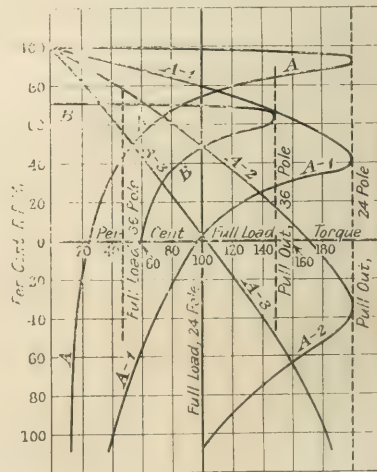


FIG. 4.—PROPELLING MOTOR SPEED TORQUE CHARACTERISTICS.

A—24 pole connections, with wound secondary short-circuited. A-1, A-2, A-3—24 pole connections, with external secondary resistance. B—36 pole connections, squirrel-cage secondary winding.

the conditions stated. In the case of squirrel-cage motors, however, it would be necessary to introduce special designs, to obtain speed-torque curves which would enable the motor to deliver torque safely in excess of the requirements under the conditions of operation described.

All such conditions, of course, must be taken into account in designing the propelling equipment and it is obvious that turbines, generators, motors and control must be designed as a unit in order that each will have characteristics which are sufficient to enable all parts of the equipment to function properly under the required conditions.

Incorporated Municipal Electrical Association.

Interesting Technical Discussions at the London Meeting.

It would be trite to say that the twenty-sixth annual convention of the Incorporated Municipal Electrical Association, which was held at the Institution of Mechanical Engineers in London last week, was only held after a good deal of trouble had been expended by those responsible for its organisation. For the expenditure of trouble is always necessary before such a meeting can be held, and the pity is that this year so much of it was to no purpose. In this particular case, indeed, it was touch and go whether the Convention would be held at all after much of the preliminary work had been done. For five years' war-time conditions rendered its holding on a pre-war scale impossible and this year industrial troubles have shorn it of most of those social amenities which go so far to make the gathering a success. However, after much uncertainty the Convention has not only happened, but has happened successfully.

Wednesday, July 20th.

When the meeting opened in tropical weather at the Institution of Mechanical Engineers (another last-minute change), on Wednesday afternoon, July 20, the pavement outside, the porch, the entrance hall and the lecture theatre were all well occupied by those attending. Unofficial gatherings were merged into the official one as time went on, and at the hour fixed for the meeting the room was uncomfortably filled and equally uncomfortably warm. We missed the usual preliminary municipal welcome and the attempts of a worthy local chief magistrate to say something new on the subject of electricity. For without any preliminary than well-merited applause, the PRESIDENT, Major H. Richardson, O.B.E., M.C., engineer and manager of the Electricity Department of the Dundee Corporation, began his Presidential Address. This we give below in a slightly abbreviated form.

Major Richardson's Presidential Address.

The Incorporated Municipal Electrical Association continues to flourish exceedingly, and it now represents a capital sum, due to municipal electrical development, of almost £80 000 000 and a total revenue of practically £20 000 000 per annum. The responsibilities and influence of this Association may therefore be readily grasped. A little over a year ago many were full of hope as to the great strides which were to be made in the direction of a cheap and abundant supply of electricity all over the country, and seemed to hold the opinion that the Electricity Commissioners would at once cause difficulties and obstructions to vanish, when each and every power supply authority, whether municipally or company controlled, would be given freedom to attain its individual ambitions.

A HUMAN ATTRIBUTE.

Being somewhat like human beings, each of these authorities, large or small, naturally thought its own scheme would be better than any other. When the obvious results of any constructive organisation became apparent, however, many of these entities felt that it would have to be a case of self-immolation for the benefit of the multitude, and, reasoning from an erroneous supposition, found this apparent self-sacrifice distasteful, and are now betraying a sudden preference for a conservative maintenance of the *status quo* rather than wholeheartedly joining in a collective effort which cannot fail to be eventually a great benefit to the community. Although this impression of mine almost amounts to a charge of small-mindedness against such recalcitrant bodies, and will probably therefore be deprecated by them, yet I believe it to be on the whole a fair and just summing up of one of the principal checks in the path of electricity supply progress.

Another case appears to me to be the quite unnecessary lack of mutual co-operation between municipally controlled undertakings and those which have been built up under private enterprise. Both are necessary to obtain the maximum benefit for the public. I do not doubt that in the past there have been faults on both sides which made it difficult for these two branches of the same industry to work harmoniously together, but it has been my own personal opinion for some years back that the old difficulties have vanished and that the interests of municipalities and companies are very much more parallel and allied than many appear to think. Although the opinion that municipal concerns cannot work as cheaply as those run by companies is, to an extent true, yet the companies should give full credit to many municipal electricity authorities which have been noticeable successes in development, economy and reliability.

ACCUSATIONS AGAINST PRIVATE ENTERPRISE.

The reiterated accusations against private enterprise which insist that industries financed by private bodies make large profits and generally batten upon a helpless public, are not borne out by the facts of the case as I see them. Indeed, I would go further, and state that it would have been impossible to develop the electrical industry to the extent it has been developed had it not been for the risks taken and losses experienced by companies and their shareholders in the early days of electricity supply.

Even to-day it is an outstanding fact that we have to rely for the necessarily expensive stages of experiment and initiative on those concerns owned by companies, and as I am making a plea for more cordial dealings between municipalities and companies, I would draw attention to what is not generally appreciated, *viz.*, that the records for cheap electricity supply in this country are held by supply companies, and that there is no evidence to show that, generally speaking, the charges made by them are in excess of those made by municipalities. In the United States of America, where current is sold comparatively as cheaply as it is sold in this country, the supply is almost entirely in the hands of private enterprise, and a noticeable circumstance in this connection is that the development of the uses of electricity have been more intense and the benefits to the public have been greater and more rapid than on this side.

MORE LIBERAL VIEWS NECESSARY.

It is no use denying that under modern conditions municipalities will have to adopt a more liberal view in developing their trading departments if they are going to maintain their hold upon such a vast industry as the power supply of the immediate future must become. Unpalatable to extreme nationalists or municipalists as these remarks may be, yet I am so anxious to see municipalities maintain a high standard of public service of electricity, with more rapid development, that I cannot refrain from pointing out the dangers of the continued parsimony of view which have recently been apparent to such an extent as to threaten their own undoing unless boldly faced and overcome. It would be easy to flatter local authorities both in and outside our Association with a few pleasant and congratulatory remarks regarding apparent progress, but at such a critical time as this it would be a most unfriendly and insincere thing to do.

SUPPORT THE COMMISSIONERS.

With reference to the best means of rapidly getting on with the good work there are naturally many opinions. To criticise is human, but not always helpful unless constructive and generous. Great as is the support the Electricity Commission deservedly enjoys, to be useful it must be practical. The Commissioners have set to work (of necessity slowly but none the less surely) to mark out the road of our future progress. It can only do good and strengthen their confidence in themselves and their work if we loyally and continuously let them feel that they have our enthusiastic and active support. I mention this because I have, and I presume others have also, heard many criticisms, but it is a remarkable fact that few have been backed up by a well-thought-out constructive statement as to what the critics would do if they were the Commissioners. I earnestly trust that chairmen and managers of both company-owned and municipally-owned concerns will use their undoubtedly powerful influence with their authorities to smooth away apparent obstacles or obstructions to recommendations the benefits of which may not be immediately forthcoming.

TARIFF PROBLEMS.

Another case of interest is that of "Tariffs." Managers and engineers of electricity supply authorities never had a better opportunity than the present for showing a keen business ability (an entirely different matter to engineering ability) in rapidly arriving at a practical basic principle of charging for electricity. It is no longer a matter of difficulty or mystery. Nothing can be clearer than the necessity for a simple charge for all purposes made up of a standard or service charge (call it what you will) graduated according to the practical demand of the consumer, and, in addition, a certain rate per unit for all current consumed. That seems to me the principle; the details can vary according to local conditions. I hope this method, already placed before the Commissioners, will receive their approval at an early date, and having been adopted let all resist the temptation to handicap the system with, might I say, the irritating

and unnecessary complications which have been the cause of so much misunderstanding among consumers and consequent loss in the past.

STANDARDISATION, FALSE AND TRUE.

Whilst on the subject of simplicity, we hear much to-day of standardisation. Personally I have taken a great interest in the matter as applied to our industry and consider that, up to a point, it is doing and has done a great deal of good. I think it will be admitted, however, that it is possible to standardise too far. To standardise up to a certain stage and to leave plenty of scope for initiative and improvement is good, but to attempt to standardise further is to affect adversely both these important factors. There seems to be also a tendency to make too many standards. For instance, may I be allowed to mention the case of standard pressures for electrical distribution? Surely there are too many, but I expect once more we are suffering from the tendency to work out mathematically the limits of cost on a pressure which suits to-day's and to-morrow's conditions, instead of profiting by the experience of the last two or three decades, which show so clearly that it pays to err on the side of giving plenty of margin for a progressing industry, therefore if in doubt about a low pressure why not go to one much higher? Why recognise a policy which harbours so many intermediates and gives so many refuges to a timid soul? Another unstable point in standardisation is the expedient of getting over a difficulty by allowing alternatives. A standard which allows alternatives seems to prove either that illogical expediency has been allowed to rule, or that an attempt has been made to standardise beyond the point where standardisation is useful.

WATER-POWER RESOURCES.

As regards methods of generation and distribution, these are being dealt with in many Papers at the present time by the different institutions, and our own Association will enjoy Papers on the subject by well-known gentlemen during this conference, but I would take the opportunity of expressing the hope that every possible encouragement will be given by the Commissioners to the development of water power in this country. I have had during the last few years ample opportunity of forming the very definite opinion that many of us have greatly underestimated the possibilities of the country in this direction. I admit that the capital, or first cost, of all such schemes is naturally very much in excess of steam, oil or gas plants, and particularly is this marked in the relative cost of hydro-electric power to steam power capital, but I am firmly convinced that as regards the running or annual costs (which eventually, of course, affect the cost per unit), it is becoming increasingly apparent that water power is likely to be cheaper, simpler and more reliable. Owing to the large capital cost, however, there is a tendency for municipalities to avoid the responsibility; therefore (assuming that they have had the opportunity and have decided not to use it) it must ultimately fall to private enterprise to develop hydro-electricity. Municipalities, however keen to insist upon control of these matters, must realise that they cannot get such control unless they supply the necessary capital and take a proportionate share of the responsibility.

A DELICATE SUBJECT.

I now come to that part of my address which deals with a somewhat delicate subject, but one on which my convictions impose a duty upon me to put forward. The suggestion which I have to make is no new idea, either to myself or to others, and it has been occasionally more than hinted at in the technical Press, notably in the columns of *THE ELECTRICIAN* and "Electrical Review." The only original part is that I put forward a definite and concrete suggestion which I hope will bring the admittedly admirable theory of co-operation in industry to an immediately practical and working attainment. In my opinion, and I believe many others are with me, the time has now come for an actual recognised co-operation of all branches of our industry, in its first stage to take the form of a National Electrical Convention to be held annually in a place chosen for its suitability, where each sectional association of the convention will hold its own meetings, yet maintaining a close contact with the main body, and thus commence to reap the innumerable advantages which the consummation of such a scheme cannot fail to produce. I suggest that such a Congress be held under the auspices of the Institution of Electrical Engineers as the proper body for the purpose. The Institution has here an excellent opportunity to put into practice many of the lines of organisation mentioned by Mr. Worthingham in his presidential address and, what is more, has a great chance to show that it is prepared to amalgamate the Institution with the industry. This, if I remember rightly, was (and I hope still is) the ideal which a President of the Institution once set forth when he said that "the Institution and the

industry should be one, and if they are not it is our business to make them so."

REPRESENTATION FOR ALL ASSOCIATIONS.

I propose that a body such as that of our own Association, whose activities have always been acknowledged to be of the greatest value to the industry in general and to its own members in particular, is thereby, by virtue of its great responsibility and influence, the right body to approach the Institution of Electrical Engineers on the matter. Each association in the whole industry should be represented at this convention; I make no exception whatever, although I believe that nowadays many of the associations (particularly, but not entirely, the smaller ones) could amalgamate with advantage, as their interests have recently become almost identical. It is not my intention, and it would not be fitting, to enter here into the actual details of such a scheme, much as I have considered them, and all I can do now is to make a definite proposition that immediately upon the formation of a new Council of the I.M.E.A. a few gentlemen from among its members should be appointed to approach the Council of the Institution and as many other associations as is possible with a view to bringing this desirable, though by no means new, scheme to fruition.

THE GERM OF POLITICAL INFLUENCE.

There are so many advantages about such a scheme that it is a temptation to take up too much of your time by trying to state some of them; but I may mention the moral effect that such a large and powerful convention would have upon the public in general by keeping them in closer and more sympathetic touch with what is of much importance to them. Again, we would have the more general support of the lay Press added to the loyal and well tried assistance of the technical Press, to say nothing of the benefits which would accrue from the incidental propaganda and advertising value. A further consideration is that under modern conditions it is an undeniable fact that it is very necessary for most industries to look after their interests politically. Personally I by no means admire the system which compels it, but one must admit the fact. At the present time each Association individually does its best to exert political influence when necessary in its legitimate interests; but I am afraid it must be admitted that that interest is very small, whereas the expressed opinions of a co-ordinated body amalgamated by means of a national convention and its organisation would be of greater consideration and carry greater weight.

Although I believe that it would be preferable for the Institution of Electrical Engineers to take a lead in this formation of a national electrical convention, yet I realise the very heavy and constantly increasing work which falls upon that body, and it is just possible that it may not be practicable for this part of my suggestion to be carried out. In such an event, and without deviating from my previous opinion, I suggest that the next institution, within whose scope such work logically comes, is the British Electrical Development Association, which has done sufficient valuable work under difficult conditions to show the necessary potentialities to indicate an assured success in such a direction. I think that an effort should be made first of all to get the Institution to move in the matter and show that it regards the commercial development of the industry as important as any other section.

PRACTICAL CO-OPERATION DEMANDED.

We are greatly indebted to the activities of the existing Associations, and we have every reason to be proud of the long and sustained record of the I.M.E.A.; but we live in an age which not only asks but demands co-operation in a practical form. Therefore I submit that, as we have heard enough talk about the advantages of further co-operation, it is time we had definite action in the matter by commencing with this suggested practical co-ordination of existing Associations.

Should this scheme raise any fears that the various Associations will lose their individuality, I would endeavour to allay them by pointing out that such a national convention does not mean any loss of importance to any of these individual bodies, but while economising their efforts, rather enhances their activities. At the present time few will deny that it is becoming increasingly difficult for the individual to keep in efficient touch with what is going on in these different groups, each having admirable objects, but very often overlapping and misunderstanding each other, thus involving a waste of energy and money.

Further, the convention itself would possibly be more largely attended owing to the time and expense saved as compared to attending several, although there is nothing to prevent any particular group holding additional meetings if it so desires; the work of the different Associations during the year would, of course, be carried on as at present.

PROGRESS NOT RAPID ENOUGH.

I would like to say that if my views disagree to any appreciable extent with those held by any members of our Association, I trust they will realise that I personally believe my views as expressed are in the best interests of the electrical industry in general, and the municipal electricity supply concerns in particular, because I do not think we have made sufficiently rapid strides up to the present, nor have we taught the public to appreciate the great benefits which are obtainable from the universal application of electricity.

Mr. Ald. WALKER (Manchester), in moving a vote of thanks to the President for his address, said that it should be remembered that it was not Major Richardson's fault that it had been impossible to hold the Convention at Dundee. The postponement was the more disappointing, as much hard work had been done to prepare for the Convention in that city, and the chairman of the Dundee Electricity Committee especially had had no opportunity of receiving members' thanks for his efforts on their behalf. During the course of the year the great distance of the place at which the President resided from London had been a great tax on his time and energy, and the Association owed him a debt of gratitude for the many hours he had necessarily spent in the train for their good.

In briefly replying to the vote the PRESIDENT expressed the regret of the Dundee and Perth Corporations at the impossibility of holding the Convention, as originally intended. He then called upon Mr. C. W. CHARLESWORTH to read his Paper on "Questions Arising in the Consideration of the Financial and Business Aspects of Municipal Electricity Supply." This we give in abstract below.

Questions Arising in the Consideration of the Financial and Business Aspects of Municipal Electricity Supply.

By C. W. CHARLESWORTH.

The very comprehensive treatment of this subject presented by the author can only be dealt with in summary. The matter is divided into eight main sections—namely, (1) Capital required, how it has to be expended, means adopted to raise money, methods of repayment of loans, &c. (2) Costs of Production, how derived and allocated. (3) Charges for supply to different classes of consumers. (4) Application of revenue earned. (5) Record of capital and revenue and statutory form of accounts. (6) Distribution of supply. (7) Sales and commercial development. (8) Legislation governing industry.

In order to illustrate the changed conditions since the war in regard to capital, the author presents figures for present and pre-war costs for a typical undertaking. Capital expenditure is shown to have increased 150 per cent., interests and repayments 364 per cent. and 138 per cent. respectively, the total charges to revenue having increased nearly 250 per cent. Generally speaking, one-half of capital is spent on generation, the other half on distribution. Methods of raising money loan repayments, &c., are next discussed and illustrated by diagrams. The accumulated sinking fund is spoken of as one of the most complicated systems; but it is very flexible and very generally adopted.

Under costs of production, attention is naturally devoted largely to the increased cost in coal. A diagram shows how the cost of coal per unit has steadily kept pace with the rising value of price of coal per ton; within recent years, however, some relief has come from the diminution in lbs. of coal per unit. So much so that for the last two years the coal cost per unit remained almost stationary. The allocation of capital charges, management, oil, water, wages and repairs, and coal is also illustrated diagrammatically. A striking point is that standing charges such as are practically irreducible form 65 to 80 per cent. of total expenditure. A supply company cannot economise in bad times by discharging labour and shutting down plant to the same extent as a manufacturer. Reference is made to the brilliant analysis of costs by Dr. John Hopkinson and Arthur Wright nearly 30 years ago, when, however, problems involved in charges were much simpler than to-day. A diagram illustrates the close resemblance between the graph cost of production of electrical energy at different times in the day, and that based on the "theory of diminishing utility." Methods of treating consumers are discussed in detail. Multipart tariffs may bring about a general system of charging for all supplies. The writer looks forward to the day when electricity will be on tap, and without any very great restriction, for an inclusive figure per kilowatt per annum, a stage that does not appear impossible.

In connection with allocation of revenue earned, the author deprecates any local rate relief (or any aid from local rates) as un-

sound. In the final section on sales and commercial developments' he urges the need for publicity, both local and on a national scale' and the education of consumers in the use of electrical appliances' Electrical vehicle working is spoken of as an excellent example of municipal enterprise. Some tabular data are presented summarising experience with two $3\frac{1}{2}$ ton vehicles during six months, the costs per ton-mile being given as ls. 3-85d. and 10-18d. respectively.

DISCUSSION.

Mr. BAILLIE SMITH (Glasgow) said Glasgow's experience of the new rules for the repayment of capital had not been satisfactory. Municipal undertakings must repay their capital in a fixed number of years and were, therefore, at a disadvantage with respect to companies who could repay it when they liked. That meant the cost price of generation, everything else being equal, would be higher in municipally-owned than in company-owned undertakings. He criticised adversely the periods allowed for the repayment of loans on land and buildings and concluded by expressing his opinion that the whips of the Scottish Office were preferable to the scorpions of the Electricity Commissioners, though the blows of the latter might be tempered by permitting more freedom in the paying off of loans.

RETROGRADE PROPOSALS.

Ald. W. WALKER (Manchester) stigmatised Baillie Smith's suggestions as retrograde. To allow the suspension of the sinking fund payments would be most dangerous. It was only fair to point out that many municipalities in addition to the statutory sinking fund had a special reserve fund which enabled them to renew their plant at the earliest opportunity irrespective of whether its life had expired.

Mr. ALEXANDER KENNEDY (Glasgow), speaking in broadest Doric, said that Baillie Smith's opinions were not the opinions of the Glasgow representatives at the Convention.

Ald. J. A. BEAUMONT (St. Marylebone) thought that if the temptation to suspend the sinking fund were dangled before municipal electricity undertakings many of them would fall to it. Mr. Charlesworth had pointed out that municipal undertakings were at a disadvantage with regard to working capital compared with privately owned undertakings, which could always raise fresh capital while the municipalities could only borrow for certain specific purposes. The only way to obtain such working capital was to create a reserve, and this could only be created from surplus revenue. In instituting this fund also the municipal manager was hampered by the fact that the primary consideration was to provide the best and cheapest supply of electricity to the consumer and not to make profits. Some remedy should be found for this state of things.

CAPITAL COSTS FALLING.

Mr. S. J. WATSON (Bury) said that events of the past few years had attracted attention to the necessity of municipal electricity undertakings having some organisation for developing their sales. Working capital was a more important consideration in the early days of an undertaking than later on, and it eased the position if revenue was collected as far as possible by monthly accounts. On the question of charges, he thought that the tariff for extra-high-tension supply should be much lower than for converted supplies, while there should also be a difference between low tension alternating current and low tension direct current, owing to the extra cost of providing the latter. The charges for electricity supply had not increased in anything like the same proportion as the prices of other commodities. He gave figures showing that the capital cost of building generating stations was beginning to fall. This fall must continue, though figures were not likely to reach pre-war level in our life-time. This tendency would be assisted by a reduction of the rate of interest. He emphasised the necessity of the general adoption of a two-rate system of tariffs.

LIVING ON OVERDRAFTS.

Mr. E. E. HOADLEY (Maidstone) did not agree with Mr. Watson that working capital was the most required in the early years of the undertaking. At Maidstone they had had no difficulty in this respect until quite recently. An application to the Electricity Commissioners had brought no assistance except a hint that a bank overdraft was a good way out of the difficulty. He had recently got permission from the Commissioners to charge business premises on either the maximum demand or the telephone systems without the option of a flat rate, for unless they could charge a flat rate from ls. 4d. to ls. 6d. per unit the supply to ordinary shops was not remunerative.

Mr. A. H. DYKES said that with the increased cost of materials it was more than ever important to have a certain reserve of working capital. A number of small undertakings had been badly hit by the increase in wages and costs of material and by the delay in giving them permission to increase their charges. A good deal would be achieved if they could bring pressure to bear on Parliament to grant the Commissioners power to permit loans for working capital. The fixed price method of charging was quite fallacious and constant reiteration of that statement would make the Commissioners see that an alteration was necessary. For while a small increase in price might be very well for industrial undertakings in those undertakings whose load was principally lighting, the only commercial way was to impose a rate which bore a relation to the cost of giving facilities to consumers, together with a small charge for the current consumed. Cases had occurred of consumers with a lighting demand of about $\frac{1}{2}$ kW putting in domestic apparatus with a demand of some 12 kW, this apparatus only being

used for a short time each day during two months of the year. For this they were charged at a penny or two-pence a unit, a rate which did not pay interest or sinking fund on the installation of the necessary transformer. Though finding capital for additional plant was difficult it was not so difficult as finding additional capital for mains.

ALTERING LOAN REPAYMENT METHODS.

Mr. C. W. CHARLESWORTH, in reply, said he did not advocate the postponement of capital repayments, but the present system whereby the repayments were equal throughout the entire life of the plant should be changed so that in the earlier years the undertaking might be relieved of a burden which could be quite easily borne later on. If loans were raised for working capital a reserve fund would have to be created, and it might be arranged that such right should only be exercisable where a reserve fund did not exist.

Thursday, July 21st.

When the Convention met on Thursday morning the weather was fortunately cooler and the room at first was not full, so that the conditions were more pleasant. This was perhaps an added advantage as the subject under discussion was closely connected with steam. Papers by Mr. DAVID WILSON on "Steam Raising, Yesterday, To-day and To-morrow," and by Mr. W. M. MILES on "Modern Boiler House Practice," were read. These we publish in abstract below:

Steam Raising: Yesterday, To-day and To-morrow.

By DAVID WILSON, O.B.E., A.M.I.E.E.

The use of steam is of early origin. Hero of Alexandria, about 283-241 B.C., devised a rotating steam boiler, the "Aeolipile," which was the precursor of the steam engine. From this time onwards to Friar Bacon, in 1264, Solomon de Cares in France in 1615, and ultimately James Watt in 1769, the generation of steam and its use in an engine were much discussed. For a long time steam was generated from water in bulk, then by the internal flue, as in the Cornish and Lancashire boilers, the loco-type boiler on land and the Scotch marine type at sea representing still further advances.

THE VALUE OF HIGHER PRESSURES.

The value of higher pressures was soon recognised and was studied very scientifically in America. Count Rumford, in 1796, adopted the water-tube principle, and Woolf, in 1803, took out a patent on this subject. The first sectional or water-tube boiler with a free circulation of water in one continuous round was patented in 1867.

Difficulties from this point related largely to material. Up to 1875 steel was regarded as a treacherous material, and wrought iron was still mainly used; it was only about 1887 that steel plates of uniform quality and adequate size could be obtained. The invention of suitable machinery soon made drilling less expensive than punching. The importance of the water-tube boiler as compared with the Shell type was well established in 1904; even in 1898 water-tube boilers were as freely used as the Lancashire type in power stations, and by 1904 were well in advance, upwards of 425 000 h.p. in the United Kingdom being generated in boilers of this class. Some twenty years ago the largest units would evaporate 10 000 lb. of water per hour into steam at 120 lb. per square inch. Present day boilers are capable of evaporating 100 000 lb. per hour at 225 lb. per square inch, and some present power stations use upwards of 50 such boilers. To-day, also, superheat temperatures up to 700°F. are common.

BOILER EFFICIENCIES.

Considerable difference of opinion in regard to efficiencies still exists, and high values are often discredited even when every care has been taken to ensure accuracy. A distinction must be drawn between *test efficiency* and *operating efficiency*. As regards test efficiency the author is satisfied that when using high grade coal in a modern boiler, a combined efficiency of boiler, stoker, superheater and economiser equal to 85 per cent. can be attained. For a complete boiler unit working at 5 lb. per square foot of heating surface, with gases leaving the economiser at 375°F., average CO₂ 12 per cent., and high grade coal, heat absorption is distributed as follows:

Heat absorbed by boiler and economiser.....	85 per cent.
Heat lost in chimney gases	9 "
Heat lost in combustible in ash.....	1 "
Heat lost in radiation	4 "
Unaccounted for	1 "

100 per cent.

Operating efficiency depends upon (1) load factor, (2) instruments for controlling efficiency, (3) variability of coal used, and (4) the human element. The time is approaching when the present big difference between test and operating efficiency will be diminished,

and in fact operating efficiency will approximate closely to that found under test conditions. With high grade coal such a figure as 85 per cent. is realisable, with the low grade coal now so common conditions are naturally more difficult.

FURNACE DESIGN.

In view of the above considerations it appears that the margin for future improvement in boilers is relatively small. Furnace efficiency is the dominating factor at the present time. Improvement in design of mechanical stokers has steadily progressed; such stokers can now be designed to burn practically any kind of coal, an advance largely due to the recognition of the principle of the "balanced draught," i.e., the intelligent use of a forced draught. Forced draught, which overcomes the resistance of the grate and completes combustion, is of chief advantage in burning low-grade fuel, sometimes containing as much as 40 per cent. of ash. Variable opinions of diverse types of mechanical stokers are due to differences in conditions rather than differences in design. Much is said in regard to maximum combustion per square foot of grate, but we have still to decide the economical limit in this direction. Whilst ground space and capital cost are influenced by this factor, high thermal efficiency is more certain with a reasonable consumption per square foot of grate. One stoker design may excel in one particular direction, but general considerations such as range in fuel, must be considered. Maintenance costs increase in proportion to the consumption per square foot of grate. Moreover, high consumptions leave less margin for emergencies and efficiency is more difficult to control. Obviously the rate may be higher for high-grade coals than for low grades. It would be better to consider coal consumption on the basis of B.Th.U.'s liberated per square foot of grate, rather than lb. per square foot. 350 000 B.Th.U.'s per square foot appears to be the maximum for normal duty.

The Bureau of Mines, U.S.A., in recent experiments ascertained that for Pocahontas, Pittsburg and Illinois coal-combustion space worked out at 3.2, 3.9 and 5.8 cubic ft. of space per square foot of grate, when burning 40 lb. of coal per square foot of grate per hour. This is equivalent to 12.5, 10.2 and 6.9 lb. per cubic foot respectively. In modern boilers in this country combustion space under the tubes works out to 6.1 cubic ft. of space per square foot grate area; with a reasonable consumption of 25 lb. of coal per square foot of grate the combustion is 4 lb. of coal per cubic foot of combustion space under tubes.

OIL-FIRING.

In view of the general interest in the substitution of oil for coal, it is of interest to discuss the chief methods employed, namely, (1) those using steam as a spraying or atomising agent, (2) those using pure air for this purpose and (3) those in which oil is atomised mechanically by pressure. In general, either (1), on the ground of simplicity, or (3) on account of the higher efficiency and greater applicability to higher rates of evaporation, is adopted. Most burners will use either steam or air, but the latter involves expense in air-compressors. Method (1) has a low first cost of equipment, but about 5 per cent. of the steam produced is needed to atomise the oil; this involves a loss in efficiency. At present the leading system uses centrifugal force as the spraying agent. This is highly economical and efficient, but involves higher first cost. Oil in England is at present about £5 10s. per ton; ultimately the price should be further reduced, making the comparison with coal much more favourable. In making comparisons due regard must also be paid to calorific values, also to reduction in cost of handling fuel, as there are no ashes or clinkers to remove. Further, boilers can be worked at higher rates (more steam per square foot of heating surface) with oil than with coal, and are more easily kept clean. In large power houses the conversion of at least a few boilers to oil-firing, especially with a view to meeting peak-loads, might well be considered.

PULVERISED FUEL.

Pulverised oil is no new idea and has received closer attention in America than elsewhere. A few modern plants are now in use in this country, but another six months' experience is needed before its effects can be fully gauged. Theoretically the method has great advantages, but mechanical stokers enable many coals hitherto regarded as refuse to be used efficiently. From the standpoint of efficiency it appears that the method is best suited to low-grade coals. Operating over-all efficiency might prove to be appreciably higher with pulverised coal. In America it is considered that ordinary bituminous coal can be burned at 2 lb. per cubic foot of combustion space. Larger combustion volume is required. In the original Paper the author remarks that three chief methods of pulverising coal are available. The method of central drying and pulverisation and subsequent distribution in suspension by low-pressure air is being tried at the power station at Hammersmith.

On the Continent a system of installing self-contained pulverisers at each unit has made progress. The power required for pulverisers approaches 75 h.p. for a mill producing 5 tons of coal per hour. The most convincing evidence in favour of pulverised coal is that of the Milwaukee Electric Railway & Light Company, which has equipped a plant of 40 000 kW. An actual gross efficiency of 80.67 per cent. for powdered fuel and 76.8 per cent. for stoker firing is given, the net efficiency being 73.32 per cent. for pulverised fuel and 70.88 per cent. for the mechanical stoker—a difference in favour of the pulverised fuel of 1.44 per cent. Mr. W. H. Jones has pointed out that for a plant dealing with 300 tons of coal per day, the cost per ton would work out at about 5s. 2d.

SIZE OF BOILERS.

Thirty years ago the maximum steam capacity of boilers was about 7 500 lb. per hour; to-day 130 000 lb. of steam per hour is attained. America has led the way in large boilers, engineers in this country prefer distribution in several units. Moderate sizes of 20 000 to 30 000 lb. per hour have been usual, but recently 50 000 to 80 000-lb. units have become common and boilers for 100 000 lb. per hour (actual) are under construction for Manchester Corporation. Size of boiler has little effect on unit thermal efficiency. Thus, Detroit Station has an over-all thermal efficiency of 16.5 per cent. with 130 000 lb. per hour boilers; in this country 18 per cent. is reached with boilers of moderate size evaporating 30 000 lb. per hour.

STEAM PRESSURES.

Steam pressures have advanced very rapidly and in this direction Britain is ahead of America. 250 lb. is quite common, several boilers are working at 350-lb. and in one case at 475-lb. pressure. Evidence so far collected is that maintenance is not greater on boilers working at 350-lb. pressure than those operating at lower values. Safety, with first-class construction, is not a matter of pressure, and an explosion on a plant working at 500 lb. would be little more disastrous than on one operating at 100 lb. Taking into account the present factors of safety, conditions are safer in the former case.

BOILER RATING.

Reference is frequently made to the high boiler ratings in the United States. In this country boiler rating is not standardised, varying with different designs but always above the American standard. Normal working in this country is at a transmission rate of 7 000 B.Th.U. per square foot of boiler heating surface per hour; this may be equivalent to an American rating of 209-249 per cent., or 261-311 per cent. at the usual overload rating of 25 per cent. The heat-transmission basis is the most scientific one for boiler rating, and the author suggests that data based on lbs. of water evaporated per square foot of heating surface are misleading. Experiments show that the value mentioned above for British boilers is well below the safe limit.

SURPLUS AND WASTE HEAT.

In the future there should be great developments in the use of surplus and waste heat in power stations. There are several large plants using surplus gas of a calorific value of 450 B.Th.U. per cubic foot. In Newcastle such gas has been brought some distance and burned under water-tube boilers with an efficiency of 79 per cent. A large plant in India hopes by this means to achieve an evaporation of 100 000 lb. per hour. With blast-furnace gas efficiencies up to 77 per cent. will doubtless be obtained. As a rule, 50 per cent. of such gas is available for steam raising. Where a large number of blast furnaces are centralised, there are great possibilities for a local power station, such as already exists in the Lorraine district. In the case of waste heat pure and simple, such as is derived from furnaces in iron and steel works, boilers would have to be placed very near the furnaces and the possibilities are less promising.

THE FUTURE.

Future progress in steam raising will involve more scientific control of boiler plant. Furnace design will continue to improve. Ultimately the use of raw coal for steam raising may be forbidden and all by-products recovered before using the carbon residue. Boiler pressures may also still further advance and even higher pressures than 600 to 650 lb. may be realised. Superheat does not seem likely to advance much beyond the present limit of 750°F., owing to limitations to the heating of the steel used for the superheater. Meantime, it is certainly unsatisfactory that the highest over-all efficiency in converting heat energy to steam does not exceed 18 per cent. and that our immediate expectations do not go beyond 25 per cent. Further, the conveyance of so much inert matter from the colliery to the furnace is a matter that calls for improvement.

As regards special devices, mention may be made of the Bonecourt surface-combustion unit, which, however, has not yet fulfilled expectations. Another new device is the mercury boiler, mercury

being evaporated and condensed on a closed cycle, and acting as a conveyor of heat from the furnace to the steam. It is claimed that with a 15 per cent. increase in coal consumption there is a net gain in station capacity of 60 per cent. The electrical boiler also deserves passing reference. In countries where coal is dear and water-power is abundant it has made progress. In certain paper mills in the Alps the largest electrical boilers in the world, each consuming 4 000 kW, are used. Finally, there is the Sun boiler at Cairo utilising the sun's rays, though this offers no immediate prospects to the central-station engineer in this country.

Modern Boiler House Practice.

By W. MILES.

The present high cost of production is largely due to the high price of coal, and to deterioration in quality. Recently slacks have increased in ash content, and decreased in calorific value. A campaign is needed to prevent power stations being made the dumping grounds of colliery refuse. In the States and abroad more or less successful attempts have been made to buy coal on a calorific content basis. The usual methods of selecting fuel in this country are inadequate. Consumers may be partly protected by a requirement that coal shall come from the same mine and seam as a sample; but much depends on the supervision at the colliery, which is to-day a fluctuating quantity. Before the war steam coal with only 10 per cent. less than $\frac{1}{2}$ in. size could be obtained; to-day samples often contain over 50 per cent. of worthless material.

COAL ANALYSIS, VALUATION AND PURCHASE.

The author recommends that, besides the ultimate analysis, the weights of each size should be given as percentage, and all slate picked out and given as a percentage of the total weight of coal. A standard method of analysis, taking calorific values, size of sieves for sampling, &c., should be drawn up. There has been no general attempt to establish a penalised system of purchasing coal. The author proposes, in determining net B.Th.U.'s per penny, to multiply the calorific value of the coal as fired by 2 240, and divide the product by the contract price in pence per ton plus one penny for each 1 per cent. ash present.

After finding the standard value in nett B.Th.U.'s per penny, future deliveries can be checked by reversing the formula and determining the relative prices—values of the coal. The essential point is that the number of heat units purchased for 1d. should remain the same. The method of collecting samples from trucks is important, and the author shows diagrammatically how this should be done. Samples are packed in air-tight tins and sent to the laboratory. For testing the bomb calorimeter is preferred, but the sample must be carefully powdered. Regular weekly samples should also be taken from the furnace hopper, as a check on efficiency of plant. Good efficiencies can only be obtained from low-grade coal by the aid of constant supervision.

Good reserve stocks of coal are naturally important. Slack coal is most apt to be subject to spontaneous combustion. Ventilating ducts are of doubtful utility, and good clean nuts do not require ventilating. Coal should never be stored where heat from another source can get to it, and start gasification.

FIREBRICKS AND REFRACTORIES.

Firebricks and refractories play a great part in fuel combustion and require regular tests. Bricks that stand well with low-grade fuel are not always suited to better grades. Extremes of temperature in boiler furnaces may cause apparently good bricks to become friable. Care should be taken in drying out brickwork arches when first built in or renewed. Many failures have been due to insufficient time for thorough drying out before being put in service.

FEED-WATER TREATMENT.

Correct treatment of boiler water is only second in importance to choice of fuel. It cannot be too pure. Scale on boilers is usually composed of salts of lime or magnesium. Carbonates are generally precipitated immediately inside boiler due to liberation of CO₂, while the more soluble sulphates pass to other parts of the boiler. Mag. sulphate and sodium sulphate are commonly considered non-scale forming. But at 400°F. tube troubles have been caused by such sulphates. Daily or weekly tests should be made for free alkalinity, sodium chloride and hardness. Boilers should be blown down regularly.

CORROSION IN STEAM BOILERS.

Corrosion may be due to (1) liberation of dissolved air and CO from too cold a feed; (2) feed water containing free or organic acids; (3) leakage of circulating water into condensate; (4) oil and other impurities; (5) decomposition of salts within the boiler; (6)

bad circulation. All causes with the exception of No. 1 can be overcome by means already mentioned, and No. 1 largely by feed-water heaters, water softeners of the hot type or evaporators.

Methods of preventing corrosion include the introduction of substances containing tannin, electric methods for changing polarity of boiler shell and tubes, or the totally enclosed system. In some forms of boilers more attention should be paid to the distribution of feed water on entering drum as corrosion is liable to occur at this point. Corrosion due to dissolved air in steel-tube economisers has given trouble. All gaseous impurities in such water should be eliminated. Tannin helps to remove oxygen and the Elliot system (U.S.A.) is claimed to achieve a similar object.

Condenser leakage and contamination of return water is apt to cause scale, and daily tests should be made on the condensate. Where circulating water contains much chlorides, silver-nitrate tests may be applied; leakage may also be determined by electric means (e.g., the Dionic water tester).

STEAM-FLOW METERS, WATER METERS, &c.

Steam-flow meters offer a ready means of finding which boilers are not evaporating at normal efficiency, and water for any unit should be passed through a suitable meter when necessary for tests. Water regulators should be used on all boilers, as assisting (not superseding) the human element. Water circulators for raising temperature of water entering condensers have helped to reduce external corrosion through condensation of moisture.

Flue-gas analysis may be effected by various forms of CO_2 apparatus, but their installation on each boiler is expensive, and there is room for a cheap reliable instrument.

BOILER-HOUSE MANAGEMENT.

During the coal-economy campaign the author gave lectures to workers in boiler houses, which led to an improvement in efficiency from 68 to 73 to 74 per cent. The effect, however, was only temporary, owing to the reinstatement of men with the Forces. America is in advance of us in such training methods.

In the boiler house, the writer arranges for the taking of the following data daily: Average boiler pressure; average total temperature; average temperature of feed water leaving tanks; average temperature of feed water leaving circulator; average temperature of feed water leaving economiser; average temperature of gases leaving boiler; average temperature of gases leaving economiser; average per centage CO_2 ; average draft; total coal burnt; total coal used for banking; sample of coal from each hopper on every boiler in commission; sample of ash as dumped from boiler; total weight of ash (calculated from analysis); total water evaporated; total water required for make-up.

Ash sampling is a ready means of stopping waste, because of the competition amongst firemen to obtain the best sample. The author uses a modified form of Goutal's formula for tests on boiler refuse.

In this formula it is assumed that fixed carbon has a constant combustion equivalent of 8200 calories or 14700 B.Th.U.'s, while the heat of combustion of volatile matter is variable and allowed for by a suitable factor.

INSTRUMENTS AND RECORDS.

Instruments for obtaining information from various parts of a boiler should be in accessible positions, preferably near floor level. All results should be entered systematically on duplicate sheets. In the original Paper typical data sheets are presented. With high-grade fuel the author thinks that boiler efficiencies of 75 per cent. should be obtained under working conditions; under test conditions, 80-83 per cent., according to grade of coal, should not be difficult to obtain. Figures are presented showing radiation losses of 4 per cent., and loss in chimney gases of 12.5-17 per cent. With high-grade coal, CO_2 may be 10 per cent. under working conditions and 14 per cent. under test conditions; with low-grade fuel, 9.5 per cent. and 12.5 per cent. is recorded. Excess air is another source of loss. Too much must not be expected from the operating engineer, and investigations on any improvement should be undertaken by the staff of the testing department. Some system of acquainting boiler-house staff with changes in load and plant should be adopted. Particulars of maximum kilowatt load, number of boilers steaming and banking, average kilowatt per boiler, &c., should be posted every 30 minutes in the boiler house for the information of the engineer. During four months ending April, 1921, the average calorific value of coal received was 1000 B.Th.U.'s above the 1920 average. The average kilowatt rating per boiler has, therefore, increased from 1600 to 2000 per boiler, which, on 40 000 kW load, means a saving of 20 per cent., or five boilers.

DISCUSSION.

Mr. W. H. PATCHELL, in opening the discussion said Mr. Wilson gave his results in net calorific values and Mr. Miles in gross calorific values.

It was a pity when they had a duct from two such capable performers that they could not keep in the same key. He agreed with Mr. Wilson on the undesirability of camouflaging reports and said that in the United States competition between stations was courted. Large boilers could be run over a wide range of efficiency especially when properly controlled and with plenty of space to get good combustion. That being so too much could be made of the influence of load factor. Using a coal with heavy ash meant that there was more fuel on the grate than was necessary or that more draught was required. In the States they were getting away from the flat grate to the retort grate. The increased height of the furnace was very important as experience at Bow had shown him that this enabled the smoke to be burnt and good combustion to be obtained before the gases touched the flues. This was confirmed by results at Detroit where they were putting in boilers 3 ft. higher than the one described by Mr. Wilson. At the Hell Gate Station of the New York Edison Company the boilers had their lower drums 21 ft. below the floor line and their inclined tubes 21 ft. above the floor line; while in the case of two Ladd boilers put in at the Ford Motor Company's works the distance from the lower drum to the ground line was 35 ft. With regard to the use of pulverised fuel it must not be forgotten that enormous space was occupied by the fuel grinding plant. In America it was often the practice to put a small grinder over the boiler and this seemed a reasonable system. He thought that Mr. Wilson's figure of 16.5 per cent. thermal efficiency for the Detroit station was the result of working several stations under ordinary conditions over a long period while his reference to 18 per cent. in this country was either a station or part of a station working on a selected load. He hoped that the British Engineering Standards Association would do something before long in regard to pipe joints for higher pressures. The limitations of boiler work were getting the gases out of the setting and the steam out of the boiler and it was not astonishing to find that there was 20 lb. difference in pressure in the boiler and in the main steam pipe.

EXPERIENCES WITH OIL FUEL AT BIRMINGHAM.

Mr. R. A. CHATTOCK (Birmingham) said that the use of oil fuel at Birmingham during the strike, although it cost considerably more than coal, was justified in the greater boiler output obtained. The use of pit mouth coal and outcrop coal cut down the boiler capacity by one third, though at first they were able to mix this with their stock of screened nuts and to obtain very good results. As regards oil burning they first employed large burners burning 100 gallons per hour fitted into the side of the boilers. These did not give satisfactory results as they tended to damp down the coal. He had often had difficulty to ignite the poor coal on the mechanical stokers as there was not sufficient volatile matter in it to keep the arches in a state of incandescence. Afterwards they adopted small burners using about 15 gallons per hour fitted at the front end of the grate on each side. In this way they kept the arches incandescent and the fuel burned fairly satisfactorily though the boiler capacity was not greatly increased. It was important to ensure that the oil used was free from sulphur and his experience was that boilers should be specially designed for oil fuel with combustion chambers of large capacity to ensure perfect combustion before the tubes were rigid.

THE ECONOMICS OF FUEL RECORDING APPARATUS.

Mr. S. E. FIDDEN (Sheffield) said that with the boilers at Sheffield they got a total efficiency of between 73 and 75 per cent. He had gone into the cost of employing extra instruments and recording apparatus and the staff for working them and found that it would cost between £5000 and £6000. It was therefore a question whether it was worth while going to this expenditure to increase the efficiency by about one per cent. In France he had seen pulverised fuel in use supplied from turbo-pulverisers. No smoke came out of the chimneys, but only a little white vapour and the ash was practically incalculable. The dust which was spread all over the country he was told, would be a good fertiliser agent and not a nuisance. Coal for pulverising, he was told, must have a high volatile content, but in some cases a low volatile coal was used mixed with oil, while the greatest efficiency was obtained when the moisture did not exceed 5 per cent. The coal in question was used in reheating furnaces and they obtained 50 per cent. more heat from the furnace with a 25 per cent. reduction in coal gas. He agreed with Mr. Wilson that the total temperature should not exceed 750 deg. as there was an enormous drop in the strength of the metal when temperatures above that were used. Low calorific value fuel was best dealt with by mixing it with tar and putting the mixture straight into the hopper. He had found that Class E. Underfed Stokers would tackle almost any fuel that would burn at all, and using this equipment they could change from coal to coke quite easily. When using oil they fed broken fire bricks on to the stokers and turned on the oil. When the oil ran out the fire bricks were dumped and the coal fed in. Tar was burned through the same pipe as the oil. Half their troubles would be swept away if the colliery owners could be forced to sell them coal and not dirt.

DIFFICULTIES OF COAL BUYING.

Mr. W. B. WOODHOUSE (Yorkshire Electric Power Company) pointed out that in buying coal they were not buying a manufactured article and all they could do was to ask the coalowner to supply them from a particular seam the product of which could be analysed in various ways and to obtain guarantees as to size and amount of ash. The important and that thing was not the total heat in the coal, but the available heat and that was practically determined by the amount of ash. Mr. Miles had shown a that as screening was continued the percentage of ash increased up to a certain point, but if he had continued his analysis until fine dust was reached he would have found that the ash percentage became less

as the screenings became smaller. In a fuel a certain percentage of moisture was of value and that increased the advantages of washed coal.

Mr. W. M. SELVEY said that his experience and that of others had led them to the conclusion that coal was not a permanent substance. It was continually oxidising and that process was more rapid the larger the coal. Small coal was not large coal broken up, but was generally coal that had been cut in the seam to get the better coal out. He did not think that much progress was to be made by buying coal on a purely calorific value basis. In the boiler house they wanted muscle controlled by conscious thought and the more conscious thought there was the less muscle would be required. Considering the power generation question as a whole considerable economies might be effected by removing the smaller water tube boilers from the larger stations and putting them into smaller stations where Lancashire boilers were now in use. The use of welded steam mains was one of the minor improvements they could well make in the design of power stations, but insurance companies were prejudiced against their use.

PULVERISED FUEL AND ORDINARY CONDITIONS.

Mr. F. F. EVANS (Underfed Stoker Company) began by reading a communication from Mr. Wood, managing director of the Company, in which he said that Mr. Wilson was on safe ground in placing the efficiency of the steam-raising apparatus at 85 per cent., as 87.2 per cent. had already been obtained in Germany in 1912 with Saar and Ruhr coal, while in America 90 per cent. had been obtained on a trial with pulverised fuel. But of what avail were figures obtained under special conditions? Pulverised fuel must also be judged by results obtained under ordinary conditions. Mr. EVANS, speaking on his own account, said that the question of the amount of dust from chimneys was important. Though its fertilising action might be of value, in America one of the largest stations had got into trouble because the cattle could not assimilate the hay which had been dusted in this way and the use of such fuel in industrial and residential areas would therefore seem to be impossible. We seemed to be reaching a time when a large variety of fuels would have to be dealt with on one grate. Coke breeze had successfully been burned in some of the London stations. When there was anything like a demand for this fuel its cost went up. If low temperature carbonisation of coal and the more general use of coke breeze and low volatile materials were to come in a considerable change in the whole system of boiler house economy would be necessary.

TAKING EVERYTHING INTO ACCOUNT.

Mr. S. UTTING said that Mr. Wilson's figures of the heat value of a boiler unit were not sufficient to make a proper analysis, as the cost of obtaining the figures given must be taken into account. If an engineer decided that he was going to get results at a reasonable cost per kilowatt air heating had no chance. If he was going to do that he must also reduce other items besides air heating if he desired a good scheme. There were engineers who were in favour of obtaining heat feeding from other sources than the economiser and if they could do this they were not likely to spend money on such apparatus. He thought therefore he was on safe ground in saying that it was possible to abstract heat and cool the gases to a given point at a lower figure with once heating than would be possible with an economiser.

Mr. CHARLES ERITH said that in steam raising plant in connection with the very large units of 60,000 kW, which were now being erected in Paris, the boilers had economisers, whereas the fire-drum boilers of the Detroit Edison Company had not. The firing methods were similar in the two cases, 218 retorts being used in the first case, as against 213 retorts in the second. Separating the air heater from the economiser gave a 2½ per cent. extra efficiency. The largest boilers now being constructed in this country were to the order of the Shanghai Municipality, and in them low and dusty Chinese slack was to be employed, so that the furnace did not require grates. The retort type of boiler referred to by Mr. Patchell, used the type of mechanical stoker with which his name was connected. This stoker was equally valuable for all grades of coal and all rates of combustion, whereas with a chain-grate stoker they were limited to the use of low grade coal.

Mr. S. R. WINDLE (Doncaster), referring to Mr. Fedden's remarks on expenditure for apparatus for boiler house, said that in smaller stations such apparatus was useful as it avoided the expense of super-men.

Mr. R. B. MITCHELL (Glasgow) asked boiler makers for advice as to the use of gauges. At Glasgow the dial type indicating gauge had been employed, but these were utterly unsuitable, and had been discarded in favour of the electrical type. Smoke nuisance had been greatly reduced in Glasgow by the use of a large combustion space. They used washed fuel entirely, but this cost them 2s. 6d. per ton extra.

After the luncheon adjournment a Paper on "Present Day and Commercial Problems in Electricity Supply" was read by Mr. E. CROSS, of Rotherham. This Paper is given in abstract below:—

Present Day Commercial Problems in Electricity Supply.

By E. CROSS.

Electricity supply problems assume an aspect different from that met prior to the war. In our anxiety to attain the highest generating efficiency we must not overlook the primary problem of supplying at the lowest rates consistent with reliability. It is not necessarily advisable to generate maximum power per given

quantity of coal. Reliability of supply may be a more important factor.

In considering extensions or improvements the question of capital expenditure is a vital one at the present time. The additional capital expenditure justified to effect a saving in coal consumption is given by the formula:—

$$E = \frac{0.196}{R} \cdot \frac{C \cdot L \cdot f}{1 - \left(1 + \frac{R}{100}\right)^n}$$

where E = additional expenditure warranted per pound of coal per unit saved; C = cost of coal in bunkers in shillings per ton; L = maximum load in kilowatts; f = percentage average load factor over one year; R = rate of interest; n = number of years of active life.

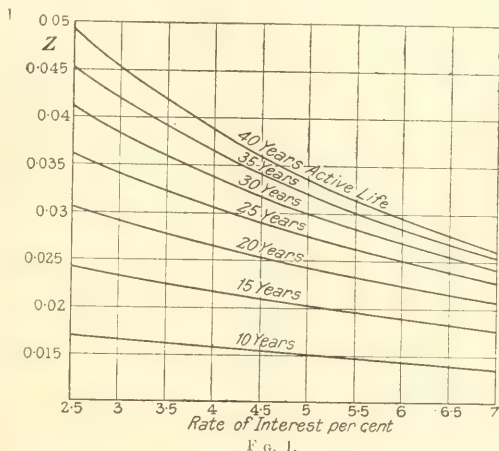


Fig. 1.

This formula can be conveniently written: $E = C \times L \times f \times Z$, where Z is a function of R and n . (See Fig. 1.)

THE INEFFICIENCY OF STEAM PLANT.

All steam plant is relatively inefficient. The present limit of thermal efficiency is near to 20 per cent. In the turbine room each pound of steam condensed artificially—i.e., by cooling water—

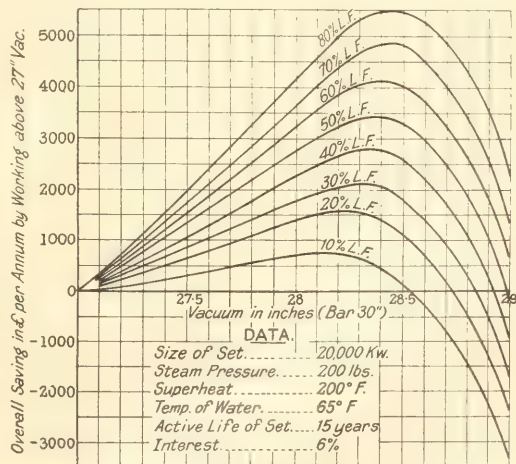


Fig. 2.—COMMERCIAL EFFECT OF VACUUM ON COST.

loses 90 per cent. of latent heat. The more work that can be got out of the steam before condensation the higher the efficiency. High steam conditions and reheating at intermediate stages make for improved efficiency. Before the advent of high steam pressures a high vacuum was more important, but the question now requires

more detailed consideration. Hence the author, in his original Paper, presents a series of curves showing its influence on cost per unit. Thus the reduction in steam consumption by increasing vacuum and rendering more heat-drop available is shown. However, the turbine efficiency falls slightly in many cases owing to increased friction and greater leaving losses. The diagram can also be arranged to show actual saving in £ s. d. This, however, is somewhat less proportionately than the gain. Gain in coal consumption can again be shown in a similar manner. In all cases the method of obtaining the vacuum is ignored.

With cooling water at a given temperature higher vacuum requires more water, more power is used in pumping and such items may have an appreciable effect. Fig. 3 shows true percentage saving in coal for a 20 000 kW set with cooling water at 65°F., and a total head on circulating pump of 30 ft. The amount of water required for condensation depends partly on the design of condenser. Another consideration, omitted in previous curves, is the effect of heating feed water by passing out steam at intermediate stages. This reduces saving due to increased vacuum. Steam auxiliaries are efficient if heat in exhaust steam is fully utilised; otherwise they are wasteful.

There is a limit to the amount of exhaust steam that can be efficiently used. Less is required at light loads than at full load, and it is best used by passing out from the main turbine rather than a small turbine or steam ejector. Electrical auxiliaries show a saving over steam auxiliaries when feed water is heated by bleeding the main turbine. Steam feed pumps, though less efficient, may, however, be recommended on the ground of reliability.

Capital cost of plant has also an effect on the most economical vacuum. It does not pay to install plant to work with a very high vacuum unless the load factor is good; see for example Fig. 2.

COMMERCIAL POSITION OF STATIONS.

We may now consider how far from the centre of the load it is commercially feasible to erect a power plant in order that an abundant supply of cold circulating water may be obtained. The chief factors that should decide such a position are: (1) Proximity to load; (2) proximity to abundant water supply; and (3) proximity to collieries. In this connection the author compares the cost of providing and operating a 100 000 kW station, comprising four 20 000 kW sets and one similar set as a stand-by, with abundant water supply at 50°F., and (a) abundant water at 65°F., (b) only sufficient water at 65°F. to deal with half load (40 000 kW), and (c) no water. Actual lives assumed are 20 years average for whole station, 25 years for cables and 12 years for cooling towers. Coal is taken at 30s. per ton, total head on circulating pumps as 30 ft., and an additional 30 ft. where towers are used. Obviously the station with water available at 50°F. would be most efficient, the coal consumption being as shown in Fig. 3.

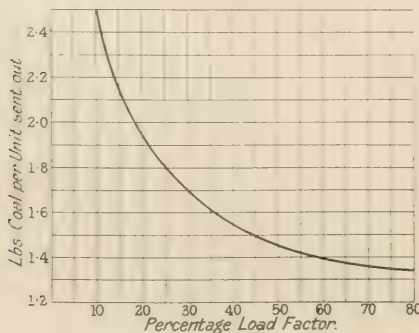


FIG. 3.—COAL CONSUMPTION (12500 B.T.H.U. PER LB.) OF SUPER-STATION USING COOLING WATER AT 50°F.

In the original Paper another diagram is presented showing excess cost in pence per unit under various other conditions. It appears that with water at 65°F. it would be more economical to run with half water with a more expensive condenser, than to install towers, unless load factor is high. The distance economically permissible from the load with abundant water at 50°F. must be such as to compensate added cost per unit in transmission. The allocation of the various losses (C^2R , eddy currents, dielectric losses, &c.) are shown for different voltages over a working range of load factors. In general, losses in transmission are small compared with annual charges due to initial cost of laying lines.

Fig. 4 shows the economical distance it is permissible to erect a station remote from load to obtain abundant cooling water at 50°F. as compared with other cooling-water conditions available at the load. The transmission costs are determined by the author for voltages from 6 600 to 33 000. They are least for 11 000 V for a distance of about 4 miles at 80 per cent. load factor, and at about 8 miles at 10 per cent. load factor. Beyond these points 33 000 V is the best commercial proposition. If overhead lines were used

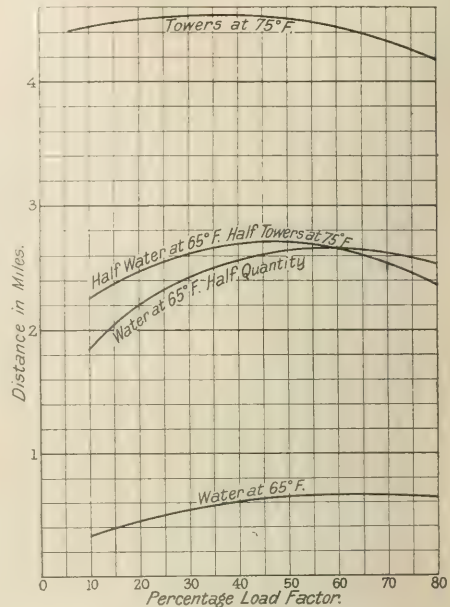


FIG. 4.—ECONOMICAL DISTANCE FROM LOAD THAT PLANT CAN BE ERRECTED FOR AN ABUNDANT SUPPLY OF COLD WATER.

instead of underground ones the result would be different, but not greatly so. Overhead lines are cheaper to install but more costly to maintain.

SOME GENERAL CONCLUSIONS.

The general conclusion is that the gain due to high steam conditions under modern practice is of less importance than when lower steam vacua were usual, and does not warrant the annual capital charges, maintenance and losses on long transmission lines. There is usually more room for economy in the boiler-house than in other departments. There is a distinct advantage in burning high-grade fuel. Too much attention can hardly be given to the taking of accurate tests of coal, ash, flue gases, &c., and it is good economy to engage highly skilled assistants to oversee such details.

HIGH COSTS OF EXTENSIONS.

It is unfortunate that at the very period when consumers are alive to the advantages of electric supply, and great demands are being made by manufacturers, the costs of extensions should be so high. The erection of new power stations to-day costs upwards of £25 per kilowatt, as compared with £10 to £12 in pre-war days. Capital charges work out to four times the pre-war value. Hence the moment is scarcely opportune to provide for long-distant developments.

Present costs may not justify extensive new schemes, even if Dr. Ferranti's estimate of an ultimate over-all efficiency of 28 per cent. of the energy in the fuel is realised. In busy industrial districts 100 000 to 150 000-kW stations seem desirable; there seems at present no commercial advantage in proceeding beyond such a concentration of power under one roof. The ease with which smaller sets of, say, 5 000 kW can be started up and put in circuit is a valuable attribute. Many advantages arise from the use of oil at stand-by stations, even at a higher cost, particularly as regards rapid raising of steam, elimination of coal and ash-handling plant, &c. The effect of the 47 hour week on load-factors has been serious. Why should not the ordinary factory operate for several shifts as is the case for heavy steel trades, collieries and power

stations? Among other possible future developments may be mentioned the gas-turbine, on which experiments have been conducted in Germany; a plant of 1 000 kW was running as early as 1913. The special mercury boiler is said to have yielded promising results, but is still in the experimental stage, and there are various practical difficulties to be considered.

DISCUSSION.

Mr. C. M. SHAW (Worcester) said that some time ago he had made similar calculations to those given by Mr. Cross, with the result that he obtained a distance of 4½ miles with 75 per cent. load factor, and 2½ to 3 miles for 50 deg. water. Stations of 50 000 kW to 200 000 kW would have to be placed on navigable rivers where only dirty water was available, and where, unless the filtering arrangements were good, the vacuum would be continually falling, whereas with cooling towers the vacuum could be maintained at a high level for as long as 1 100 hours. Mr. Cross suggested utilising the available water at 65 deg., and supplementing this by cooling towers to give an average throughout the year of 75 deg. If the cooling towers were designed to give 75 deg. as a minimum temperature the average throughout the year would be considerably less than that.

LIMITS TO HIGH PRESSURES.

Mr. S. E. FEDDEN (Sheffield) said that Mr. Cross's figures showed that with 28½ in. vacuum the percentage gain in steam consumption at 400 lb. over 200 lb. pressure was under 2 per cent. Everyone was clamouring for high pressures, but the cost of the unit at the switch-board must be considered. Careful detailed figures proved that no great benefit would be gained by going in for these high pressures. His experience had been that auxiliary steam plant was useful in preventing complete shut down. With plant at present prices it did not pay to scrap old plant, but it could be usefully employed at peak loads when the high cost per unit generated did not matter owing to the short time it was in use. Reheating resulted in only a very small saving, and the general consensus was that this saving was more than counteracted by the large capital expenditure and maintenance necessary. Passing out steam to heat the feed water was like throwing away money in the hope of getting it back later, before the "bus bars" were reached. Air heaters were also supposed to effect a saving, but the difficulty was to know what to do with the hot air obtained. Twenty years was too long an average life for plant, which ought to be renewed when anything like 1 lb. per unit could be saved. On the other hand, 12 years for cooling towers was much too short. He had cooling towers in good condition after 20 years. He advocated generating at 11 000 V, and using transformers to step down direct to 200 V or 250 V. It paid to use cheaper coal if plenty of boilers were available. He noticed a day or two ago Mr. Merz had said he was buying plant at £3 per kilowatt. If that was the case they could all start putting down power stations as fast as they could. The concentration of too much plant at one point was undesirable, in view of the large quantity of coal required and the enormous amount of ash resulting, the excessive quantities of cooling water and the large amount of current which had to be transmitted. 100 000 to 120 000 kW was enough to deal with at one point. Generating sets even in large power stations should not have outputs exceeding 10 000 or 15 000 kW, as the efficiencies of these sets at 3 000 revs. per min. was nearly as great as that of the larger sets, and the slightly larger capital expenditure was more than counteracted by the greater reliability. Going to rivers to get cooling water could be overdone, as at Stonebridge Park and Neasden. Where all the water was obtained from wells excellent results had been obtained, and all the figures he had seen showed that it paid to stay near the load, even if cooling towers had to be employed.

THE REPAYMENT OF LOANS.

Mr. C. W. CHARLESWORTH said that in dealing with capital charges, the various methods of repaying loans should be given due weight. Mr. Cross's formula was only applicable to the terminal annuity method, and the example given in the Paper did not disclose the actual position when other methods were used. Buying at present high prices and borrowing at present high rates was likely to have an effect which would continue throughout the life of the asset for even though the rates of interest fell the replacements would have to cover the additional outlay, and if the money was provided out of stock with the usual long term of repayment the effect of the long life and the higher price of interest would still be felt.

EXHAUST STEAM AND HOUSING SCHEMES.

In a written communication Mr. A. C. PAIN said that facilities should be afforded to anyone who was in a position to generate electricity cheaply by exhaust steam or waste gases to dispose of it by feeding it into the public supply mains. There were various sources of supply individually small which would mount up to a large aggregate and cause a saving of millions of tons of coal if this were done. Such an arrangement would assist in the supply of current to municipal housing schemes, but, unfortunately, the tendency at present was for the monopolistic electricity supply companies and municipalities to stifle such development in spite of the fact that it would be of the greatest benefit to the community.

Mr. W. M. SELVEY congratulated Mr. Cross upon being the first to demonstrate that it was unnecessary to place a capital station some 30 or 40 miles away from the load on the banks of a tidal river. The present demand for power was likely to continue for another five years and this would give them time for calm consideration and allow conclusions to be come to on a firmer basis, especially as prices were falling,

and caution was, therefore, desirable before erecting a station at a great distance from its load. With unlimited cold water and the most efficient towers 100 000 kW stations with a load factor of 60 per cent. could be placed every 20 miles. Sixty-foot cooling towers were rather high. He suggested 45 ft. should not be exceeded. The gas turbine required not only new material but a new cycle, for on the cycle on which it was at present working its maximum efficiency was much lower than that of the steam turbine.

LARGE TURBINES AND OVERHEAD TRANSMISSION.

Mr. W. H. PATCHELL regretted that they had not heard about Mr. Cross's 30 000 kW machine. He gave some particulars of the station of the Detroit Edison Company where six 30 000 kW sets were to be installed, and of another station where seven similar sized sets would be erected. Overhead transmission was the cheapest and best for high pressures, and every engineer should see what Mr. Kerr had done in Hereford and what Mr. Napier Prentice had done in East Anglia. Such work would have been impossible with cables. They must, therefore, crave for plenty of latitude from the authorities for pioneer work on overhead lines.

The PRESIDENT said that when he first saw the Knapsack station in the Rhine Valley with its capacity of 195 000 kW he thought it remarkable that they had gone in for cooling towers, although they were so close to water of the right sort and were even preparing to extend to an unlimited extent on the same system. The station was, however, quite close to the lignite coalfields and they had made it clear that it was more economical to use cooling towers than to place the station on the banks of the river.

ANNUAL DINNER.

In the evening the annual dinner of the Association was held at the Hotel Cecil under tropical conditions. In spite of this, however, a company of nearly 200 were present, including a number of ladies.

A VISION OF WIDER ISSUES.

Sir JOHN SNELL, in proposing the toast of the "Association," apologised for driving them from the Institution of Electrical Engineers into the arms of the "Mechanicals." Referring to the work of the Commissioners, he pointed out that that body had had concentrated upon it the work of five Government departments, while in addition the arrested development due to the war had caused a regular flood stream of new legislation to be necessary. Some delay was therefore inevitable. But out of an apparent *malice* the incipient stages of crystallisation were becoming evident and he devoutly prayed that a perfect crystal would appear before long. It was interesting to draw comparisons between the limited influence of the Association 20 years ago and its great influence now. If it had not been for the existence of such bodies as theirs it would not have been possible to deal with the exigencies caused by the war or with the individual cases which had arisen since. In his own mind he was sure that there was important electrical development to come. But the electrical industry had got to fit itself for that development, and as an old municipal servant he implored them not to look at the problems which would arise in a purely parochial spirit, but with eyes open to a vision of wider issues. Without that vision the country could not retain its commercial supremacy. Each member of the Association must remember that it was their great and common duty to assist in the rehabilitation of the country as the great industrial and financial centre of the whole world.

A VERY BIG THING INDEED.

The PRESIDENT, in reply, said that his answer to Sir John Snell's remarks was contained in his Presidential Address. He very seriously meant all he had said in that address and also that the electrical industry was going to be a very big thing indeed. Believing in the future of the industry, we could enthuse and enthusiasm made for success. The personality of the Commissioners ensured that while their policy was likely to be cautious, they would not display that caution which developed into a rigid insensibility. These are the merely dry bones of Major Richardson's remarks. They were illustrated by a wealth of humorous anecdote whose aroma and point would be lost by committing them to cold print.

THE WORK OF THE NATIONAL COUNCIL.

In proposing the toast of the "Visitors," Ald. W. WALKER pleaded for a closer relation between companies and municipalities. These two factions had, he said, learned to work together during the war and on the industrial councils. Such co-operation in the general interest was necessary as they were supplying a commodity which was essential to the industrial development of the country. It should be borne in mind that the work of the National Council had lifted a great deal of responsibility from the shoulders of individual electricity-supply undertakings. The National and District Boards were representatives of the undertakings, and in coming to national decisions on wages questions had to look at the matter from every point of view. But unless these decisions were fully recognised

there was a fear that we should slip back into the old bad state of individual bargaining with much worse conditions for single undertakings. The good feeling that now existed would make the problem of wage reduction much easier, especially as 95 per cent. of the undertakings had accepted the conditions. He urged on the small minority that had not accepted to remember that they were part and parcel of a great industry, and that to hold out might cause injury to the industry as a whole.

Mr. J. S. HIGHFIELD, in reply, said that the President could not have done a greater service to the industry than to get the municipal and company interests to see eye to eye. As long as electricity supply went ahead it did not much matter who made it go ahead, and he hoped, therefore, there would be less talk and more results. He urged the manufacturers to remember that their prosperity depended on the efforts of the electricity-supply undertakings.

Friday, July 22.

The Annual General Meeting of the Association was held this morning. On the motion of the PRESIDENT, Mr. S. T. ALLEN (Wolverhampton) was unanimously elected president for the ensuing year, and Mr. A. S. BLACKMAN (Sunderland) vice-president. It is hoped to hold next year's Convention at Wolverhampton.

The hon. treasurer (Mr. H. FARADAY PROCTOR), the hon. solicitor (Mr. P. M. HEATH), and the hon. secretary (Mr. A. C. CRAMB) were unanimously re-elected.

The HON. SECRETARY presented the accounts (which show a surplus of £372), in the absence of the HON. TREASURER, and they were adopted without discussion.

The Council's Annual Report was then presented. Extracts from this are given below.

ANNUAL REPORT.

The membership of the Association includes a representative of the Electricity Committee and the chief engineer of 204 municipal supply undertakings. In addition there are 15 associates. During the year applications for membership have been received from eight undertakings and resignations from five undertakings, while in three other cases the membership has lapsed. Since the last annual meeting Sir Thomas Robinson, M.P., has resigned his seat on the Council, and Ald. J. A. G. Beaumont has agreed to serve for the remainder of the period.

A MONTHLY REPORT.

In the autumn the Council decided to start issuing a monthly report with the primary object of keeping the members of the Association in closer touch with the Council. There are, of course, many other ways in which the usefulness of the Association might be extended, but the want of funds and the need of more office accommodation prevent this development.

Full particulars are given in the report of the Standing Committees of the Association. These include the Emergency Committee, the Finance and General Purposes Committee, the Editing Committee, the Centres Committee, the Remuneration and Conditions of Employment of Chief Engineers' Committee, the Remuneration and Conditions of Employment of Staff and Employees' Committee, the Selection Committee, and the Law and Parliamentary Committee.

UNDERGROUND MAINS.

The Council were notified that trouble was likely to arise owing to the Post Office laying its mains underground in unmarked 3 in. stoneware conduit of exactly similar pattern to that which has been used for a number of years by electricity supply undertakings. A deputation waited upon Sir William Noble to discuss the matter, but a decision has been postponed pending the collection of further information.

During the year many points have been raised by members on the legal aspect of various problems concerning electricity supply, and the Association is greatly indebted to its honorary solicitor, Mr. P. M. Heath, for the valuable assistance he has so kindly given in this matter.

ELECTRICITY SUPPLY LEGISLATION.

The Law and Parliamentary Committee, among other matters, have dealt with the Electricity Supply Bill, 1921. The evidence collected during the year confirms the unanimous opinion of the last general meeting, that no efficient progress can be made by Joint Electricity Authorities unless satisfactory financial arrangements are incorporated in the schemes. In co-operation with the Conference of Electricity Supply Local Authority Undertakings, London, certain amendments have been suggested to the Electricity Supply Bill, No. 2, 1920. The magnitude of the costs already incurred in connection with electricity supply inquiries is causing the Council much concern, but as the Commissioners appear to be equally

anxious about this expenditure and are considering steps to minimise future costs no action at the moment is necessary.

AGREEMENTS TO SUPPLY.

During the year the Agreements Committee has made close and lengthy investigations into the many forms of agreement in use, and has prepared certain clauses in connection with ordinary consumers electricity supplies, electricity supplies under contract and hire of apparatus. The Council consider that it is not advisable to draw up any standard form of agreement, but they approve of the clauses referred to as being useful in forming a basis upon which agreements can be drafted.

COAL PROBLEMS.

The Representation Committee of all electricity supply interests, which has been called together from time to time by the Institution of Electrical Engineers to consider coal questions, has constituted a standing committee to deal with this matter in its effect on the electricity supply industry. The questions of pit-head prices, railway rates and profits, were considered during the year, while the effect of decontrol of coal on prices and supply also received attention. The Coal Mines Department agreed to the committee being represented on any committee or conference which was set up, and Mr. H. P. Gaze and Mr. A. C. Cramb have been attending meetings of the Metropolitan Coal Emergency Committee dealing with the coal crisis. Mr. R. A. Chattock is representing municipal electricity supply interests on the Federation of British Industries Special Committee, which is considering a revision of railway rates.

BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION.

Reference is made to the work of the British Electrical Development Association, and municipal electricity supply undertakings are recommended to support the work of the Association, and to contribute to its funds on an agreed scale, which is based on the gross revenue of the undertaking. The British Electrical Development Association is really instrumental for securing for the I.M.E.A. working funds of more than double the amount paid, because the amount contributed by the manufacturer and the contractor groups is largely influenced by the support given by the supply interests.

WORK ON THE B.E.S.A.

Reference is also made to the work of the I.M.E.A. representatives on the various committees of the British Engineering Standards Association, dealing with such questions as nomenclature, standard voltages, electrical machinery, rating, lamps, cables, accessories, prime movers, switches, accumulators, heating and cooking apparatus overhead transmission equipment. The Council trust that members inviting quotations or issuing orders will specify that materials and apparatus are to be in accordance with the B.E.S.A. specifications relating to the materials and apparatus which have been approved and issued.

In accordance with the recommendation of the British Engineering Standards Association and in accordance with the wishes of the Institution of Electrical Engineers the Council is of opinion that the term "direct current" and not the term "continuous current" should be generally used.

STANDARD VOLTAGES.

At a conference held at the offices of the British Engineering Standards Association on the question of standard voltages, the I.M.E.A. representative, Mr. Roles, urged that the pressures recommended should be kept as high as possible to increase the capacity of the cables, but as the majority of existing supplies are at 230 and 460 V for direct current and at 230 and 400 V for alternating current he recommended one standard direct current pressure not less than 230 V. Standard pressures were considered essential for manufacturers and supply undertakings and as manufacturers feel that high pressures are not practicable it has been decided that the British Engineering Standards Association standard be agreed upon. These pressures are, for low pressure direct current, 220 V, and for low pressure alternating current, 240 V.

ENFORCING THE WIRING RULES.

The Council of the Association have passed a resolution to the effect that it is most desirable that electricity supply undertakings should have statutory powers to enforce the I.E.E. wiring rules or other approved regulations and that a clause authorising this should be inserted in the No. 2 Electricity Supply Bill. The Electricity Commissioners to whom this resolution was communicated replied that they were revising the regulations for securing the safety of the public and that they proposed to provide in this revision regulations that connection should not be made unless the undertakers were satisfied that consumers' installation was quite in order. A conference of the chief officials of the London Electricity Supply Companies strongly opposed the enforcement of wiring rules.

THE NATIONAL JOINT INDUSTRIAL COUNCIL.

The National Joint Industrial Council has now been in existence just over two years and most of the 13 District Councils have been formed and working for about twelve months. So far the I.M.E.A. Council has elected the six municipal members for the N.J.I.C. in accordance with the instructions of the Ministry of Labour that the employers' side of any industrial council should consist of members elected by employers' associations. This method of electing the municipal members has apparently not satisfied all the members of the 13 District Councils and a meeting of representatives arranged by these Councils was held in January, 1921, to consider the possibility of the District Councils themselves electing the members. There being only six municipal seats on the N.J.I.C. and 13 District Councils, each council cannot have direct representation. The suggestion was therefore put forward that an Election Committee be formed, it being thought that if this Election Committee remains in being as a consultative body it will act as a link between the District Councils and the National Council.

Attention is called in the report to the course followed in dealing with the salaries and working conditions of technical staffs and states for the present the same representation of the Association as are serving on the N.J.I.C. are also serving on the Joint Board which deals with this question as far as technical and clerical staffs are concerned.

FINANCE.

The report concludes by pointing out that the revenue from subscriptions under the scale which came into force on April 1, 1921, amounted to £1 613 and a substantial balance was carried forward at March 31 last. Members do not probably realise that up to the present the Association has carried out secretarial work to a considerable extent by making use of the office equipment of the Corporations of Bristol and Croydon, and the balance will be very useful for providing office requisites which are badly required. The non-technical detail work is carried out by the secretary, one assistant and an office boy.

PRICE ADJUSTMENT DIFFICULTIES.

Mr. S. E. FEDDEN (Sheffield), referring to the discontinuance of the Price Adjustment Clause, said he wished to dissociate himself from the decision of the Agreements Committee. He did not think it was right that the manufacturer, who had had all the plums during the past seven or eight years, should, now that prices were beginning to fall, have a fixed price in contracts which might take a year or two to carry out. Prices might fall 30 or 40 per cent. during that time, and yet manufacturers wanted to tie the purchasers down to the present high prices. He therefore wished to protest strongly against this decision of the Committee.

Mr. F. W. PURSE said it had been pointed out to the Sub-Committee dealing with the Contract Price Adjustment Clause that even if the Price Adjustment Clause continued there was very little chance of any reduction in price after the contract was entered into. The B.E.A.M.A. said quite frankly that all the material would be ordered when the contract was obtained. It was known fairly well what wages would be during the next six months and generally there would be very little chance of reduction.

THE PENALTY CLAUSE.

Mr. A. C. CRAMB (hon. secretary) said the I.M.E.A. was pressing for a penalty clause, because many of them who had large contracts without a penalty clause found themselves without any pull on the manufacturers at all.

The President said he was in favour of a fixed price. He did not believe in sliding scales, which only formed pegs for the manufacturers to maul the buyer.

Mr. N. STANLAND (Hornsey) said that whether they got a sliding scale or a fixed price they would be "had." One of these days the I.M.E.A. would have to fight this question with the B.E.A.M.A. Under the authority of the B.E.A.M.A., however, these big firms were no better off than the little trade unionist, and he personally had been told that if he wanted these goods at the right price, he had better go elsewhere. As long as this condition of things lasted, it would affect the price far more than any sliding scale or fixed price.

CONDUITS AND COOKING APPARATUS.

Mr. J. K. BRYDGES (Eastbourne) asked if any further progress had been made with regard to marking underground conduits by the Post Office, and also whether any progress had been made as regards cooking apparatus. They were still up against the extraordinary attitude of the British manufacturers in respect of cost of replacements, and the absurd time they took in making elements or carrying out repairs, much to the annoyance of consumers.

Mr. S. T. ALLEN (Wolverhampton), replying on the first point, said no arrangement had yet been made with the G.P.O. The latter claimed that they used conduits before the electricity supply people, and moreover, that as the conduits which the electric supply industry used were those rejected by the G.P.O. it would be difficult to mark the conduits, because the electric supply industry would then get them marked G.P.O. as well.

Mr. A. C. CRAMB (Croydon), replying with regard to cooking apparatus, suggested that he should be placed in possession of information on the

point which he would forward to the Electrical Development Association, which was dealing with the manufacturers of cooking apparatus.

A resolution on the question of Council members' expenses being borne by the whole of the undertakings affected was carried.

The President announced that the Council had decided to award the ten guinea premium to Mr. Charlesworth and Mr. Miles for their Papers read at the meeting.

The result of the ballot for members of Council was as follows: *Engineers of large towns*: Messrs. S. E. Fedden (Sheffield), P. P. Wheelwright (Blackburn), and G. Tough (Coventry). *Small towns*: Mr. R. W. L. Phillips (Bedford). *Committee Representatives*: Councillors E. C. Ransom and E. P. Dymond (Hereford).

Correspondence.

AN "ALL ELECTRIC" CONFERENCE.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I gladly respond to your invitation to comment upon your suggestion for a comprehensive electrical conference contained in your issue of the 15th instant, because I attach great importance to gatherings of the kind. In my Presidential Address to the I.E.E. I advocated the holding of meetings in various provincial towns, and I called attention, as you do, to the advertising value of the publicity so afforded. I did not, however, contemplate the suppression of the I.M.E.A. Convention by merging it in a larger one, which would presumably be one result of the carrying out of your proposal. I should be sorry to see an old-established annual event such as this absorbed in a larger gathering; it has a distinctive note of its own and there is a certain camaraderie connected with it that would hardly be possible with the large affair.

While concurring that too many Conferences are a mistake, I would point out that the electrical contribution to the surfeit that you complain of can hardly be regarded as excessive. In very few years of this century have we had more than one; last year we had the summer meeting of the Western Centre of the I.E.E. in addition to the I.M.E.A. and this year two were contemplated, but one of these has not taken place at all and the other is only an apology for a Convention. What I think is really influencing your mind is the holding of two overlapping Conferences, one by the Inst. C.E. and one by the Inst. M.E. In this connection I do not reckon small local gatherings, such as those very enjoyable ones promoted by the Scottish Centre. From the point of view of enjoyment, the smaller the gathering (in reason) the better. From the advertising point of view numbers count, no doubt, but only up to a certain point; other important factors are catchy subjects for discussion that appeal to the public and the capture of a few individuals that the non-technical pressman condescends to recognise. So far as advertising is concerned I suggest that the nucleus should be the I.M.E.A. Convention conducted on its present successful lines and that there should be added to this an Exhibition with popular lectures, discussions and demonstrations held at the same time and place under the auspices of the E.D.A., the two bodies working in close co-operation, but maintaining their respective identities.

Publicity is not, however, the only thing to be aimed at, and I think much good would ensue from a comprehensive engineering Conference dealing only with professional matters. I would suggest that the Institutions of Civil, Mechanical and Electrical Engineers might each in turn be responsible for an Annual Conference of the members of all three Institutions, the programme to include a first-class conversazione and possibly a civic reception, and papers on engineering subjects together with visits to works. The Conference would be in the name of the Institution responsible for it in any particular year, but the other Institutions would contribute to the cost.

An important matter to bear in mind in connection with Conventions or Conferences on the scale proposed is that the large assemblage of persons involves such ample hotel accommodation that the choice of possible meeting places is restricted to London and a few of the largest provincial centres, unless meetings in Continental towns be contemplated. There may be a great deal to be said for showing some of our neighbours

that Englishmen do know something of engineering and can behave like ordinary civilised beings instead of like the typical tourist. I would apologise for the length of this letter, but the matter is of great importance and I hope it will be adequately discussed in your columns.—I am, &c.,

C. H. WORDINGHAM.

London, July 20, 1921.

MECHANICAL ADVANTAGES OF "ELECTRIC" LOCOMOTIVES COMPARED WITH "STEAM."

TO THE EDITOR OF THE ELECTRICIAN.

SIR: The remarks of Mr. Dalziel in to-day's issue of THE ELECTRICIAN are of high interest. I take it he is under the impression that the "Squirrel-cage" induction motor cannot be used satisfactorily for efficient electrical traction on railways.

Whilst thoroughly appreciating the many sound advantages of the "Quill" type direct drive, I would point out that we use the squirrel-cage induction motor for the axle driving on high speed "Paragon" electric locomotives—in fact, a big scheme is now under consideration abroad, on a hydro-electricification proposition, in which squirrel-cage induction motor final drive is proposed.

Variable speed is obtained by means of variable frequency transformer-generators and the supply voltage is to be 15 000 V 50 period single phase alternating current, which as Mr. Dalziel is perfectly well aware is the best all-round system of energy distribution for trunk-line work. I may say that our collecting current is much lower than in the ordinary single phase alternating current traction system, as we use synchronous prime-power motors, in conjunction with transformer-generators, and so unity power-factor is secured. There are besides very many other important advantages brought into play with the "Paragon" system of main line or suburban electric traction too numerous to mention here. One of the features is, however, the much higher efficiency, and automatically operated regeneration which the squirrel-cage motor brings into play on this system.

The idea that the squirrel cage induction motor is not suitable for railway traction work is wrong as applied to the "Paragon" electric locomotives, and railway traction engineers should have a thorough look into this system before coming to the conclusion that the Ministry of Transport has been wise in rigidly fixing the supply with direct current for railway traction work, and so stopping all progress in the development in this country of other than those systems which have been tried, and found very much wanting, from the commercial aspect.—I am, &c.,

London, July 22.

WILLIAM P. DURTNALL.

TRADE DISCOUNTS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: There is one point that has been omitted in the timely article by "Electrocynic" on "Money for Nothing," and that has not received attention in subsequent correspondence. I refer to the case of new articles which a manufacturer desires to place on the market. In the case of articles which the public will buy at any price the point does not arise, but where price is a consideration the point is of importance. Suppose a manufacturer is willing to sell a new article at £20, so far as his own costs are concerned. Then to meet the custom of giving 33½ per cent. discount he must add 50 per cent., listing the article at £30 and selling at this price to the public. Now there are many people who will buy at, say, £22 (thus permitting a small discount), but who will not buy at £30. There is no doubt that this unnecessary addition does a great deal of harm.

If the contractor really does sell, by all means give him a substantial discount. The real stumbling-block is that, if Manufacturer A refuses the high discount and Manufacturer B gives it, Manufacturer A is boycotted by the contractors. The sane thing would be for all manufacturers to agree to

discontinue the absurdity of money for nothing, as this ultimately means that they get nothing for selling if they do it themselves, giving the selling cost away to those who do but little of the work.—I am, &c.,

London, S.W.1,

July 25th.

W. R. COOPER.

Sir Samuel Waring's Conference.

By ERNEST J. P. BENN.

On Saturday and Sunday last the Industrial League held a further highly successful week-end conference, the host being Sir Samuel Waring, Bart., who entertained a party of twenty at his residence, Footscray Place, Kent. The subject of discussion was "Foreign Expenses and their Influence on Industry," and some twenty representative men in four sessions on Saturday evening and during Sunday debated the matter in all its bearings. The discussion was opened by Mr. H. G. WILLIAMS, and among those who took part were:—

Mr. E. J. P. Benn (Messrs. Benn Bros.), Mr. A. Bellamy (National Union of Railwaymen), Mr. A. Dalgleish (Workers' Union), Mr. A. Dumas (British Thomson-Houston Company), Mr. H. H. Elvin (General Secretary, National Union of Clerks), Mr. E. J. Garmeson (Lloyds Bank, Ltd.), Mr. Jabez Hall (Iron and Steel Trades Confederation), Mr. Hugo Hirst (General Electric Company), Mr. S. E. Jackson (National Union of Railwaymen), Mr. J. W. H. Juddery (Messrs. Juddery & Company), Mr. R. Sim (National Foremen's Association), Lieut.-Colonel E. Lawson, the Right Hon. G. H. Roberts, M.P., Mr. E. Wharton (Assistant General Manager, London & North-Western Railway), Mr. H. G. Williams (Machine Tool Trades Association), Mr. H. T. Young (Messrs. Troughton & Young) and Mr. John Ames (General Secretary, Industrial League and Council).

This is the third occasion upon which Sir Samuel Waring has entertained a party at his Kentish home. Indeed, he has done more than anyone to promote and popularise the idea of the week-end conference. The first occasion, so far as is known, upon which representative employers and employed have met together at a private house for the week-end was in March, 1919, when Mr. E. J. P. Benn entertained a small party at Blunt House, Oxsted. The experiment was so successful that Sir Samuel Waring was approached to ask that he would take it a step further. Accordingly a conference was arranged in June, 1919, under his auspices. Since then both Mr. Benn and Sir Samuel have acted as hosts each year, and others have now joined in this growing movement. Mr. Hugo Hirst, Mr. H. V. Roe and Viscount Burnham are among the hosts announced for this scheme. The Industrial League and Council believe that most of our industrial difficulties arise from misunderstanding and consequently devotes itself to the simple work of bringing representative trade unionists and employers together for social intercourse and exchange of opinion. Among the many methods that it adopts for this purpose the week-end conference is undoubtedly the most effective and delightful. It now seems that the fashion which it has set is likely to be widely followed, and we look in future to the week-end conference as a regular means of educating both sides in industrial problems.

Employment of Defence Force Personnel.

We understand that a number of the officers, N.C.O.s and men who are being discharged from the electrical branch of the Defence Force urgently require employment. Many of these men gave up good positions in order to enlist in answer to His Majesty's appeal to loyal citizens, and they now find themselves in the position of being unable to regain their former employment or get work of any description.

Some of these men served as officers during the war and, practically without exception, are all engineers, the following being a summary of their professions and trades:—Electrical engineers, 4; mechanical engineers, 2; electricians, 9; fitters (mechanical and electrical), 13; turners, 1; cabinet makers, 1; draughtsman, 1; and tool makers' improver, 1.

Full particulars of every man are available at the Headquarters of the London Electrical Engineers, 46, Regency-street, London, S.W., and if prospective employers write them a suitable man will be instructed to make application.

THE NAVAL WIRELESS STATIONS at Bathurst (Gambia), Mauritius, Port Nolloth (Cape Colony) and the Seychelles have been closed on the ground of economy, but the station at Demerara is being retained for the present. The above stations were built during the war, and they remain in the hands of caretakers until it has been decided whether the Colonial Office or the Post Office will take them over.

London Electricity Inquiry.

This Inquiry by the Electricity Commissioners has been continued during the week, and we hope to conclude our report of it in our next issue.

COMPANIES' TENURE OF DISTRIBUTION BUSINESS.

MR. A. COLLINS, recalled, said it was after considering the figures he had put before them that the Executive of the Conference of Local Authorities had passed their resolutions to the effect that the acquisition of the Companies' generating stations should be considered apart from the question of the extension of the tenure of their distributing powers. He had expressed the view to the Conference that the Joint Authority would be fully employed for a considerable period on the generation side, and that it was doubtful whether it was practicable for one Authority to deal with the distribution over such a large area, and moreover some local authorities might wish to acquire the companies' undertakings while others might be content that the distribution powers should remain in the Companies hands. In regard to the value of plant to be taken over, the obsolescence and depreciation had been more rapid during the war period than previously, and that counterbalanced, to a large extent, the general rise in value of plant and materials. It would be unwise to conclude a bargain at present in view of the falling prices.

To Sir JOHN SNELL, witness said if the representatives of the conference and the companies met and discussed the matter again he hoped that they would get nearer together as regarded terms of transfer, but he feared that there was little likelihood of the local authorities agreeing with the companies unless they were prepared to accept a lower price for their stations or a great reduction in the extended periods of tenure. Rather than accept the companies' present proposals he thought the 34 local authorities concerned would make their own arrangements.

Further examined by Mr. TURNER, witness said the companies had nothing more than a sporting chance of getting in 1931 more than the pre-war cost price. Another resolution of the Conference Executive proposed that the capital value should be paid to the companies by way of an annuity. The rate of return shareholders had had on their capital should be taken into consideration. The conference and the companies had two millions at issue on valuation alone. It would be unwise for the local authorities to undertake to pay rental until 1950 for assets which would have disappeared a long time before that date.

To Mr. HENDERSON, witness said the companies' generating stations could only be acquired by agreement. The conference proposed to offer cost, less depreciation, on income tax basis. The extended tenure of the distribution systems need not necessarily be taken into consideration. In regard to Mr. Henderson's suggestion that the L.C.C. and the companies should be left to come to an agreement as to price and terms, Mr. Collins said the local authorities were the parties most concerned, and could not be expected to accept any bargain made by the L.C.C.

Sir JOHN SNELL said it was embarrassing to the Commissioners that the chairman of the conference, Mr. Duncan Watson, should say the conference was willing to grant almost unlimited extension of tenure to the companies and then to find that the conference had changed its mind two days later.

Mr. TURNER said the Executive had not expressed an opinion on the principle of extension of tenure, but the question would be submitted to the full conference.

Witness said he would advise the conference not to accept the principle. It would be preferable for the local authorities to undertake the distribution. If the L.C.C. only bought one undertaking they might be able to manage it, but if they bought the nine it might be beyond them.

To Mr. KENNEDY, witness said the local authorities were more interested if the companies' stations were taken over now than they would be if they were taken over by the L.C.C. in 1931, because the L.C.C. would not be able to charge them then over the whole of the local authorities' areas.

DIVERSION BY ISLINGTON.

Mr. ALBERT GAY (Islington) said he wished to state on behalf of Islington Council that the Council objected to the expenditure of money on capital stations until the existing undertakings were insufficient to meet the demands, to the creation of a Joint Authority, and to the provisions enabling possible demands to be made upon the ratepayers in support of any scheme which might be approved. At a later stage it was, however, announced that Islington had again altered its mind and would support the Conference Scheme.

Mr. COLLINS said he would not advise the local authorities to refrain from making a bargain if the price of the companies' undertakings to be acquired was not too much in excess of his estimate of their values. He would pay great respect to any sliding scale principle which might be suggested as a solution of the difficulty.

To Mr. BOOTH, witness said the payment of a higher price to companies than to local authorities for their generating stations would be a burden upon the whole area, including the 34 local authorities represented by the Conference. He did not think the question which party was to get the better of the bargain would cause the question of the greatest good of greater London in the matter of cheap supply of electricity to be lost sight of.

To Mr. PAGE, witness said the granting of an extension of tenure to the companies would be a more apparent than real inducement to the companies to accept a moderate price for their generating stations. He would not advise the Conference to pay the terms that had been proposed if any extension of the companies' tenure were conceded. If the purchase of the companies' stations would throw no burden upon

the local authorities they would have nothing further to say, but the feeling of many of the local authorities was that they had no right to barter away their rights to the distribution business.

Sir JOHN SNELL said in the event of no agreement being reached as to the terms of purchase, the local authorities could not carry out anything effective amongst themselves in the way of linking up or buying plant without coming to the Commissioners for permission. If some sort of compromise were not arrived at between the parties and there had to be two or more groups—say, a group composed of local authorities and a group composed of companies—it would be difficult to bring about the co-ordination of supply aimed at.

Mr. COLLINS said the organisation of supply over such a large area was a great ideal which he was not optimistic enough to believe could be reached in one step.

COUNTY OF LONDON COMPANY'S ATTITUDE.

At this stage Mr. S. MORSE announced that the County of London Company had decided to put in a witness or witnesses. He remarked upon the fact that although the opposition at the inquiry in October last urged that the site at Barking was in the wrong place, owing to the heavy cost of transmission, a site proposed for a station under the schemes now being considered was only one mile to the west of Barking. There would be nothing inconsistent in the Commissioners consenting to the erection of the Barking station and also approving one or more of the schemes now before them.

Sir JOHN SNELL said strong representation had been made at that inquiry that no capital station would be wanted for some years, which was in direct opposition to the Company's proposal to erect a capital station almost immediately. It was to that point and to the support of the Company's estimate of an increase of the demand on the Company's stations in the County of London to 42 000 kW that the Commissioners wished the Company's evidence to be directed.

Mr. PEARMAN (Secretary of the London Electricity Joint Committee) put in a table and said he had taken a 6 per cent. rental as one of the means of paying off the capital sum of £14 469 000. He had assumed in the first table 4 per cent. interest on the amount invested in the sinking fund, but since a conversation he had had with Mr. Johnson and Mr. Collins he had adopted their figure of 3½ per cent. At the end of eight years, when the old plant was presumed to be worn out, the sinking fund would amount to £6 405 000. In the years after the 8th the rent was based upon the value of 9-359 millions, and from the beginning of the 9th year at 6 per cent. it gave a rent of £561 480.

Replying to Sir JOHN SNELL: The table was put forward with the object of showing that if the rental of 6 per cent. on the capital was paid in accordance with Mr. Fladgate's suggestions the annual capital charges shown in the supplementary particulars would be sufficient to meet the rental as suggested by Mr. Fladgate. If these conclusions were correct the payment of 6 per cent. rent and sinking fund would not have any effect on the price per unit ultimately arrived at in the supplementary particulars, supposing the engineering figures were correct. The capital indebtedness could be reduced so that the figures from 1929 onwards would be a much smaller rental and a much smaller sinking fund and the debt would be exterminated at a much earlier date, because one would be converting a 3½ per cent. sinking fund into a 6 per cent. rental.

Mr. JOHNSON (Comptroller to the L.C.C.), recalled, said in his tables he had taken land occupied by the companies' stations without depreciation. The buildings were taken as 32/60 unexpired at 1929 out of the assumed life of 60 years. Plant was taken at the same date as an average of 12 years already expired, and some of it would reach the end of its 20 years life in 1929. It had been assumed that equal amounts of plant had been put in each year during the 20 years, so that same would be new and the remainder vary up to 20 years old in 1929. If the L.C.C. calculation of depreciation were brought up to 1921, the remaining value of the assets would be £6 729 000, compared with the companies' figure of £8 207 000. For mains an average life of 35 years had been taken. On the basis of the companies' valuation, 6 per cent. rent on the companies' part of the undertakings would be £492 000 per annum. In 1929 there would be 6 per cent. to pay on a lower sum, and out of £914 000 available for capital charges there would be £614 000 left for sinking fund. He recommended that the whole indebtedness should be paid off by 1941. At that time the Joint Authority would have land and buildings which cost £3 600 000, and some effective plant, more particularly mains.

To Mr. KENNEDY: The Council had approved the principle of extension of tenure, provided acceptable terms of purchase could be arranged.

Re-examined by Mr. HENDERSON: There were companies' undertakings within the area but without the county of London which were not purchasable until dates after 1931 varying up to 1950, so that it was not feasible for the L.C.C. to have put a definite date in its scheme.

THE CASE FOR HERTFORDSHIRE.

Sir CHARLES LORRIMORE, K.C.B., Clerk to Herts County Council, said roughly half the county was within the delimited area. Taking the south part into the Joint Authority's area would detrimentally affect the remainder. Watford's supply covered 50 sq. miles. That part of the county did show considerable industrial development. The supply from the power company's stations at Hertford and St. Albans was sufficient. The company was making arrangements to supply various additional

places from Brimsdown. The county and local authorities had not the money since the war to finance such schemes as electric supply and tramways. They were far better left to commercial undertakings. A resolution was passed by representatives of Herts County Council and by 34 local authorities in the county that it was undesirable that any part of the county should be included in the proposed Joint Authority area. The county had a strong objection to being connected with London. He did not see that it would do any good to the consumer if the power company and its distributing companies had to pay £5 000 a year towards the expenses of the Joint Authority.

To Sir HARRY HAWARD, witness said, although the power company had not been able to supply certain towns in the county owing to financial reasons, he thought they were now reaching a strong financial condition, and would soon be able to supply the whole of their area.

Mr. WM. B. KEENE, accountant to Herts County Council, objected to the inclusion of the county because, he said, joint boards were invariably unsatisfactory in their working. There was a lack of definite control in such cases by the county which led to the possibility of extravagance. It was difficult to realise what the schemes really were, because they had been altered so frequently during the inquiry, and engineers' estimates were frequently exceeded. The estimates showed a saving of a farthing a unit in the average charge for current by the Joint Authority compared with the average of the present undertakers' charges, but that would be washed out in the case of Hertfordshire when the zonal system of charges was applied. It was stated that the charges were not to exceed the present charges, but any advantage to Hertfordshire in the matter of price was very problematical.

Mr. HORACE FENTON handed in a statement on behalf of the Electrical Power Engineers' Association, and disclaimed all connection with the Electrical Trades' Union.

THE PORT OF LONDON AUTHORITY.

Mr. PADDON addressed the Commissioners in support of the Port of London Authority's claim for direct representation on the proposed Joint Authority. He claimed that it would be of mutual benefit to both authorities, but more important to the electrical than to the river authority. He only asked for one representative. Even as users of current the Port of London Authority was entitled to some consideration, as it purchased 17 million units per annum.

MIDDLESEX COUNTY COUNCIL'S POSITION.

Mr. WROTESLEY (Middlesex County Council) said his Council asked that the whole county should be taken in or that the whole should be left out. The County of Middlesex was the most developing of all the areas around London. In his view the principle of the engineers who selected the ten-mile radius as the right area for electricity supply was not a proper one. In any event he asked to be left out of the L.C.C. scheme, which was not fair to the inhabitants of Middlesex. If the interests of Middlesex were not to be considered let the whole of Middlesex be excluded, which would exclude the site of the Chiswick station. The real ground upon which County Councils should be given representation on the Joint Authority was in their capacity of representatives of the consumers, and London County Council should not be given additional representation because of its option of purchase. Also, if any financial assistance was required from Middlesex County Council the Council claimed that it should have representation on the Joint Authority on that ground also. The representation on the Authority proposed by the L.C.C. was hopelessly ill-balanced in favour of the L.C.C. The terms of purchase under that scheme were not regarded by Middlesex Council as being as fair as those in the Conference scheme. Middlesex Council asked for two representatives, and their support of the Conference scheme was dependent upon that representation being given.

EVIDENCE FOR COUNTY OF LONDON COMPANY.

Mr. C. H. MERT (on behalf of the County of London Electricity Supply Company) said the company's application in October last was for a station of 100 000 kW capacity. It was shown how the Barking site could be utilised for a more comprehensive scheme. The company's own supply was equivalent to that of many large cities, and the area was also equal to that of many large cities. The station was even then pressing for the company's own needs, and the pressure was now still greater. To delay in erecting really modern plant for this important area was a want of policy, and it would be disastrous to the company's interests. For the whole supply of London he did not see how the wisdom of erecting a modern plant at once could be seriously challenged. In England one was so accustomed to doing things the wrong way and then having to put it right that one could hardly visualise doing it in the proper way. Power load would develop if the power supply was already there. The Company's policy was to get there first. He did not think any more favourable time than the present for drawing up plans for a modern plant would come in the next 10 years. In the last three months he had received lower tenders for plant than he had ever seen, even before the war. Turbine plant was what he had chiefly in mind. It was ridiculous to suggest that stations would now cost two or three times the pre-war cost. There had been great advances made recently in power-station design. The thermal efficiency the company estimated in October for the proposed station was 17 000 B.Th.U. per unit sent out, and they could now do still better. On the basis of work that had been carried out, he maintained that large stations could be designed to-day which would give better thermal efficiencies than 17 000. Recent improvements were of a very different order from those during the first 15 years or so of the present century. In 1901 the cycle adopted was 560 steam pressure, 500 to 550 deg. super and condensing terminal pressure of 1 in., and stations were being designed with that cycle at the beginning of the

war, and even later than that 15 000 kW plants had been ordered on that cycle. But now, with modern plant, the pressure was 300, superheat another 100 deg., or 120 deg., and there was improved vacuum. It was important that railway load and power load should be supplied by the same plant, as the general power load wiped out the violent swings in the traction load. It would give a better load factor both as regarded the traction and the power supply. The question was, did they want to develop electricity or merely to meet an existing demand? It seemed to him that all recent legislation was directed to the latter object, and that was all wrong. His experience was that one did not get the business until the trunk mains were down, and the supply taken to people's doors. He took such an entirely different view that he did not understand the evidence that had been given that it was not necessary to erect a station to supply railways until a contract for taking current was made. Units sold per head of population in 1918 were: London, without railways, 96; Glasgow, 189; North East Coast, 298; Mersey Power Company, 369; County of London Company, 50 (which proved that there was a demand to be met). There were power companies in whose areas the demand was as high as 550.

THE RAILWAY DEMAND.

Mr. MERT said the power companies had obtained the railway demand by being ready to supply it. He supposed the London Electric Supply Corporation got the L.B. & S.C. contract because they already had a suitable waterside site for the station. He did not see how the Joint Authority could comply with the requirement in the 1919 Act of proving that they would be in a position to supply a railway company more cheaply than the railway company could supply themselves, unless the Joint Authority had the necessary station already working or nearly so. The Commissioners' power to refuse permission to the railways to erect stations was largely illusory. In his opinion our ability to hold our own as regarded export trade would be handicapped unless our manufacturers had the experience that would be gained by making the plant for these large stations. A large order for plant for Melbourne recently had to go to America because of the work of confidence on the part of British manufacturers in consequence of this lack of experience. This country had lost its position as the leading country in the manufacture of electrical plant, and it should be given the opportunity of regaining it by carrying out orders for plant for large modern stations. In the case of many other stations in London there was no obstructive opposition to the putting down of new plant. But now in the case of the County of London Company—the one concern prepared to put down a large modern plant at their own cost—the project was stopped. The County Company had visions, and the other people had none. Ten years ago there was justification of railway electrification on the ground of increase of revenue. Now there was justification in the prospect of reduction of operating cost, but it was much more likely to be carried out if power companies had ample supplies of current ready to be supplied for the purpose. The provision of the supply the Company proposed in the Romford area would encourage manufacturers to establish works there. He had known more than one instance of works being removed from London to the North-east coast because of the cheap electric supply available there. The site of the proposed Barking station was about 90 acres. A site of 20 or 25 acres was not large enough for a large power station. A larger site should be taken so as to permit of great extension if and when required. Extension of coal storage also had to be considered. There might also be said to be a necessity now for oil storage, with a view to using oil fuel in emergencies. Sufficient oil could be taken from the coal to deal with the peak load, and this would mean a saving in the equipment of part of the boiler plant for oil burning, and also a saving in the reduction of the coal bunkers. He could not visualise a commercial undertaking which supplied current at a low price with coal at twice the price that it ought to be in the hope that some day the demand would grow to such an extent that the coal cost could be reduced. He was sure the 42 000 kW demand which the company anticipated in 1924 or 1925 would be greatly exceeded if the company had the large modern station which they proposed to build at Barking, and that if they were allowed to go ahead that station would reach 200 000 kW in comparatively few years.

ENCOURAGEMENT OF BRITISH CABLE MANUFACTURERS.

British high-voltage cables were the best in the world, but the manufacturers had not had the opportunity of supplying them for the highest voltages. They could not quote the lowest prices for 60 000 or 70 000 V cables until they had experience of making them. The extra cost of the extra mile of transmission between Barking and Beckton would not exceed £0-35 or £0-4 per kilovolt-ampere mile. The cost of the station was taken in October at £27 per kilowatt, but the corresponding figure now could be put at £20; the cost of transmission mains was £0-7 per kilovolt-ampere mile, but it might be put now at £0-5. That meant a saving of £965 000, and the total cost was reduced from about 4½ millions to something less than 3½. By carrying out the alternative policy there would also be a reduction of cost, but not in the same proportion. In increasing the plant at Wandsworth and City-road there would be considerable alterations required. But as a matter of fact it was physically impossible to enlarge those stations to the necessary extent. The coal consumption at Wandsworth and City-road was given in October as 2-95 lb. per unit, but the present figure was 2-8 lb. He estimated an annual saving of £30 000 in running the plant at Barking, compared with that of running the present stations at Wandsworth and City-road. The cost of running the former would be £35 700, when working at a maximum load of 60 000 kW, and having an output of 130-75 million units.

Mr. C. P. Sparks was also called for the County of London Company. The evidence is now concluded and the addresses of Counsel commenced.

Electricity in Factories.

The annual report of the Chief Inspector of Factories for the year 1920 contains interesting notes on industrial developments and the state of trade, on safety regulations, tables of accidents, &c., and also the Report of H.M. Electrical Inspector of Factories (Mr. G. S. Ram) on the use of electricity in factories.

ELECTRICAL ACCIDENTS.

Mr. Ram commences his report with a summary of the year's accidents, which numbered 394, including 23 fatal cases, about the same as in the previous year; 18 of the latter were due to shock from alternating currents at low pressures. Although in most of these cases the systems were three-phase, up to 440 V between phases, the neutral point being earthed, the pressure of the shock would not exceed about 250 V, as contact was made with one-phase only. In three cases the shocks were from lighting circuits taken from one-phase and the neutral. The one fatality from direct current at low pressure was not a case of electric shock, but was due to burns from an arc caused by a short-circuit at a switchboard. Of 20 high-tension (2 000 V to 11 000 V) accidents reported, only four had fatal results. The injuries in a number of the others were, however, severe, some involving permanent incapacity. In 16 of the cases, 11 of them in public supply stations, the injured persons were engaged in cleaning or other work on switchboards. Six were due to mistakes in switching, the sections of the switchboards on which work was to be done having been supposed to have been made dead. In five, work was deliberately undertaken close to unscreened conductors known to be live, and one was due to a faulty arrangement of an interlocking device. Others were due to carelessness or forgetfulness. The low and medium pressure accidents were due to varied causes—*e.g.*, non-earthing of metal work (four fatalities), handling of fuses of non-protected type (two), contact with bare conductors, including trolley wires of cranes and furnace chargers (six fatalities). Many were due to faulty type of apparatus or inadequate protection, and others to carelessness or ignorance on the part of the injured persons.

DANGEROUS OCCURRENCES AND DEFECTS.

Amongst the "dangerous occurrences" were several breakdowns of turbo-generators. In one case both the turbine and generator of a 6 000 kW set were completely wrecked. Mr. Ram states that although in his visits during the year he came across many instances of excellent work, he found, as usual, numerous examples of the opposite variety, such as have proved fruitful sources of accidents in the past. Some of these defects are indicated, *e.g.*, in connection with h.t. switchboards, isolating switches and oil switches in the same compartment without any division, isolating switches and oil switches in separate compartments, but having one door common to both or having two doors but wrongly interlocked; live metal within reach unprotected; potential transformers connected direct to bus bars without any isolating switches or the isolating switches placed in the same compartment with the transformers. Low pressure and medium pressure switchboards were found with working platforms of iron plates and no insulating mats, switchboards for continuous use, day and night and week-ends, without any means of isolating the oil switches from the bus bars, &c. There were transforming sub-stations in factory premises without being screened off and h.t. conductors exposed, and h.t. terminals of transformers exposed within reach. Many cases were discovered of non-earthing of metal work, including portable apparatus, *e.g.*, grinders, drills; a number where the earthing was inefficient, of inadequate size and loosely connected without proper clamps. There were also many distribution fuseboards of a dangerous type, and many unprotected switches, terminals of motors, &c., were found and cables, where liable to damage, unprotected by casings.

ANTQUATED SUPPLY STATIONS.

Amongst the public supply generating stations visited were several which have been in operation for 20 to 30 years, and which have always been in an unsatisfactory condition. Badly located and designed in the first instance without due regard to probable developments, when extensions of plant have become imperative they have been put in from time to time without adequate extensions of buildings. Old and out-of-date switchgear remains in use with extension panels added in inconvenient places, some at a distance from the original switchboards at which there was no room for extension and blocking access to other plant. The various cables are mixed up in a hopeless tangle. High tension has been added, in some, the switchgear being placed in most unsuitable positions. Naturally these stations are running at a loss. They are unsatisfactory from the safety point of view, and it has been difficult to get even small improvements carried out. In one case a new station has been "in contemplation" for over 12 years, but appears to be as far from realisation as ever. Mr. Ram hopes that under the new supply schemes such stations will be made into up-to-date sub-stations.

Extracts are given from the reports of Mr. Lowe, of the N.E. Division, and other inspectors who have done useful electrical work are Mr. Topham in the N.W. Division, Mr. Law (Sheffield), Mr. Lauder (Newcastle) and Mr. Bennett (Stockton). Mr. Lowe refers to the practice of unqualified persons being in charge of important installations, and Mr. Ram states this practice is by no means uncommon. At a large engineering works which he recently visited in Scotland, and where over 200 motors of various sizes up to 50 h.p. were in use on a 440 V three-phase supply, no electrical engineer was employed. The manager stated that he "did not believe in electricians as he had tried them and found they really had nothing to do, and were always messing about with the plant." Repairs had to be sent out, and there was strong evidence of the need of a proper electrical

staff; in fact, the visit was paid on account of an accident which proved to have been due to the want of skilled supervision.

ARTIFICIAL RESPIRATION.

With regard to the practice of applying artificial respiration in cases of electric shock where the victim is rendered unconscious, there is still much ignorance on the matter, even by ambulance men and doctors. The importance of commencing the treatment at once, and keeping it up for at least two hours, if the patient does not recover before that time, is not generally realised. During the year there were several cases where it was applied very soon after the accident and proved successful. In two cases of shock from 6 600 V systems the patients came round in 20 minutes and two minutes respectively; in a 3 000 V case in 20 minutes; in a 2 000 V case in three minutes; in a 250 V case in 10 minutes. In order to bring the importance of this matter to the notice of the medical profession a memorandum on this subject has been sent to all lecturers on forensic medicine in medical schools.

Commercial Topics.

New Industries in Australia.

It is announced that over 200 new industries have been established in Australia since 1914, and under the influence of the high tariff recently introduced, and of Government encouragement every week sees some new factory inaugurated. The majority of the new works are occupied with the manufacture of iron and steel goods, agricultural machinery, tools, gas, steam and oil engines, electrical plant and apparatus, &c. Among the electrical goods now produced in Australia are the following:—Batteries and parts, circuit breakers, conduit tubing and fittings, motor controllers, electric motors, dynamos, fuses, porcelain insulators, mica for electrical purposes, radiators, resistances, starters, switches, &c.

Engineering Combinations in Germany.

Mergers and combinations of industrial firms, particularly in the engineering industry, continue to be the order of the day in Germany. One of the most significant is that the Rheinische Metallwaren & Maschinenfabrik, of Düsseldorf, recently combined with the A.E.G., the Friedrich Krupp A.G. & Otto Wolff, of Cologne. At the same time the company's capital was increased by 95 000 000 marks. By this move the Rheinische Company hopes to become one of the leading locomotive manufacturers of the world, and its connection with the A.E.G. probably indicates that attention will be paid to electric locomotives in view of the increasing demand for the adoption of electric traction. The Krupp & Wolff companies will supply raw materials and semi-finished products, and thus the four companies involved will benefit directly or indirectly.

The British Industries Fair.

Already the members of the Executive Council of the Birmingham section of the British Industries Fair are busy with their preparations for next year's fair, confident that they will receive the continued support of manufacturers. The schedule of exhibits at the 1922 Fair (to be held at Castle Bromwich from February 27 to March 10) has been considerably widened, and several new groups are included, while several existing trade groups have been enlarged. The manufactures now covered include: power, lighting, heating, cooking and ventilating plant, equipment and fuels; general machinery, engineering and industrial tools, sheet metal machinery; transmission, conveying, lifting and hauling appliances; saw mill equipment; industrial rubber goods and engine packings; forgings, castings, metals, wire, tube and rolling mill plant; weighing, measuring and testing instruments and appliances; heat treatment of metals, industrial equipment; railway materials; constructional building; agricultural and mining machinery; motors, motor-cycles and cycles; hardware, ironmongery, &c.

A Call to Work and Economy.

We have frequently referred to the economic situation and called attention to the urgent need of greater industry and to the necessity for the utmost economy in all public and private affairs in order to compensate for the wealth destroyed during the war. It is true that there has been much talk, of economy in Government and political circles, but, unfortunately, it has been mainly talk for nothing tangible appears to have resulted from all the discussions that have taken place. It is, however, gratifying to notice that this important matter is now being taken up seriously by the City, for there was a large and representative gathering of banking, commercial and trading interests on Tuesday last to consider the situation. The meeting, which was non-political in character, was presided over by the Lord Mayor, and after addresses by Mr. Walter Leaf, the Hon. Lionel Holland and Sir Hugh Bell, the following resolution was carried unanimously:—

"That this meeting of merchants, manufacturers and shipowners, held under the presidency of the Lord Mayor in the Mansion House in the City of London, desires to impress upon the inhabitants of the country the absolute need for greater industry and thrift. The destruction of wealth caused by the war has necessarily imposed on the country a heavy burden of debt. To meet the taxation which this involves and to replace the wealth destroyed by the war are matters of supreme urgency. Economy, both personal and public, of the most rigid character must be practised. This, supported by greater industry, will, it is believed, rapidly restore the credit of the nation, and whatever the future may have in store for the world, the re-establishment of British credit would appear to be of the greatest importance."

Electricity Supply.

PRESTON Corporation has received sanction to a loan of £77 130 for extension of the electricity undertaking.

For the electric lighting of the Farnley, Farnworth and Chorley Street Urban Council has been ready to erect a station for a £4,000.

The PRESTON Electricity Supply Company recommends that Mr. J. A. Robertson, of Salford, be asked to prepare plans for a new generating station.

The CARLISLE Electricity Committee has obtained a report from Mr. Arthur Ellis on the position of the electric-supply undertaking. The erection of a new generating station at Willow Holme has been deferred, but the capacity of the existing station is to be increased.

The Electricity Commissioners have again extended the time for submitting schemes for the reorganisation of electricity supply, &c., in the SOUTH EAST LANCASHIRE ELECTRICITY DISTRICT from the 30th inst. until Oct. 31 next. This is the third time an extension of time has been made for this district.

The OSWALDTWISTLE Council is unable to secure a supply of electricity from Accrington or Blackburn Corporation but as Accrington is pressing the Electricity Commissioners to approve of an extension scheme the Oswaldtwistle Council has decided to support it, in the hope that in this way they may get a supply.

Though we are not surprised, we regret nevertheless to learn that the ELECTRICITY SUPPLY (No. 2) BILL has been abandoned by the Government. In announcing the programme for the remainder of the Parliamentary Session, Mr. Austen Chamberlain stated on Tuesday that this was one of the measures for which time could not be found.

WORCESTER City Council has deposited a scheme with the Electricity Commissioners in which it is suggested that the Council's area of supply should be extended over South Worcestershire. The reason for this step is that the Shropshire, Worcestershire & Staffordshire Electric Power Company will not be in a position to generate energy at its proposed Stourport super-station until 1925 and Worcester and the south part of the county would only be dealt with in the quinquennial period extending from 1925 to 1930. Ultimately the Worcester, Malvern and Redditch stations would be used for distributing purposes.

Like the majority of small provincial supply undertakings the MENAI BRIDGE Electricity Supply Company has found it difficult to carry on under present conditions and it offered to sell its undertaking to the Urban Council. The latter, having exhausted its borrowing powers on the new water reservoir, declined the offer, but promised, if the directors laid before them a satisfactory scheme, they would be prepared to call a public meeting to consider it. This meeting was held last week when a resolution pledging the meeting to do everything possible to carry the scheme into effect was adopted. A committee of ten was appointed to carry out propaganda work and to canvass for more consumers. Of the additional capital of £3,000 required, £600 was subscribed in the room.

The accounts of MANCHESTER ELECTRICITY DEPARTMENT for the year ended March 31 show revenue £1 547 226, compared with £1 197 199 in previous year, working and general expenses and special charges were £1 115 239 (£765 357), leaving a balance of £431 987 (£431 842). Interest required £103 115 (£93 709), and income tax £55 659 (£39 714), £34 027 (£49 871) has been placed to renewals suspense account, and £170 509 (£161 361) to sinking fund, £31 893 (£5 822) to reserve fund, and £37 230 (£68 207) applied to aid of rates. Total maximum supply demanded was 59 500 kW (82 150 kW). Units generated were 256 656 070 (241 776 060) and sold 199 618 813 (182 419 070). The report of the Electricity Committee states that further borrowing powers amounting to £1 750 277 were secured during the year, of which £1 392 000 was in respect of the new Barton station and h.t. mains. Total capital outlay now amounts to £4 149 345, and the outstanding debt is £2 178 368. In view of values still being abnormal, and in view of the heavy interest charges on new outlays, no proposals will be put forward which do not seem to be called for by the vital importance of electric power to the industrial success of the district. Average cost of fuel rose 9s. 11d. per ton during the year and the fuel consumed rose 0.051b. per Kelvin sold.

In connection with the Barton station, the following additional contracts have been placed: British Thomson-Houston Company, e.h.t. and l.t. switchgear; Metropolitan-Vickers Electrical Company and Ferranti Limited, 33 000-6 600 V transformers; Mather & Platt, circulating water pumps; F. W. Brackett & Company, circulating water-screening plant; Babcock & Wilcox, electric cranes; Sir Wm. Arroll & Company, steel work for buildings; F. Morton & Co., steelwork for bridges; Edmund Nuttall & Company, circulating water culverts. A 2 000 kW motor generator and a 1 500 kW motor converter have been put in at Dickinson-street distributing station. Further contracts have been placed with Bruce Peebles & Company for eight 1 500 kW motor-converter for Corporation distributing stations. Additions have been made to the plant at a number of large consumers' distributing stations, and several new stations have been established, one in each case a construction. A supply was being furnished to the Temple and Blackley housing estates, and substantial progress has been made in connection with the services to the Gorton, Anson and Wilbraham-road estates. A contract has been placed with Callenders' Cable & Construction Company for the 33 000 V transmission cables required in connection with the first section of the Barton station. Other 33 000 V cable contracts for supplies to Failsworth, Droylsden and Middleton have been placed with W. T. Glover & Company and the British Insulated & Helsby Cables, Ltd. The efficiency of the distributing system was whole equalled 88.21 per cent.

Electric Traction.

GRIMSEA Corporation has decided to purchase the undertaking of the local tramways company.

BARKSLEY Corporation has received sanction to a loan of £1 000 for electric vehicle charging plant.

Owing to the heavy capital outlay on the tramway scheme, ABERDEARE Council, according to its accountant, requires money badly and has asked the heads of its departments and the local school teachers to lend at 5 per cent. tax free, whatever they can spare out of their monthly salaries. The heads of departments have already lent the council £700.

Bearing in mind the fate of last year's Tramway Extensions Bill, the LONDON COUNTY COUNCIL has decided against promoting another Bill in the 1922 session for the construction of new tramways on account of the veto of the Borough Councils.

In June, 1918, the Council approved a bonus scheme by which motor-men and conductors received 50 per cent. of the value of the direct saving in fuel due to any decrease in the consumption of electrical energy effected by them. Although the scheme has not been quite so successful as was anticipated, the Highways Committee believe it is formulated on right principles, and they have considered the desirability of experimenting with a power-saving device in use on American tramways and which has been introduced on the cars of the Metropolitan Electric Tramways with good results. The recording device has an ordinary clock movement with a solenoid and cyclometer attached. In working, the time during which the current is used on either the power or brake side is recorded on the cyclometer in minutes. In actual use the starting figure on the cyclometer would be entered on a record form on the departure of a car from a depot, and at the point of "relief" the figures would be recorded and checked by the motorman commencing duty. The record form would remain on the car until the completion of the day's work and at the depot the final figure would be checked by the staff. It is proposed to equip at a cost of £440 a few cars with the instrument in order that the motor instructors may illustrate to motormen the possibility of economy in electrical energy.

Business Items, &c.

Archibald Hy. O. Walker and Thos. Storey, trading as A. O. WALKER & COMPANY, electrical and mechanical engineers, 6, Norton-street, London-road, Liverpool, have dissolved partnership. Debts by Mr. Walker, who continues the business.

John Palmer Castle and Cyril John Arnold, trading as the ELECTRICAL EQUIPMENT & INSTALLATION COMPANY, 64, Finsbury-pavement, London, E.C., have dissolved partnership. Claims and debts should be sent to Messrs. Castle & Company, 31, Gracechurch-street, E.C.3.

MESSRS. WILLIAMS, PELL & BARING have removed from 5, Chancery-lane, W.C. 2, to 4, Regent-square, Gray's Inn-road, W.C. 1, where they will hold a stock of the Electrical Alloy Company's nickel-chromium wires and ribbons, and also of three-phase motors, starting gear, switch-gear, rectifiers and overload switches, &c., manufactured by the Heemaf Company, of Hengelo, Holland.

MESSRS. W.M. GEIPEL & COMPANY have acquired the business (stock, plant, patents and goodwill) of the Quead Electric Fires as a going concern, and have made provision for the manufacture and sale of these fires at their St. Thomas-street Works, London, S.E.1. Future correspondence should be sent to the Trade Department of the company at that address.

Personal and Appointments.

MR. S. H. C. WEBSTER, of Surbiton, has been appointed assistant mains engineer at Hammersmith in succession to Mr. F. V. Jordan, who recently resigned.

MR. M. T. M. ORMSBY, A.R.C.Sc., M.I.C.E.I., University Reader in Surveying, has been appointed to the Chadwick Chair of Engineering at University College.

MR. E. C. S. DICKSON, B.A., Ph.D., has been appointed senior lecturer in physics, and Mr. C. M. MASON, M.Sc., senior lecturer in engineering at MANCHESTER UNIVERSITY.

TO MR. H. W. LAING, general manager of St. Anne's Council tramways, who has completed 15 years' service the staff have made a presentation of two silver entrée dishes and a silver mufin dish as a mark of esteem.

Miscellaneous.

A boy named Fredk. Harwood, of NEW TREDEGAR, while birds'-nesting recently, climbed up the side of an engine house at a local colliery and coming into contact with an electric wire carrying current at 3 000 V, received a fatal shock. At the inquest a verdict of accidental death was returned. A similar case has occurred in Scotland and the jury suggested special precautions should be taken to prevent such accidents in future.

The "Electrical World" announces the death of Prof. FRANCIS BACON CROCKER, a pioneer of the electrical industry in the United States. In conjunction with Mr. S. S. Wheeler, Prof. Crocker founded the Crocker-Wheeler Company in 1888. At the same time he was engaged in giving instruction in electrical engineering in the Columbia University and was appointed professor in 1893. Prof. Crocker was a past-president of the American Institute of Electrical Engineers and was largely concerned in the promulgation of the standardisation rules of the Institute and of the National Electrical Code.

Tenders Invited and Accepted.

GLASGOW Corporation requires tenders by August 8 for electric light installation work at Meriklands Cattle Wharf, Partick. Forms of tender from the Electrical Engineer, 75, Waterloo-street, Glasgow.

FIFE EDUCATION AUTHORITY invites tenders for electric lighting and other works in connection with additions to Buckhaven infant school. Schedules from Mr. G. Sandilands, Master of Works, Education Offices, Kirkcaldy, to whom tenders by August 8.

DURBAN Corporation invite tenders (by Aug. 10) for supply of superheaters and motor-driven mechanical stokers for three water-tube boilers. Tenders to Town Clerk, Durban. Specifications may be inspected at the Department of Overseas Trade.

Tenders are invited by Aug. 15 for the supply and delivery to the Postmaster-General's Department, State of TASMANIA, of switchboard material. Tenders, forms, &c., from the High Commissioner for Australia, Room E.5, Australia House, Strand, London, W.C.2.

MANCHESTER Education Committee requires tenders by August 3 for providing and fixing an electric light (2½ cwt. capacity) at the Municipal College of Domestic Economy, Chorlton-on-Medlock. Specification can be obtained at the Education Offices, Deansgate, Manchester.

The Commercial Secretary to H.M. Legation at MONTEVIDEO (Capt. E. C. Buxton) reports that the local authorities advertise for tenders (by Sept. 3) for the supply of 59,250 metallic filament lamps (from 10 to 300 c.p. for 225 V circuits) which are required by the State Power-House. Local representation is essential.

BRISTOL Electrical Committee invite tenders for the supply of a 3,000 kW single-phase and a 6,000-kW 3-phase turbo-alternators, with condensing plant and auxiliaries. Specifications and forms of tender from the chief engineer and general manager (Mr. H. Faraday Proctor, M.I.C.E., M.I.E.E.) to whom tenders are to be sent by noon, August 15.

THE VICTORIAN RAILWAY COMMISSIONERS invite tenders (by Aug. 17 for renewals for 3,000 sets of caustic soda primary cells (Contract 34 145); and by Aug. 24, for motor generator set, accessories and switchgear for automatic telephone exchange (Contract No. 34 132); also (by Aug. 31) for the supply and delivery of accumulator cells and accessories (Contract No. 34 171), including (a) 100 sets, 140 Ah capacity in sets of 12, and (b) 32 sets, 200 Ah in sets of 12 cells (electrolyte not included); also for electric lighting equipment (axle generator system), including (a) 45 sets, 30 A set for passenger car, (b) 10 sets 30 A set for van, (c) 16 sets, 40 A set for special car; (d) 72 main car switches (chopper or rotary type), and an extra battery, &c. Tenders to the Commissioners, Spencer-street, Melbourne, and must be accompanied by a preliminary deposit of 4 per cent. of the total offer. Local representation is essential. Specifications at Department of Overseas Trade.

CHESTERFIELD Council has accepted the tender of Plowright Bros. for coal and ash elevators, at £2 570.

STRETFORD (Lancs.) Council has accepted the tender of Babcock & Wilcox for coal bunkers, &c., £1 950.

LEEDS Corporation has accepted the tender of W. T. Henley's Telegraph Works Company, for the supply of cables, at £2 270.

ROTHERHAM Corporation has accepted the tender of Steel, Peech & Tozer for 400 tons of Sandberg steel rails, at £27. 15s. per ton.

Messrs. CHAMBERLAIN & HOOKHAM, LTD., Solar Works, Birmingham, have been successful in securing contracts for a 12 months' supply of electricity meters to the following municipalities:—Glasgow, Battersea, Belfast, Gloucester, Islington, Bath and Llandyfair.

LONDON County Council has accepted the following tenders: Western Electric Company (lowest tender received) for h.t. cables, £38 486 (eight tenders received, highest £41 912); British Thomson-Houston Company, seven 1,000 kW rotary converters, £54 598 (19 tenders received, including alternatives for different efficiencies). The highest was £65 982 and the lowest £48 040; W. H. Allen, Son & Company, condensing plant, £17 893 net (17 tenders received, varying from £24 957 to £16 067, the last mentioned being from Escher, Wyss & Company.)

Bankruptcies, Liquidations, &c.

A meeting to receive an account of the winding-up of the SURREY ELECTRICAL COMPANY, LTD., will be held at 227/8, Gresham House, London, E.C.2, on August 22.

Claims against the LITTLE WONDER BATTERY COMPANY, LTD. (in voluntary liquidation), are to be sent by Aug. 19 to Mr. R. G. Pye, 26, Budge-row, London, E.C.4.

Mr. Wm. Brittain, 15, Pilgrim-street, Newcastle-on-Tyne, has been appointed trustee in the bankruptcy of BARTHEM BROS. DALE, electrical engineer, Erick-street, Newcastle-on-Tyne.

Claims against John Harrison, trading as HARRISON & SON, electrical engineer, 9b, Princes-street, London-road, Southend-on-Sea, are to be sent by Aug. 10 to Mr. T. Gourlay, 29, Russell-square, London, W.C.1.

Claims against Wm. Hy. S. WARD, electrical engineer, 56, High-street, Acton, are to be sent by Aug. 6 to Mr. T. Gourlay, 29, Russell-square, London, W.C.1.

JOHN HY. TAYLOR, electrical engineer and contractor, 99, Blackhorse-street, Bolton, has been adjudicated bankrupt. The first meeting of creditors will take place on Aug. 3 at the Official Receiver's Offices, Byrom-street, Manchester, the public examination on Sept. 21 at the Court House, Mawdsley-street, Bolton.

Companies' Reports, &c.

GENERAL ELECTRIC COMPANY'S MEETING.

At the annual general meeting of the General Electric Company, Ltd., last week the chairman and managing director (Mr. Hugo Hirst) delivered a long and interesting speech on the progress of the company and on the future of the electrical industry. He said that when in 1889 he assisted as one of the founders in the formation of the company, with a registered capital of £300,000, he little dreamt that it would be his good fortune to direct its affairs for 32 years. In spite of his most enthusiastic belief in the future of the electrical industry, he could not then imagine that they should grow into a world-wide concern that would find it necessary to build its own home suitable for its own specific purposes, including the hall in which they met, which served for the instruction and welfare of the employees. Ever since 1910 it became apparent that their efficiency was impaired through the inadequacy of their head office accommodation. In 1912 they secured the site, and the plans and general lay-out of the building were decided then. It was a distinct credit to the prevision of the management of the company that nine years after—in 1921—they found it exactly suitable for their purposes. After referring to the design and general features of the new building, Mr. Hirst said they had every reason to be proud of the past year's balance-sheet, though the four months of the new year were casting a shadow over those results. Unrest in the labour world, the stoppage of the coal mines, the shutting down of most of the steel works, the standstill of the shipbuilding and automobile industries, and other causes had reduced their home market beyond recognition. The general fall in the values of securities had impaired the purchasing power of the public. Simultaneously, the state of exchange in many foreign markets had interfered with export and had added to the depression. He hoped that the slight improvement noticeable during the last week or two might continue, and that they might still create in the course of the remaining eight months a peak in the curve of business which would counteract the depressions during the first four months. He was satisfied that as soon as the difficult period was passed the future of the G.E.C. would be as happy and prosperous as the past.

RAPID GROWTH.

Their progress had been so rapid that it was difficult to compare the results of the last few years. They had endeavoured in the report to explain the enormous growth of the essential items in the balance-sheet, and he had little to add. A considerable percentage of the increase in the item "sundry debtors" was due to an improved export business, while the large amount of work in progress for orders received during the year swelled the item of "stock in hand." "Trade investments" represented sound assets, and wherever there was any doubt a reserve had been created. The profits amounted to £796 148, and gave him great pleasure. Out of the total profits only £539,000 would flow into the pockets of the shareholders, who, had they invested in British and Colonial securities the capital which they had invested in the G.E.C., would have had an income of at least £300,000, without risk. To secure to them the remaining £239,000, distributed amongst 12,500 shareholders, they had been able to employ usefully 16,640 workpeople and staff. They had paid to them in wages and salaries £2 864,000. In simple language the figures meant that the whole of the dividend which these shareholders received, compared with the whole of the wages and salaries was in the ratio of 2s. for the shareholders and 8s. for the workers. In addition, they had contributed another £2 000,000 of wages to workers in other industries, spent on transport, and on raw materials. They had, besides, contributed at least another million to the wages in the building trade alone; but the main benefit to all was that capital and labour had jointly created new values and added to the much-needed wealth of the country some £8,000,000 or £9,000,000. A trader or distributor could do the same volume of business as they had done with, say, only one million or one and half million of capital. However, instead of employing nearly 17,000 workers, 90 per cent. of whom had to be highly skilled, he could have done that amount of business with 500 to 700 workers, only 10 per cent. of whom need be skilled. The reason for his comparison lay in his belief that, owing to want of understanding, industry did not receive the same support as trade from all shades of public opinion.

KEY INDUSTRIES BILL.

The relative importance of industry and trade were equally misunderstood in other walks of life, and quite recently in following the debates in the House of Commons in connection with the Key Industries and Anti-Dumping Bill, he noticed among some of our legislators equally hazy views on the subject. The name of the General Electric Company was frequently mentioned in connection with the decision of the Government to include electric light carbons in that Bill. Some seemed to imagine that all their results were due to carbons. The total capital invested in the carbon enterprise up to the outbreak of war was only £40,000; the total losses incurred in it up to 1914, through no fault of theirs, but through the deliberate attacks of foreign trusts, was £78,000. Year after year the directors considered the shutting down of the works. Nothing but the fear of war, the knowledge that electric light carbons were as important for the defence of the country as shells or guns, and nothing but the feeling of duty in the interest of the safety of the country prevailed upon the directors to continue that unremunerative enterprise. At the outbreak of the war it became apparent that the Government had under-estimated the probable requirements of carbons in the ratio of 1 to 10. Additional works had to be established at a cost of £50,000. Towards this the Government contributed £30,000, which was to be paid back out of future profits. They continued the supply of carbons

throughout the war at pre-war prices, and their total accumulated losses to March, 1920, amounted to £115,000.

Another industry with which they were connected—their Lemington Glass Works—proved almost of equal value as the carbon works, and they regretted that it had not received the protection from the Government which was promised. The financial results of those works, owing to foreign competition, were always indifferent, but during the war they had supplied much essential war material. In the telephone works they had also been busy throughout the war in making telephone material for the trenches, but since the war they had made such progress as to reduce the dependence of the British Post Office on foreign trusts to a minimum, and they hoped that with their new and enlarged works they would succeed in making it entirely independent.

COMPANY'S PROGRAMME.

The war had recast the map of the world and had created a large number of new and small countries, but their endeavours to be self-supporting would fail. Only producers in great countries with a large and secure home market could, by producing cheaply and efficiently, supply the demands of the world. It was on those fundamental ideas that the greater programme of the G.E.C. had been conceived. Other countries had produced electrical concerns with large capital, a large number of works covering every branch of the electrical industry, assisted by the capital and the brain of the whole country. It was no use replying to those mammoth organisations by the disjointed efforts of the 60 or 80 small specialist electrical concerns which this country had before the war. In order that Britain should have its share in the electrical work of the world, bigger groups had to arise, and they for one had laid themselves out accordingly. Every one of their works has been enlarged or modernised. A great deal of money had been spent in improving the conditions under which work would be carried on in future, welfare arrangements for the comfort and happiness of the workers playing an important part. Laboratories and development departments had been started, and the results—modest as they were—had already added to their prestige. After citing some of the problems to be solved, Mr. Hirst said they were equipped to deal with all demands that might arise. He was as convinced as ever that throughout the world the demand for electric light and power was greater than ever. The whole world was considering, wherever possible, large hydro-electric schemes to counteract the absence or the dear price of coal. The whole world was considering power stations of one kind or another. Railway electrification schemes in this and almost every country were pressing. Mines, steelworks, factories all the world over had to be modernised. New fields would be opened for lamps, fittings, motors, and the whole range of products for which the company had ever been famous. The demand of this and every other country for improved telephony was a well-known fact. They had prepared themselves to meet all those demands and had their fair share of the world's work, and nothing but the financial or social collapse of the country could stop the G.E.C. from obtaining that ideal, never mind what temporary holdup or check it might experience.

The directors of MATHER & PLATT, LTD., have declared an interim dividend of 3 per cent. (actual) on the ordinary shares, as in 1920.

The directors of the CHelsea ELECTRICITY SUPPLY COMPANY, LTD., have declared a dividend of 5 per cent. per annum (less tax) on the ordinary shares for past half-year, payable Sept. 15.

The METROPOLITAN DISTRICT RAILWAY COMPANY announce an interim dividend for the half-year to June 30 on the five per cent. second preference stock, of 2½ per cent., against 1½ per cent. in 1920.

The directors of the KENSINGTON & KNIGHTSBRIDGE ELECTRIC LIGHTING COMPANY, LTD., have declared a dividend of 4 per cent. on the ordinary shares for the half-year ended June 30.

The interest on the 4 per cent. mortgage debenture stock of the EASTERN EXTENSION AUSTRALASIA & CHINA TELEGRAPH COMPANY, LTD. for the half-year ending July 31, due on the 1st proximo, will be paid by warrant on the 2nd proximo.

New Companies.

The following list is compiled from information supplied by Messrs. Jordan & Sons, Ltd., company registration agents, Chancery-lane, London, W.C.2:—

DISC BEARINGS SYNDICATE, LTD.—(175 677). Reg. July 12, capital £500 in £1 shares, to acquire rights relating to anti-friction bearings, &c. Directors: J. F. Monnot and K. O. Leon. Reg. office: 115, Great Portland-street, W.1. Private company.

SUSSEX ELECTRICITY SUPPLY COMPANY, LTD.—(175 686). Reg. July 12, capital £20,000 in £1 shares, to acquire and carry on business of electrical engineers. Directors: H. W. Humphries, W. Simms, E. Prior and A. H. Hunt. Reg. office: 85, Gracechurch-street, E.C. Private company.

The Editorial, Advertisement and Publishing Offices of "THE ELECTRICIAN" are at 8, Bouverie Street, London, E.C.4. Telegrams: Benbrock, Fleet, London. Telephone: City 9852 (5 lines).

The subscription to "THE ELECTRICIAN" is £2 12 0 per annum in the United Kingdom, and £2 14 0 per annum Abroad. Advertisement Rates can be obtained on application to the Manager. Advertisement copy and blocks should be received on the Friday preceding date of publication.

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"Aeronautics": Special Spanish Edition: "The Lords and Stresses in Aeroplanes"; and "The Aerial Timetable."
"The Cabinet Maker": "Waring & Gillow's Athletic Meeting"; "The Modern Shop Front"; and "Instruction in Cabinet Making at Shoreditch."
"Chemical Age": "Annual Report on Alkali Works"; "Future of Chemical Industry in India"; and "Reviews of New Books."
"Farm & Home": "Implements and Machinery" ("Successful Farming" Course); "Rothamsted Experimental Station"; and "Use of Lime in Agriculture."
"The Fruit-Grower": "The Growers' Marketing Association"; "Effect of Frost on Fruit Buds"; and "Ormskirk Potato Trials."
"Gardening Illustrated": "Rhododendrons in a Dry Summer"; "Fruit Prospects in North London"; and "Strawberries in a Sussex Garden."
"The Gas World": "The Junior in Industry," by John W. McLusky
"The Gas Industry and Smoke Abatement"; and "How the Gas Industry Met the Coal Stoppage."
"Hardware Trade Journal": "The Manufacture of Galvanised Sheets and Corrugated Iron"; "Hardware Prices: Is the Public's Education Neglected as to Costs"; and "Notes on Pumps (V)," by Joseph Horner.

Forty Years Ago.

(THE ELECTRICIAN, JULY 30, 1881.)

THE RANELAGH CLUB.—On Saturday, the 23rd inst., the last polo match by the electric light was played at this club.

THE NEW ATLANTIC CABLE.—The telegraph steamship "Faraday," on Thursday, July 21, landed at Whitesand Bay, near Land's End, the shore end of another new Atlantic cable.

BROOKE'S SYSTEM OF INSULATION.—We understand that the work of extension of this system has been completed between Waterloo and Clapham, that the tests are satisfactory, and that in a few days it is to be tested for telephonic work.

A TELEPHONIC DIRECTORY.—The United Telephone Company have issued the second edition of their subscribers' list, which is brought up to the 20th of July. The list is classified under the heads of the professions and trades to which the subscribers belong. In a preface to the list it is stated that the company have now in London upwards of 1,000 subscribers, and that the "calls" average 6,000 a day. As we stated in a recent note, the company have arranged with the Post Office to connect three of their exchanges to the Postal Telegraph Department at St. Martin's-le-Grand, so that messages can be handed to non-subscribers having their place of business within a short radius of the Post Office at a charge of 3d. per twenty words, or they will be forwarded anywhere in the United Kingdom at the usual rates for telegrams.

Prices of Metals, Chemicals, &c.

		Price.	TUESDAY, July 26.	
			Inc.	Dec.
Copper—	Best selected.....	per ton	£70 10 0	—
	Electro Wirebars ..	—	£75 10 0	—
	H.C. wire, basis ..	per lb.	0s. 11½d.	—
	Sheet	—	0s. 11½d.	—
	Sheet	—	0s. 11½d.	—
Phosphor Bronze Wire (Telephone)—				
Phosphor-bronze				
wire, basis				
Brass 60/40—				
Rod, basis				
Sheet, basis				
Wire, basis				
Pig Iron—				
Cleveland Warrants ..				
Galvanised steel				
wire, basis 8 SWG ..				
Lead Pig—				
English				
Foreign or Colonial ...				
Tin—				
Ingot				
Wire, basis				

Salammonic.—Per cwt. 65s.-60s.

Sulphur (Flowers).—Ton £13.

" (Roll-Brimstone).—Per ton £13.

Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.

Rubber.—Para fine, 11d.; plantation 1st latex, 9½d. lb.

The metal prices are supplied by British Insulated & Helsby Cables, and the rubber prices by W. T. Henley Telegraph Co., Ltd.

Copper Sulphate.—Per ton £30.

Boric Acid (Crystals).—Per ton £69.

Sodium Bichromate.—Per lb. 7½d.

Sodium Chlorate.—Per lb. 4d.

THE ELECTRICIAN

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Notes.

The Work of the Electricity Commissioners.

THE Report of the Minister of Transport on the progress effected under the Electricity (Supply) Acts for the period from June 27, 1920, to March 31 last is a record of much useful work. The date of the report has been altered so as to coincide with the financial year, as from the 1st April, 1922, the expenses of the Electricity Commissioners will be provided by contributions from the electricity supply industry. For the first two years the expenditure of the Commissioners, which amounted to £43 500 from the period of their appointment to March 31 last, will be met by temporary advances from the Exchequer.

Many Price Increases.

DURING the period under review only three Special Orders were submitted by the Electricity Commissioners for confirmation to the Minister, but the latter has made no less than 159 orders for the increase of the maximum prices of electricity. These Orders have been made after consultation with the Commissioners, but we hope that in future there will be less need for the activities of both in this direction, for electricity supply authorities ought now to be more concerned with a reduction than an increase in their charges. Five extensions of time for carrying out compulsory works scheduled in Provisional Orders and six in the case of special Acts were granted. The revocation of six provisional orders has been deferred, but orders to break up private streets were made in six instances. We are pleased to notice an increasing tendency to allow overhead wires, for there were thirty orders permitting this course made by the Ministry, including one which was opposed by the local authority. In the case of Woking the Minister sanctioned a wayleave for part of the route of an overhead line subject to special conditions. Of four applications to the Minister for the construction by him of generating stations or main transmission lines pending the creation of Joint Electricity Authorities, one was not entertained, two were accepted subject to conditions which were not fulfilled, with the result that the applications have lapsed. The fourth application is still under consideration.

Electricity Supply Progress.

It is, however, from the Report of the Commissioners themselves that we get the best insight into the real progress of the supply industry. Apart from their activities in connection with the reorganisation of electricity supply and the provisional determination of thirteen electricity districts, they have issued their formal consent for the erection of eight new generating stations and four main transmission lines, while over 120 applications for the extension of existing generating stations have been sanctioned. The new stations represent the initial installation of 150 000 kW of generating plant, with the possibility of further extensions at a later stage, while the authorised extensions of existing stations represent about 550 000 kW.

Exercise of Borrowing Powers.

OVER 500 applications were received by the Commissioners from local authorities for authority to borrow money for their electric supply undertakings and sanction was given in 432 cases. The total amount of the loans sanctioned was £15 181 298, including £9 805 990 for plant and £3 428 161 for mains and services. The Commissioners state that in every case they have satisfied themselves of the necessity for and the cost of the proposed extensions. And it must be pointed out that this vast sum, which represents only nine months' requirements of the industry, was borrowed on the security of the rates, which augurs that Joint Electricity Authorities would be equally successful if the same course were followed.

British Engineering Standards Association.

THE address given by Sir ARCHIBALD DENNY at the recent annual meeting of the British Engineering Standards Association made his audience realise not only the vastness of the work undertaken by this body but the economical way in which its operations are carried out. It will doubtless come as a surprise to many to learn that there are now more than 1 500 engineers engaged in helping the work of the Association. The time and experience of these workers are, it must be added, given quite voluntarily and often at great personal expense and inconvenience. It is therefore somewhat unfortunate to

find, as Sir ARTHUR DENNY pointed out, that the business community is not as impressed as it should be with the commercial value of standardisation, for this is the only conclusion which can be drawn from the difficulty which is found in raising the comparatively small sum of money required for carrying on the work of the Association. A certain amount of indifference is doubtless due to lack of connection between the engineering and the selling sides of the industry, but we agree with certain critics at the meeting who suggested the advisability of giving greater publicity to the doings of the Association. For we feel it is in this way that the really excellent work which is being effected would best be made more generally known and the financial results which are so eminently necessary would follow. In these columns we have often called attention to the benefits of real standardisation and we are therefore glad to learn that there is a growing appreciation both by the Government and by the industry of the value to the trade of the country of an organisation such as the British Engineering Standards Association. For our part, we have no doubt that as useful as this Association has been in the past, it will be even more useful in the future.

The Story of the Induction Motor.

It is one of the shortcomings of the engineering profession that it is not often favoured with Papers which deal with subjects of general interest and importance from the historical point of view. This is a pity, as Papers such as that by Mr. B. G. LAMME, which we publish on another page of this issue, have a considerable educational value, for after the lapse of time it is possible to speak freely on many developments which have hitherto been obscure and to learn much from accounts of early troubles and mistakes. Some of the author's recollections of those early days are quite amusing. We like the description of the starting resistance composed of large carbon rods, used in the experimental Westinghouse display at the Chicago World's Fair in 1893, which occasionally became red hot and was therefore judiciously kept out of public view in the basement. Other exhibits, too had their humorous aspect, notably the A.E.G. water-rheostat, which at one stage of the proceedings caught fire! Our chief impression on reading this account, however, is regard for the indomitable perseverance of these early investigators and the highly enterprising action of manufacturing firms in so constantly revising their methods—in some cases so rapidly that experience of the defects of new lines of motors was gained mainly at the expense of equally enterprising purchasers. It is interesting to observe that, according to Mr. LAMME, most of the fundamental, original work on the induction motor was completed at a comparatively early date. During recent years its history has been mainly one of extending and perfecting detail, accompanied by revisions of design necessitated by new applications, e.g., in large steel works where speed adjustment is an important item. It may be noted that the use of these motors for electric ship-propulsion, though occasioning so much comment, is not regarded by Mr. LAMME as a very radical technical novelty. The conditions met with on shipboard are, in his opinion, easy to fulfil and the problems are not so severe as those which are present, for example, on railways and in steel mills.

Electricity Supply in Rural Areas.

JUDGING from the number of applications recently lodged with the Electricity Commissioners for special orders, a distinct revival in the demand for electricity supply in smaller towns and in certain rural areas is in prospect. This tendency is good in itself. But what is more important is that the movement is not confined to any one part of the country. It applies equally to industrial districts in close proximity to

the great manufacturing centres in the Midlands and the north as to isolated towns in purely agricultural areas in remote parts of the country. This revival is, no doubt, partly due to the high price and poor quality of gas and partly to a natural desire to offer the advantages derivable from the use of electricity to all who desire it. Unfortunately, one of the immediate results of the proposals for the reorganisation of electricity supply and the co-ordination of existing undertakings has been that several extension schemes have been postponed and fresh consumers cannot therefore be connected because the existing generating plant is overloaded. An example of this is to be found at Oswaldtwistle, where the urban council has been anxious for some time to obtain a supply either from Blackburn or Accrington. But neither of these corporations can meet the demand, though Accrington has submitted proposals to the Electricity Commissioners for the extension of its plant and the Oswaldtwistle Council is urging the Commissioners to approve the scheme without delay so that it may have a chance of getting a much-needed supply from them. There are several other districts in a similar position and it is to be hoped, therefore, that some means will be devised to meet the situation and so enable progress to be made with the expansion of the supply industry into districts where it is sorely needed.

An East Anglian Example.

IN this connection it is interesting to notice the progress made by the East Anglian Electricity Company in many of the towns in Norfolk and Suffolk, i.e., small towns in agricultural counties. Already the company is supplying electricity in Stowmarket, Diss, Needham Market, Beccles and other districts and a scheme has been prepared by the Company's engineer, Mr. NAPIER PRENTICE, for the towns of Framlingham, Saxmundham, Leiston and Wickham Market. It was stated at a public meeting recently that out of a sum of £4 000 needed to give a supply in Framlingham, £2 800 had been secured and a committee of ratepayers had been formed to find the balance. The Company's publicity campaign in East Anglia is also having a good effect and there is little doubt that other towns in the neighbourhood will take similar steps. But what is being done in East Anglia can be done in other districts and now that things are becoming more stabilised we hope the Company's example will be widely followed.

Trade Revival and Taxation.

THE hopes of a trade revival, which were engendered by the settlement of the coal strike, have also increased the already strong feelings of exasperation against Government interference with industry. Control, as we understood it during the war, is, it is true, disappearing under the acid effect of public opinion, but although the Excess Profits Duty is moribund its harmful influence still exists and the burden of excessive taxation of other kinds prevents a full development of those powers which alone can restore our national trade and prosperity. It is trite to say that taxation, both indirect and direct, is unduly high, and, although we must regard this as an inevitable legacy of the war, we can hope for no mitigation of these evils while the present spendthrift national policy continues. Economists have often called attention to the drawbacks of taxation passing a certain critical point and they have also recognised that to prevent revolt taxation must be fairly imposed. This is not the case with many of our present taxes. Indeed, the reformers' old cry that there should be "no taxation without representation" might very well, under present conditions, become "no representation without taxation." For while certain persons and trading bodies are taxed beyond endurance, a large majority of the electors escape more lightly than is their due.

The Injustice of the Corporation Tax.

THE Corporation Profits Tax, which the present Finance Bill seeks to continue for another year, is an example of the unfair taxation to which we have just called attention. This tax puts the limited liability companies in a class by themselves and imposes obligations upon them which private firms, individuals trading on their own account and salaried and professional persons escape. It also discriminates between classes of trading bodies. For in no other way can we regard the decision to exempt co-operative societies from its operations. The result of this exemption is that while a million miners may run a co-operative stores and escape taxation half-a-dozen ex-officers who club together and form a small business will be liable to the new imposition. This may be politics, it is hardly justice.

Yet Another Government Department.

It has often been stated that certain taxes which are good in themselves are in practice inadvisable owing to the difficulty of their collection. This difficulty forms one of the most practical objections to the Corporation Tax, for it has caused the Inland Revenue Authorities to set up a new taxing department and to extract from unfortunate traders yet another set of figures and particulars about their businesses. Further, it may be pointed out that the Corporation Tax is a tax upon industry, and not upon income, and that it would be possible under future Governments to increase it indefinitely and thus to place all limited liability companies in the country in an impossible position. We should have thought the Excess Profits Duty would have been a sufficient example of the baleful effect of this sort of interference with private enterprise, but apparently the Government, like the Bourbons, can learn nothing from experience.

Avoiding Excessive Taxation.

THE harmful effect of present taxation cannot be better indicated than in the unabated tendency of Anglo-Colonial and Foreign Companies to change their domicile in order to avoid a double income tax. If this movement continues at the present rate in a year or two there will be few such companies with head offices in this country. For example, the shareholders of the Melbourne Electric Supply Company, which has expended over two millions on successful electric supply and tramway undertakings in Melbourne and Geelong, recently decided, without a single dissentient, to change the headquarters of the Company from London to Melbourne. The Compania de Electricidad de la Provincia de Buenos Aires also proposes, in connection with a scheme for the reorganisation of its capital, to transfer the control from this country to Buenos Aires; and at a meeting of the Vryheid (Natal) Railway, Coal & Iron Company, the chairman foreshadowed the possibility of a change in the Company's domicile to South Africa. Such an exodus will undoubtedly be not only a great loss to the revenue, but also to the trade of the country. For while in the past these companies were large buyers of British electric plant and machinery, with the control in the hands of local colonial or foreign boards we are afraid there will be little desire to give us any preferential treatment over foreign products.

Facing Both Ways at the Inquiry.

THE humorous element at the London Electricity Supply Inquiry was provided by Sir H. NIELD who, apart from his eloquence and pertinacity on all sorts and kinds of questions connected with the great problem of electricity supply, offered occasion for Gilbertian comment from the fact that he represented both the Surrey and Hertford County Councils. In happier surroundings this might not

be a difficult position, but as Surrey wished to be included in the new electricity area and Hertford wished to be excluded the position of Sir H. NIELD was equivalent to that of Mr. Facing-Both-Ways and gave him an opportunity not only for the display of humour, both conscious and unconscious, but for the exercise of much ingenuity in producing arguments at one time why his clients should be included in the district and the other time why they should be excluded. We suggest to those legal lights who may have to deal with a similar problem at other inquiries, for the supply of counsel is apparently much less than the demand, that a study of Sir H. NIELD's procedure is a liberal education in the art of being at least two things to all men.

Reflections on the London Inquiry.

THE prolonged inquiry by the Electricity Commissioners into the arrangements for the supply of electricity in the London and Home Counties Electricity District, which lasted seven weeks and occupied 26 sittings, has at last come to an end. For anything like a precedent to such a gathering in bulk and importance we must go back to the year 1889, when Major MARINDIN investigated the various applications for supply powers in London. The Electric Lighting Act of 1888, which amended the abortive Act of 1882, had just made electricity supply a business proposition and consequently the portioning of London among the various companies became a matter of urgent importance.

A FORMER LONDON INQUIRY.

On that occasion there were 13 applications for provisional orders and for licences, together with a Bill by the Metropolitan Electric Supply Company. The inquiry into the various proposals, many of them of a competing character, began on April 3 and concluded on May 1, 1889, after 18 sittings. We hope that the result of the present inquiry will prove not less satisfactory for the supply industry than that of Major MARINDIN, though the problem which the latter had to solve was quite different and much less difficult than that now before the Commissioners. It is interesting to note that one of the applications in 1889, when the battle of the systems of supply was yet in its virulent infancy, was made by the London Electric Supply Corporation which submitted a scheme by that engineer of vision and foresight, Dr. S. Z. DE FERRANTI, for a high-tension alternating current station on the river side at Deptford. There was, of course, no precedent for such a scheme, and though Dr. FERRANTI received much support from engineers there was an idea in the minds of some that the proposed voltage of generation and transmission, 10,000 V, was too high and dangerous. Fortunately, Major MARINDIN considered that "under proper regulations the London Company should not be prevented from carrying out a scheme in which they have the greatest confidence," and to this report, therefore, may be traced the first real advance in the supply of electricity for lighting and power in London. We trust that the report of the Electricity Commissioners on the recent inquiry will prove to be an equally auspicious stage in the development of the supply industry.

OBSTRUCTION AND IRRELEVANCY.

Readers of THE ELECTRICIAN are already aware of the various developments at the inquiry, as we have given as full a report of the evidence submitted on behalf of all the parties as we have been able, or have thought necessary. For, in our opinion, the proceedings were rendered unnecessarily long, partly owing to the prolixity and irrelevance of the legal representatives of some of the parties, partly owing to the conflicting views of the various local authorities interested, and partly owing

to the absence of any general agreement as to the principles upon which a Joint Electricity Authority should be constituted. It may seem a little ungracious, in view of the extreme patience and tact, coupled with the firm grasp of detail, shown by the Commissioners, to criticise the conduct of the inquiry, but we confess that at times we wished the Chairman had intervened and put a stop to the flow of irrelevant and factious loquacity. It was mainly an inquiry into an engineering problem, though important financial and administrative questions were incidentally involved, yet many of those present, including several of the witnesses, had no clear conception of any of the issues. They seemed to us to be there for purely obstructive purposes, to hinder and not to help in the solution of one of the most urgent and complicated questions of the day.

CHANGE OF PLANS.

There were two dramatic developments in the course of the proceedings—shortly after the start of the inquiry and when the case of the County of London Electric Supply Company was presented. Each of the three major schemes—those of the L.C.C., the Conference of Local Authorities and of the London Electricity Joint Committee—was based on the detailed information and estimates supplied by four eminent consulting engineers, and each originally contemplated the formation of a Joint Authority, the acquisition of existing generating stations and main transmission lines and the erection of four capital generating stations. However, after the inquiry was opened it was announced that these proposals had undergone serious modification owing to financial and other reasons. Supplementary particulars and estimates were placed before the Commissioners and, as an alternative, it was proposed to adopt an elaborate scheme of interlinking existing supply systems with considerable extensions of plant at the most economical of the generating stations.

ARE CAPITAL STATIONS NECESSARY NOW?

By this means it is hoped to avoid the heavy capital expenditure entailed by the erection of the new stations, at all events for some years, while all demands for industrial power would be met for the next four or five years. The altered scheme would be carried out in two stages, in the first of which eighteen of the least efficient of the present stations would be shut down and in the second twenty-six others would be dispensed with, leaving only seventeen, of which twelve are at present owned by companies. Much could be said in favour of this modified scheme, especially in view of the dearth of money and of the relatively high cost of electrical plant and mains compared with what existed in 1914. There are, however, other factors to be considered, and though a good deal depends upon the accuracy of the revised estimates, the relative efficiencies of the existing plant and of modern turbo-generators and the cost of mains, buildings, &c., must also be taken into consideration.

MR. MERZ'S OPINIONS.

Mr. MERZ, always an engineer of most optimistic and progressive views, created a great impression by his evidence. He put forward facts and figures which seemed to place him in sharp conflict on some points with the engineers for the schemes under consideration; he pleaded boldly for the erection of capital stations at once, and he seemed to regard it as an engineering heresy, or at least a faint policy, to place any hindrance on the erection of modern plant, more especially for dealing with the supply in the areas of the County of London Company, on whose behalf he was giving evidence. His policy was to anticipate the load and not to wait for the demand before attempting to deal with it. There is undoubtedly much force in this argument, for we know from past experience that manufacturers are reluctant to adopt

the electric drive until a supply is available, and judging by the success achieved in the Newcastle area and elsewhere, we believe Mr. MERZ is correct in holding that plant should be instantly available to meet the demand that is sure to come.

We should like, however, to know something more about that 150,000 kW turbine of his at £3 per kW before finally accepting his ideas as generally applicable at the present time, though we are aware that the price of plant has fallen and is continuing to fall. It must also be remembered that the electrical plant forms only a portion of the cost of a modern electricity undertaking; the expenditure on the transmission lines, buildings, &c., has also to be taken into account, and the cost of these is still very much above the pre-war standard.

RAILWAY LOAD AND CONSERVATISM.

We consider that the attitude of Mr. MERZ towards the railway loads is the correct one. There is no need for the erection of separate stations for supplying the railway load and no economy could be effected by it that could not be obtained from a bulk supply from a modern station. The one real difficulty is the frequency, and it should not be impossible to overcome that. Railway directors are extremely conservative and move very slowly; otherwise the electrification of the whole of the suburban railway lines would have been carried out long ago. When, however, a fresh start is made on this work, which we hope will be before long, it will take some years to complete it; the growth of the traction demand will be a progressive one and it should pay the railway companies to purchase energy in bulk provided a suitable and sufficiently cheap supply is available.

COMPOSITION OF JOINT AUTHORITY.

Much time was wasted on the question of the constitution and size of the proposed Joint Electricity Authority, and upon the proper representation of the various local authorities and other interests on it. In our opinion, this matter, like all questions of constitution making, will prove a source of endless trouble and of political agitation, unless some general principles can be laid down at the outset. For instance, it must, first of all, be determined who are entitled to be represented on the Authority and then the maximum number must be decided upon. Having done this the number should be appointed or elected by the several supply authorities, company and municipal, either in proportion to the number of units sold per annum or to the population of the supply area. Notwithstanding the modest, but characteristic, claim of the Electrical Trades Union, made through Mr. WEBB, for half the membership of the Authority, we cannot see that Labour is entitled to any special representation on the Authority. All questions directly affecting the workers will be decided by the Industrial Councils and as Labour has no special aptitude for running electricity supply undertakings, we sincerely hope that the Commissioners will pay no attention to this preposterous demand.

COMPANIES' TENURE.

Another subject upon which much time was expended was the extension of the distribution rights of the supply companies beyond the year 1931. Though the majority of the local authorities favoured the principle of an extension, there was some opposition, and it is clear that there is no general agreement on the point yet. There can, however, be no doubt of the advisability of an early settlement of the question, and in view of its importance we hope that the parties will soon come to terms on the conditions of the extension.

POPLAR IN THE LIMELIGHT.

Though the Poplar Borough Council kept itself well in the limelight throughout the inquiry, there was evidence that

their proposals were not treated as a serious contribution to the solution of the problem, and towards the end the Council's claim dwindled to a demand for a separate committee for the East End. The railway companies also cut a somewhat inglorious figure at the inquiry. They appear to have entered it with fluid views and open minds, and they seem to have left it in the same delightfully vague and uncertain mental condition.

SOME FINAL THOUGHTS.

To sum up, we do not think that either of the major schemes, though each of them contains much that is useful, would form an ideal solution, but whatever solution of the question of the London electricity supply problem is proposed by the Commissioners, whether a Joint Authority be suggested for the whole of the District as provisionally defined, or whether the area be divided up into compartments with temporary separate committees, the position has not been made easier by the failure to pass the Electricity Supply (No. 2) Bill. It will, however, take some time to carry out the preliminary work entailed in the formation of a Joint Authority, and if we could hope to see the Bill, or a modification of it, revived and passed early in the next Parliamentary session, no permanent injury would have been done. Without some such legislation as that proposed the municipal and company undertakers cannot co-operate fully in the work of a Joint Authority, and in the task of reorganising and developing the supply industry, and unless co-operation is secured now we are afraid that later on we shall have to face a fresh agitation for the public control of such a key industry as electricity supply. This would indeed be a disaster for any industry, and particularly so for one which has already suffered much from rash legislation, and therefore we hope that some means will be found of securing the friendly co-operation of both sides.

Salaries of Technical Teachers.

THE third Burnham Committee has just issued its report on salaries scales for Technical Teachers. As will be remembered, the first two Burnham Committees dealt respectively with the salaries of teachers in Primary and Secondary schools, but the technical branch of the profession has had to wait a considerable time for a reasonable adjustment of their emoluments. As we have often pointed out the salaries offered to men whose qualifications have necessarily to be high were scandalously low, and the ultimate effect must have been that the ranks of technical teachers would have been seriously thinned. There has, in fact, been a shortage for some time now and the salaries offered have not attracted men from the practical world, which in technical training is a grave disadvantage.

THE CLASSIFICATION OF TEACHERS.

This report of the Standing Joint Committee—known better as the Burnham Committee—begins by classifying technical teachers into five grades, viz., Principals, Heads of Departments, Graduate Assistants, Non-graduate Assistants and Instructors. Of these five grades the Committee has only found it possible to formulate by agreement scales for the Graduate Assistants and the Non-graduate Assistants, but it strongly recommends all local Education Authorities to formulate their own scales for Principals, Heads of Departments and Instructors. The difficulty in the way of a national scheme for these classes is said to be due to the varying types of technical schools and to the differing local conditions.

■ The scales for the graduate and non-graduate assistants

are practically identical with the scales for the corresponding assistants in secondary schools. Graduate assistants (men) commence at £240 and rise by £15 annual increments to £500 in England and Wales except London, where the minimum and maximum are £50 greater. Women graduates start at £225 and rise to £400 by £15 increments, except in London, where the minimum is £275 and the maximum £440. In the case of the non-graduates (men) the scale is £190 rising to £400 by increments of £12 10s., except in London, where the minimum is £210 and the maximum £450; whilst for women the scale is £177 10s., rising to £320 by increments of £12 10s., except in London, where the minimum is £197 10s. and the maximum £360.

SCALES STILL TOO LOW.

We are bound to say that we feel some surprise at the fact that the technical men have not received a higher award than their secondary brethren. This is not to suggest anything derogatory regarding secondary school work or teachers. But they themselves would be the first to admit two very important points for which the technical teacher should have some recognition, namely, that the average technical teacher must have practical works experience in addition to academic qualifications and teaching ability and further, generally speaking, he must do a great deal of his teaching work at night and so suffer the discomforts of the split-shift system.

WORKS EXPERIENCE.

We note that there is one concession made for works experience. Time spent in the industry or in professional or research work after the age of 21 years may be approved as "service" in determining at what point on the scale a teacher should be placed, provided that not more than five years, or in special cases seven years, shall be so counted. Alternatively such time and experience may be regarded by a local Education Authority as a qualification to one who is not already a graduate which would entitle the individual to be placed on the graduate scale. This is a very proper concession.

SATISFACTORY BREADTH OF THOUGHT.

The additions to the scales are similar to those of the secondary teachers, and we note the insertion of a useful phrase in the expression "For a good Honours Degree or its *Technological equivalent* as determined by the local Education Authority, to the minimum £25; to the maximum £50." We are glad to note the recognition of the education authorities that attainments are not only to be measured by University achievements. This recognition indicates that there was some breadth of thought on the committee and we only hope that the local Education Authorities will show an equal breadth in their "determinations."

The date of application of the scale is from April 1, 1921. In this respect the technical teachers will suffer in comparison with the primary and secondary teachers, and it is difficult to see any reason why they should. The cry for economy may be a political reason, but it cannot be regarded as a just one, especially as the technical teachers were distinctly given to understand that their case would not be prejudiced by the fact that it had to be considered after the other two branches had been disposed of.

On one point it is to be presumed that everyone will agree. Lord BURNHAM has rendered a very valuable service to the nation by his work on these committees and his efforts to draw up national scales of salaries must make for a better all round standard of education. The scales may not be all that can be desired, but they do mark a very decided advance over existing conditions, an advance which we cordially welcome.

A New Instrument for Measuring Frequency and other Quantities.

By R. C. CLINKER, M.I.E.E.

PRINCIPLE.

A well-known experiment, originally shown by Prof. Elihu Thomson, consists in placing a metal ring, *A*, around a laminated iron core, *B*, which latter is magnetised by an alternating current in the coil, *D* (see Fig. 1). When the current is switched on, the ring is repelled by the coil and shot off the core. A solid ring is generally used for the experiment, but a short-circuited multi-turn coil, of course, also exhibits this repulsion. The explanation of the repulsive force lies in the fact that, owing to the inductance of the coil, the current in it is displaced nearly 180 deg. from the flux. Now it is clear that if the induced current be reversed in phase—i.e., be turned through 180 deg. with respect to the flux—the force will be

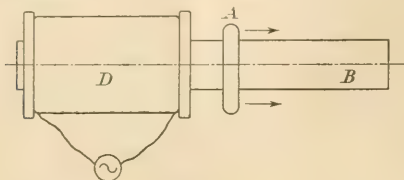


FIG. 1.

reversed, and the coil attracted on to the core. This can be effected by connecting a condenser across the coil. The capacity value, *C*, of this condenser must not be too large.

It must clearly be less than the resonant value $\frac{1}{\omega^2 L}$ (where $\omega = 2\pi f$ and *L*=inductance of coil), in order to produce a phase displacement and an attractive force.

Let us suppose that, with the coil near the end of the core, the capacity is only slightly less than the resonant value (Fig. 2). The coil, if freely supported, is then drawn along the core, as shown by the arrow. But, as it moves, its effective inductance increases, and at a certain point the resonant condition exists, where $\omega^2 LC = 1$. In this position the mean force becomes zero, as the phase of the current is now in quadrature with the flux. Further movement would produce a repulsive force, and so the coil remains in stable equilibrium at the position of resonance. It will be noted that the coil has so moved as to "tune" its circuit to that of the primary. It

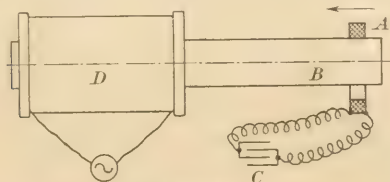


FIG. 2.

forms, therefore, a self-tuning system, which restores the quadrature relation of current and flux whenever that relation is disturbed.

With the coil in this position of equilibrium, let us consider the effect of variation of frequency upon it. An increase of frequency calls for a re-tuning, and the coil moves away from the primary so as to reduce its inductance by the requisite amount, and again find the resonant point. A decrease of frequency has the opposite effect, and the coil is drawn towards its primary. On the other hand, a change of flux intensity produces no movement, but merely increases the stability of the moving coil.

It will be seen from the above that, with constant inductance and capacity, the position of the coil depends upon frequency

only, and the arrangement is, therefore, very suitable for a frequency meter. It is only necessary to pivot the coil freely, balance it, provide a scale, and calibrate in cycles per second.

OPENNESS OF SCALE.

The distance between two scale divisions corresponds to a certain change of effective inductance as the coil moves from one position to the other. The larger the rate of change of inductance with position, therefore, the closer will be the scale of frequency, and vice versa. To open out the scale, a constant external inductance may be placed in series, as this reduces the rate of change of the total inductance of the moving-coil circuit. By this means an exceedingly open scale may be obtained. Fig. 3 shows a station type of meter having 2 in. of scale for 1 cycle per second change, enabling the frequency to be accurately read at a considerable distance. There



FIG. 3.

is no difficulty in obtaining high torque—i.e., large stabilising force—even with such an openness of scale, and the latter may be exceeded if desirable.

ERRORS.

As shown above, there is no error due to the variation of supply voltage over a considerable range. The stabilising torque becomes weak, of course, at voltages very much below normal. At voltages very much above normal, when saturation approaches, a changed distribution of flux may introduce error. A variation of voltage in the ratio of 1 to 3, however, does not, with careful design, affect the reading appreciably.

Variation of resistance in the moving coil circuit produces no change of deflection. Clearly this follows from the fact that such variation does not change the phase of the moving coil current. Hence the instrument is free from any temperature error due to change of resistance.

The effect of harmonics in the wave form of the applied E.M.F. can be reduced to a very small value if the resistance of both coils is kept low.

A test was made upon the instrument shown in Fig. 3. Harmonic E.M.F.s were introduced into the circuit in varying amounts by an auxiliary alternator, the result showing that a triple harmonic having 43 per cent. of the amplitude of the fundamental produced an error of only $\frac{1}{4}$ cycle in 50. A harmonic of five times fundamental frequency and 43 per cent.

amplitude showed a still smaller error. Such magnitudes of harmonics represent far more distorted E.M.F. waves than occur normally in practice.

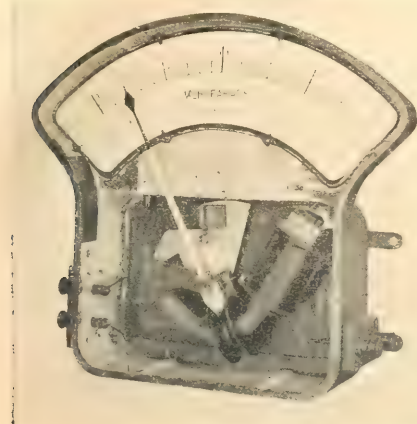


FIG. 4.

USE OF INSTRUMENT FOR OTHER MEASUREMENTS.

From the foregoing it is clear that the instrument may be used also to measure capacity and inductance. An instrument for the former purpose is shown in Fig. 4. For this measure-

ment a permanent capacity is connected to the moving coil of such value that the pointer stands at zero at the normal frequency. The instrument is then calibrated by connecting known capacities to the moving coil terminals and noting the reading. Or it may be calibrated by applying known frequencies, and calculating the corresponding values of capacity. This can readily be done by noting that the frequency is proportional to the square root of the capacity. For instance, the change of deflection produced by increasing the frequency from 50 to 60 cycles is also produced by increasing the capacity in the ratio $\frac{(60)^2}{(50)^2}$.

The instrument shown in Fig. 4 was made for quickly measuring the capacities of magneto condensers. A short scale of frequency was provided near the zero to enable correction to be made for any variation of supply frequency.

For measuring inductance, the instrument has a "control" condenser connected to it, to stabilise the pointer at any desired reading. Any series inductance now introduced into the circuit is at once balanced by an equal reduction of inductance as the moving coil "retunes" itself, and indicates the change of inductance on the scale.

There are various forms in which the instrument may be constructed, but that described above is the simplest and gives an arrangement which is almost ideal for the accurate measurement of commercial frequencies. For high frequencies, other forms are preferable.

The constants of the instrument remain the same for widely varying frequency. For instance, a change of frequency from 50 to 500 cycles per second requires a reduction of capacity in the ratio of 100:1 very closely, in order to maintain the same scale reading.

The writer is indebted to the British Thomson-Houston Company, Ltd., for permission to publish the above account of an instrument invented and developed in their laboratory.

The Extension of the Valtellina Railway from Lecco to Milan.*

By G. HULDSCHNER.

In one way, the Valtellina Railway is the cradle of main-line electric traction in Europe, because this was the first successful conversion of a heavy service from steam to electric operation. When the Italians at the beginning of this century chose the three-phase system, no alternative was available for the service conditions. The results have proved the soundness of the choice. The original electrified section is shown in Fig. 1. It includes the sections from Lecco-Colico-Chiavenna and Colico-Sondrio—a total length of 106 km., all of which is single track. It carries the traffic from Splügen, from the Bernina Railway, and from Stilsfer Joch to Milan, and is thus essentially a tourist's route. The goods traffic is not so great. The route is very steep and along the lake Lecco-Colico, 33 per cent. is in tunnels, 50 per cent. in curves of small radius; inclines (up to 22 in 1 000), and declines alternate in rapid succession.

THE ORIGINAL ELECTRIFICATION.

When electric traction commenced in 1902, the Italian main lines had not been taken over by the State, but the State strongly encouraged the electrification. Practically the whole of the original electrical equipment was supplied by Ganz & Company, of Budapest. The power is supplied from the Morbegno station (see Fig. 1) on the river Adda, the head being 35 m., and the intake canal 4.8 km. long. There are three Francis turbines coupled to Siemens-Schuckert three-phase generators, each supplying 1 050 kW at a power factor of 0.7, a frequency of 15 cycles per second, and a pressure of 20 000 V. Except in the tunnels the transmission lines are carried on the poles supporting the overhead conductors to nine transformer stations, each (with one exception) containing one 300 kVA, three-phase transformer with the ratio 20 000/3 000 V. The transformer can carry 500 per cent. overload for short periods. Each of the overhead conductors consists of two 8 mm. wires, 6 m. above the rail-head.

The original electric rolling stock consisted of 10 motor coaches and two locomotives. A 53 ton motor coach could haul five to

seven coaches (load about 150 tons) up inclines of 10 in 1 000 at 65 km. per hr. A motor coach has two bogies, each with two motors, the hollow motor armatures being centred about the driving axles, so that the whole weight of the motors is spring-borne. The two motors of a bogie are wound for 3 000 and 300 V respectively—the latter serving as a cascade motor to the former. The two locomotives have four axles, and round each axle is mounted—as in the motor coaches—a 3 000 V motor of 110 kW. A locomotive weighs 46 tons, and develops a maximum draw-bar pull of 8 000 kg at 30 km. per hr.—the only running speed.

MORE POWERFUL LOCOMOTIVES.

To deal with the rapidly increasing traffic, three more powerful locomotives of type 1-C-1 were ordered from Ganz & Company in 1903. These have a total weight of 62 tons, an adhesive weight of 42 tons, an output of 750-900 kW, and two running speeds of 31 and 62 km. per hr. They exert a force of 9 300 kg. at the wheel rim during starting. The direct drive was dispensed with, the motors (two per locomotive) were mounted higher, and the method of driving through frames and coupling rods—now so widely adopted—was introduced as a novelty. A motor consists of two parts—a high and a low-voltage part, the two working in cascade at the lower speed, and the former working alone at the higher speed.

In 1906 four further locomotives were supplied by Ganz & Company, similar to the foregoing, but with high-voltage motors only having 8 and 12 poles; so that by using one or other motors or the two in series, three running speeds are obtained—viz., 25, 42 and 62 km. per hr. The force at the wheel rim is then 9 200, 7 200 and 6 500 kg., respectively, corresponding to 625, 900 and 1 100 kW.

In the same year, three 1-C-1 locomotives should have been delivered by Brown, Boveri & Company, but by agreement these were transferred to the Simplon Tunnel. These locomotives had two speeds, 34 and 68 km. per hr., obtained by changing the number of poles from 16 to 8.

* Abstracted from the "Elektrotechnische Zeitschrift," Vol. XLII., p. 556.

LOCOMOTIVES.

Locomotive equipment was supplied by Westinghouse, by Brown, Boveri and by Oerlikon Company.

The Westinghouse locomotives are of particular interest (see Fig. 3). The chief details are:—

Type	1-C-1
Diameter of driving wheels	1 630 mm.
Diameter of pony wheels	960 mm.
Length over buffers	11 066 mm.
Total weight	73 tons
Adhesive weight	45.51 tons
Weight of mechanical part	33 tons
Weight of electrical part	40 tons
Speeds at 16½ cycles	37.5, 50, 75 and 100 km./hr.
Output	1 250, 1 670, 2 600 and 2 200 h.p.
Pull at wheel rim	9.9, 9.5 and 6 tons
Maximum pull	12 tons

The locomotive has no fixed wheel base. The middle driving axle has 25 mm. and the outside driving axles 20 mm. side play. The pony axles form bogies with the neighbouring driving axles. The two motors are mounted high, and the power is transmitted through triangular frames and coupling rods.

The motors are not fixed rigidly to the frame, but suspended elastically, as in the earlier Valtellina locomotives, each stator resting on four strong spiral springs fixed to the frame. The rotor has two sets of bearings, one set in the stator end shields, the other fixed to the frame. By adjusting the spiral springs supporting the stator, the latter can be entirely unloaded, which is good for smooth running and the small gap (2 mm.). The double collecting bows are of the standard pattern in use on the Italian railways, and similar to those used by Brown, Boveri on the Simplon locomotives.

LOCOMOTIVE ELECTRICAL EQUIPMENT.

The current passes from the bows into the overload oil switches, and the choking coils to the main switch and reverse. Thence it passes either direct to the stators or through a Scott-connected transformer. At two of the four speeds the motors are supplied with two-phase current from the Scott-connected auto-transformer. There are seven slip-rings per motor, four at one end of the shaft, three at the other. The slip-rings extend beyond the frame. The control is operated electropneumatically. There are four forward speeds and two reversing speeds, the latter corresponding to the two lowest forward speeds.

The main motors are induction motors, each having a maximum output of 950 kW. There are four speeds, two for operation with three-phase current at 3 000 to 3 300 V, and two with two-phase current at 3 300 to 3 600 V. The rotor leads are carried to the slip-rings through the hollow shaft. The open rotor slots are closed by brass wedges. As three-phase the motors have eight poles, as two-phase six poles; in either case the motors can be connected in parallel or in cascade. The connections for the four speeds are described in detail. Pneumatically-operated controllers are attached to the motors.

DETAILS OF LIQUID RESISTANCE.

The liquid resistance possesses novel features. It consists of a metal tank with cooling ribs and plate electrodes, between which the electrolyte—a soda solution—closes the circuit, when the solution is raised by compressed air. The valve controlling the air is operated manually by a lever in the driver's cabin, but is also controlled by a spring which is actuated by the moving part of an electromagnetic wattmeter. The current coil of the wattmeter is in the earthed phase, and the pressure coil is between the two overhead lines. To each power input to the locomotive there is a definite position of this regulator and consequently of the valve which admits air to the liquid resistance. At starting, the driver places the lever in a certain position, thereby admitting air to the liquid starter, and causes the train to start. If now the input increases beyond the value corresponding to the lever position, the deflection on the wattmeter is increased accordingly, and by means of the spring partly closes the air valve thereby, and so reduces the input to the proper amount. In this way the locomotive automatically takes a constant input during starting, this input being determined by the position of the levers. Pulsations in the supply pressure are also compensated for in this manner. When full speed is attained, the liquid starter is automatically short-circuited. The volume of soda solution is about 900 litres, and the liquid is actively circulated to assist cooling.

TRIAL RESULTS.

In the trials, the temperature rise of the stator copper was 69.5°C., the speed being 75 km. per hr., and the draw-bar pull 9 500 kg. The electrical performances of the motors were determined in the usual

way from no-load and short-circuit tests. At the two highest speeds and exerting a pull of 5 000 to 10 000 kg., the motor efficiency was about 0.955, and the power factor 0.87 to 0.93. With the motors in cascade and two-phase connection (50 km. per hr), the efficiency was 0.915-0.89, and the power factor 0.66-0.77; and with three-phase connection (37.5 km. per hr.) the efficiency is 0.925 to 0.875, and the power factor 0.715 to 0.813. The transformer partly accounts for the lower figures with the two-phase connection. With a 340-ton load on a straight level track, the train was started 20 times from rest to the bottom speed, with intervals of 120 seconds, and a temperature rise of 71°C. in the electrolyte was measured.

In the starting trials with the dynamometer coach, and a load of 348 tons, a speed of 70 km. per hr. on an incline of 11 in 1 000 was reached in 267 seconds, the drawbar pull averaging 7 800 kg., and reaching a maximum of 12 000 kg.

Hauling with two locomotives was found to be very satisfactory, the load distributing itself uniformly between the two engines. If the wheels are differently worn, this can be compensated by not completely short-circuiting the resistance of the locomotive with the higher speed. Experience has shown that the efficiency is not seriously influenced thereby. The above locomotives have often worked together with the E type Giovi locomotives without causing undue disturbances.

ENERGY CONSUMPTION.

The energy consumption of the new locomotives on the Monza-Lecco line was found to be 23.2 W per ton kilometre for the total weight and 28 W per ton kilometre for the hauled load. Taking the gradients and curves into account, these figures are reduced to 18.38 and 22.1 respectively.

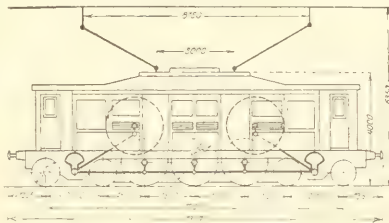


FIG. 4.—EXPRESS LOCOMOTIVE (BROWN, BOVERI AND OERLIKON) FOR VALTELLINA RAILWAY.

The locomotives, supplied by Brown, Boveri and by the Oerlikon Co., are of the type shown in Fig. 4. The chief details are—

Type	2-C-2
Diameter of driving wheels	1 630 mm.
Diameter of pony wheels	960 mm.
Length over buffers	13 370 mm.
Total weight	92 tons
Adhesive weight	49.5 tons
Weight of mechanical part	50 tons
Weight of electrical part	42 tons

Speeds, outputs and drawbar pulls are the same as for the above Westinghouse locomotives, the four speeds being obtained by changing the number of poles and by cascade connection. The efficiency varies from 0.89 to 0.97, and the power factor from 0.68 to 0.93. Further details of these machines have been described elsewhere.

Electricity Supply at Accrington.

An inquiry was held at ACCRINGTON last week into the application of the Corporation for sanction to borrow £150 000 for extensions of the electricity undertaking. It was explained that the Corporation had sold two old sets of plant for £7 600, or £1 000 more than they paid for them. The extensions were absolutely necessary, for there was no reserve plant, and, if anything went wrong, consumers might be without current. Accrington supplied the neighbouring townships at the same price as its own townspeople. Mr. A. W. Clegg, borough electrical engineer, gave particulars of the maximum demand and of the increase in the load. He said it was desired to put in a 6 000 kW turbo-generator and four boilers.

Mr. R. BLACKMORE, of Stalybridge, also gave evidence in support of the application, and Mr. P. P. WHEELWRIGHT, of Blackburn, said his Corporation was willing to supply Accrington, but he did not think any alteration in the price quoted could be considered at the present time.

Mr. BLACKMORE stated that if Accrington obtained electricity from Blackburn at the price Blackburn quoted it would cost Accrington £10 000 a year more than under the proposed scheme. The Blackburn price was higher than that at which Accrington had contracted to supply consumers.

Magnet House.

The Latest Achievement of the General Electric Company.

AS readers of THE ELECTRICIAN are aware the GENERAL ELECTRIC COMPANY, LTD., have recently removed their head office and show-rooms from the building in Queen Victoria-street, which had been their home for over 32 years, to their new premises, Magnet House, Kingsway.

ARCHITECTURAL FEATURES.

As an architectural achievement, Magnet House is excellent in conception and harmonious in design as the main facade (by Mr. R. Frank Atkinson, F.R.I.B.A.), a photograph of which is reproduced in Fig. 1, testifies. The building covers a ground area of 25 722 sq. ft. and has eight floors including the basement. Each floor is divided into eight sections by brick walls, fitted with double iron fire-proof doors. These doors, of which there is a total of 130, were made by the Company at their Fraser & Chalmers Engineering Works, Erith. They are of several types, some consisting of a single panel and others of three or four panels with hinged folding sections allowing room for people to pass through without having to open the whole door.

There are five staircases giving access to the various floors, which are also served by seven passenger and eight goods lifts, made and erected by the Express Lift Company, Ltd. The Express Lift Company was also responsible for the complete system of hoists and runways for loading and unloading vans and lorries and for handling bulky goods. This lift equipment, comprising a total of 23 machines of various types, forms a complete epitome of modern practice in life design and construction. For this reason alone Magnet House is well worth a visit by all interested in lifts or goods handling systems.

All inter-departmental correspondence is distributed by means of pneumatic tubes. A central exchange is located near the entrance hall for dealing with this service and is also used as a sorting office for incoming mail, letters being afterwards sent to the various departments by the tubes.

Ventilation is secured by a network of ducts connected to a modern air-washing plant and vacuum tubes are also installed for cleaning.

The main entrance hall shown in Fig. 2 is of stately proportions, the stone walls and marble floor forming an excellent background for the massive bronze gates and fittings. A wide marble staircase, in the well of which runs two high-speed passenger lifts, leads from the basement to the sixth floor and at each floor opens out to a spacious vestibule.

A GALAXY OF SHOWROOMS.

In the basement are a galaxy of showrooms offering a large and comprehensive selection of electrical goods. These include a handsomely decorated suite of rooms devoted to the exhibition of electric light fittings and domestic electrical appliances.

The various rooms illustrated in Figs. 3 to 6 have been laid out with the object of facilitating the selection of fixtures to harmonise

with any existing scheme of colour or decoration and serve to make this an easy and pleasant undertaking. The central apartment which is decorated in Georgian style contains a large display of Georgian and modern fixtures of all types. In the French room, which is tastefully decorated in white and *vieux rose*, is to be found a choice selection of Louis XIV. and Louis XVI. electroliers and brackets, together with French statuettes, bronze figures and table standards. The Adam section, carried out on tints of Wedgwood green, contains many chaste examples of brackets, pendants and electroliers in this style.

Another period room is arranged as a Jacobean dining-room, displaying chandeliers, lanterns and table candlesticks of Tudor and Jacobean design, many of which are faithful reproductions of antique originals. The section devoted to alabaster ware holds an unrivalled assortment of inverted fittings, vases and pedestals.

Unique and artistic silk shades in great variety are arranged in an adjoining room and the remaining apartment is devoted to an exhibition of domestic electrical appliances. Here are demonstrated heating and cooking appliances, electric irons and fans, vacuum cleaners, washing machines, and, in fact, every conceivable electric requisite for domestic purposes.

AN INDUSTRIAL DISPLAY.

On the opposite side of the vestibule is a large industrial show-room containing comprehensive displays of lanterns and fittings for factory and street lighting, shop fittings and other items of electrical equipment for ships, switchgear, telephones, electric light supplies, cables and wiring materials and other products of the company. One interesting feature of the display in this section is a board demonstrating the company's new surface

wiring system—"The Kingsway" system. A certain amount of the wiring in the showroom is also carried out by this system.

SALES COUNTERS.

The greater portion of the ground floor is taken up by the sales counters, which form a continuous line 140 ft. long. Considerable storage accommodation is arranged behind the counters, and the bins can be quickly replenished from the main stockrooms on the upper floors by means of electric service lifts operated by a system of push buttons. The salesmen are in telephonic communication with their departmental stockrooms, so that in the event of any required article not being available at the counter instructions can immediately be given for it to be sent down by these lifts.

Under the counter runs a silent belt conveyor, which carries customers' purchases to separate packing benches at one end; the salesmen are thus relieved of the task of tying up parcels, and are consequently enabled to attend to the requirements of customers



FIG. 1.—FRONT ELEVATION OF MAGNET HOUSE.

in the most expeditious manner. This belt conveyor—another product of Fraser & Chalmers' engineering works—consists of a rubber-covered duck belt running over idlers mounted on a sub-

by a "Salford" ironclad double-pole switch and fuse, and a standard G.E.C. face-plate starter. The goods to be packed are placed in wire baskets fitted with wooden runners, and during the busy hours follow each other in endless succession to the delivery end, where they pass over ball-bearing rollers to the packing benches.

In the van dock at the rear of the building are three cranes and runways for handling incoming goods. Cases are lifted from the lorries and lowered to the receiving department in the basement.



FIG. 2.—ENTRANCE HALL.



FIG. 3.—GEORGIAN PERIOD SHOWROOM.



FIG. 4.—FRENCH PERIOD SHOWROOM.

stantial steel frame. It is driven at a speed of 120 ft. per minute by a 2 H.P. "Witton" direct-current motor through one of the Express Lift Company's silent worm gears. The motor is controlled



FIG. 5.—ALABASTER WARE SHOWROOM.

Here the goods are unpacked and distributed by lifts to the stockrooms on the fourth and fifth floors.

ADMINISTRATIVE DEPARTMENTS.

The first and second floors are principally devoted to administrative departments, among which the spacious counting house on the first floor, the board room and the catalogue and information bureau on the second floor deserve special note. The offices of the departmental managers and the large departmental general office are also situated on the second floor. A plentiful provision of signs in prominent positions directs the inquirer to the various departments.



FIG. 6.—DOMESTIC ELECTRICAL APPLIANCE SHOWROOM.

On the third floor is the commodious and well-arranged despatch department, with its rows of bins and packing benches. To each despatch clerk is allotted a definite section of the alphabet, so that he always deals with all the orders of every customer in his section. Adjoining the despatch department is the packing room. Goods are delivered to the despatch department by goods or service lifts, and the completed packages are lowered in special containers by combined cranes and runways into waiting lorries in the van dock below. The stockrooms on the fourth and fifth floors are equipped

with some 12,000 steel bins, and are arranged on a definite plan to facilitate the work of looking out goods for the execution of orders.

TELEPHONE EXCHANGE.

The private telephone exchange, which has 50 incoming lines and 300 internal extensions, is situated on the fifth floor. The whole of the equipment was manufactured by the Peel-Conner Telephone Works.

The offices of the illuminating engineering department, a large and well-lighted fixtures design office and a meter test room and work-

shop are located on the sixth floor. Near by is a large staff canteen fitted with a complete equipment of "Magnet" cooking apparatus, including urns, hot water calorifiers and hotplates. Here the staff can enjoy a light luncheon at mid-day and a cup of tea during the afternoon.

A large lecture hall is also situated on this floor. It has a seating capacity for 350 people, and is used for the social recreation of the staff, as well as for lectures on technical and commercial subjects.

We are asked to state that the Company extend a cordial invitation to all their clients to visit Magnet House.

Copy for Electrical Advertisements.

Three Essential Qualifications of the Copy-Writer.

By "ELECTROCYNIC."

Having in a previous article criticised the English of electrical advertisements, I feel that I ought to see what I can do in the way of constructive suggestions, even should such an attempt expose me to the ridicule of those whom I have criticised. I am not at all afraid of the sneer, "You can't do it any better yourself," because I have never considered that there was any moral obligation upon the critic to be an expert executant of the art which he criticises. In any case, I do not propose to adorn this essay with examples of my copy-writing skill.

To begin with, I would like to clear the ground of one very encumbering theory—a theory which has been responsible for more bad copy than almost any other wrong idea. This is the vicious assumption that advertising copy is or should be simply written speech.

It is clearly necessary that advertising copy should be brief, since it has to occupy a small space. In text-books and articles on copy and form letter-writing, it is usually enjoined upon the embryo propagandist that he should write as he would speak. That is to say, the copy-writer is recommended to use in his advertisement or letter the language which (if he were a good salesman) he would employ in an actual interview.

THE WRITTEN WORD.

This, of course, is very absurd. Any kind of writing, excepting that which reproduces dialogue or police-court evidence, must necessarily differ both qualitatively and quantitatively from the spoken word. The teachers of advertising say, "Be natural." It is human nature to be diffuse in speech, and this is just the one characteristic which must be avoided in advertising copy. Literature is essentially artificial. The past-masters of publicity say, "Write as though you had your 'prospect' (horrid word!) in front of you, and could address him face to face." To do this would be flying directly in the face of Providence, since the fact that the advertiser has not to deal with a single individual, but must make his message attractive and convincing to entire populations, is the only thing that makes advertising (in the general sense) either necessary or possible.

I wonder if the people who so glibly recommend this "natural" kind of copy-writing have ever troubled to consider how many spoken words are required to convey even the simplest idea. In ordinary conversation, one probably speaks at the rate of about 200 words a minute; and I should like to be introduced to the salesman who could tell his story in a minute—or in five. (He should be the sole supplier of my electrical needs.)

A LITERARY ART.

The number of words in an advertisement might be anything up to a hundred. This figure is rarely exceeded by the best people, and then only in full-page advertisements which are predominantly textual. A hundred words wouldn't carry the salesman very far. An ordinarily courteous greeting would account for this miserable allowance.

The writing of advertisements is essentially a literary art, and the electrical advertiser who appreciates this fact has mastered an important and profitable truth. It is, of course, ruled by commercial considerations; but, for that matter, so was the work of indisputable *litterateurs* like Shakespeare and Dr. Johnson.

The first requisite of the electrical copy-writer is, therefore, the ability to use words in a competent, expressive and economical manner; that is, he must possess the knowledge of English and the faculty of composition which are fundamental to all successful literary endeavour.

TECHNICAL KNOWLEDGE ESSENTIAL.

Another essential quality in the writer of electrical copy is a reasonable degree of technical knowledge. I do not pretend that it is necessary for a man who is going to write advertisements about turbo-alternators to have a close acquaintance with the whole theory and practice of turbo-alternator design—although it is certainly desirable that he should be so equipped if other requirements are not sacrificed therefor. But I do say most emphatically that any man who intends taking up the business of electrical advertising should have had some previous engineering experience. Perhaps not such as would entitle him to membership of the Electrical or Civil Institutions; but certainly sufficient to enable him to appreciate the general purport and significance of any technical phrase or appliance with which he may be brought in contact. Every engineer will realise the importance of this qualification.

No one—however clever and assimilative he may be—can, without a certain amount of engineering training and experience, attain that contemptuous familiarity with technical terms and turns of speech which enables the engineering journalist, for example, to write on any engineering subject in the comfortable assurance that he is at least safe from the perpetration of "terminological inexactitudes."

PITFALLS FOR THE LAYMAN.

A layman may learn a great deal about a specific apparatus—say a dry cell or a telephone—and, so long as he keeps to generalities may succeed in writing passably accurate copy; but so soon as he is required to dwell on certain technical features, and to provide a reasoned argument on their merits, his inevitable ignorance will betray itself. Faced with such a task, he is compelled to seek the aid of the works manager—not for advice simply (no advertising man would hesitate to do that)—but to get his copy drafted.

Many advertising men affect a kind of omniscient pose; and one may often hear, in the quiet haunts of the professional propagandist the remark, "A good copy-writer can extract the gist of any proposition and produce copy thereon in a few hours." This is absolutely untrue in respect of engineering and scientific matters, which will always be inaccessible to the layman, except by the long and stony road of workshop and lecture-room experience.

THE RIGHT APPEAL.

The third essential qualification of the copy-writer is, of course, a sense of advertising. He must be able to pick out the "selling points" of any article, and to employ them in a discreet and appropriate fashion. The copy-writer has to remember that a feature which may be advantageous to one section of buyers may be quite uninteresting, or even repulsive, to another group.

For example, let us suppose that the copy-writer is employing his literary art in the endeavour to make the general public buy a type of vacuum cleaner which has so far not proved very popular. The manufacturer might have decided to allow an abnormally large discount to the retailer in order to encourage his co-operation in pushing the sale. Now a large discount, although a thing of joy to the contractor, is not regarded in so favourable a light by the ultimate purchaser. In advertising the cleaner to the trade, the big discount might form a good selling point; while, of course, no one would think of using it as an argument in advertisements addressed to the public. This is a very obvious and elementary case, which calls neither for discretion nor advertising experience; but subtler modifications of the same problem crop up in regard to every advertised article. Again, it might be advisable to state, in advertisements to the trade, that the sale of a particular appliance would bring the buyer back from time to time to the dealer's shop to get

certain parts replaced. This would not necessarily argue any fault in the apparatus itself: but, on the other hand, it would hardly be a suitable argument wherewith to persuade the coy public.

A NECESSARY DISTINCTION.

This distinction between selling points which are appropriate to the trade and those which are appropriate to various sections of the public, has to be drawn in all advertising, although, of course, such examples as I have given are so childishly evident that decisions there-*anent* would be made automatically. To every man, however, who sells or advertises electrical apparatus there will occur multitudinous instances in which it has been necessary to employ considerable judgment in the selection of selling arguments.

In closing these discursive notes I should, perhaps, explain that

in writing them I have purposely limited myself to a series of rather vague generalisations on the subject of copy-writing. I have said that the writer of electrical copy should have literary ability, technical knowledge and experience and a sense of advertising. If he possesses these qualifications he is luckier than the majority of copy-writers whose lucubrations adorn the advertising pages of engineering papers and to offer him further and more detailed advice would be a needless impertinence, of which I am far too lazy to be guilty. If he is not thus triply qualified, I hope that he will be overcome by a noble sense of his own inadequacy, and, in the interests of electrical propaganda, vacate the position which he cannot fill. He will in that case need no detailed instruction in the art of electrical copy-writing. Hence my self-imposed limits.

The Story of the Induction Motor.*

By B. G. LAMME

(Chief Engineer, Westinghouse Electric and Manufacturing Co.)

The induction motor has played a very great part in placing the polyphase alternating current system in its dominating position to-day. Practically 95 per cent. of the generated electric power of to-day is by alternating current. It is inconceivable that the alternating-current system could have reached this dominating position but for the existence of the induction motor. It should be understood that this history applies only to American development, and covers principally those developments with which the writer has been in more or less personal contact.

The induction motor, in its early days known as the "Tesla motor," appeared in 1888. It is difficult to say just when it was invented. Tesla, Ferraris, Shallenberger and others worked in this field. However, to Tesla belongs the credit of independent invention and of bringing the matter before the public in such a way as to lead eventually to practical results.

When the Tesla motor first came out, it was doubtful whether anyone had any real conception of its action or its characteristics as we now see them. Tesla recognised two fundamental facts, that if a magnet was moved across a conducting surface or plate, it would tend to drag the plate with it; and that the action of such a moving magnet could be produced by out-of-phase alternating currents. The induction motor of to-day is simply the above action put into practical form.

CIRCUMSTANCES UNFAVOURABLE TO INDUCTION MOTOR.

There were originally various circumstances unfavourable to the induction motor. The only frequencies were 133 and 125 cycles per second, and only single-phase alternating current were available. Following Tesla's work in 1888 he was assisted by C. F. Scott, who made some remarkable advances in the then prevailing state of knowledge. Scott developed the slotted secondary with overlapped distributed winding, but did not fully recognise the relations of secondary resistance to starting torque, nor the inherent speed-torque characteristics of the machine. His work, however, showed clearly that a materially lower frequency was needed. The early Tesla motors showed promise and might have proved commercial with suitable supply. Some small installations for mining work were fairly successful. In those days distributed field or primary windings were unknown, and only simple polar types of magnetic construction were recognised. Induction motors were made with distinct polar projections, each carrying a primary winding. The flux from adjacent poles or phases did not overlap, as in the modern induction motor and uniform progression of the magnetic field as we now understand it was not possible. One of the greatest subsequent advances was the recognition of the advantages of distributed over-lapping primary windings. When Mr. Scott abandoned the work in 1890 he had probably done all that was possible with that type of construction and the knowledge available. He had a distributed short-circuited secondary winding adapted for averaging torque conditions, an odd hunting tooth in the secondary to lessen magnetic leakage, a relatively small air-gap and a well laminated primary structure. In appearance his motor was not unlike the induction motors of to-day.

SLOTTED TYPE ARMATURES.

During 1890 and 1891 slotted type armatures for railway motors and direct-current generators were developed by the Westinghouse Company, and the use of a direct-current type of slotted armature

winding for generating polyphase currents was considered, especially in connection with synchronous converters. This led to the consideration of similar windings for induction motors and the writer after consultation with Mr. Scott, followed up this line of work. An experimental motor was authorised in 1891. At the same time Mr. Stillwell reported in favour of a frequency of 60 cycles. Thus one handicap to the induction motor was in course of disappearance. Polyphase circuits, however, had still to come.

The first motor with distributed windings was tested in 1892. This motor closely resembled the modern type and gave highly promising results, notably a large "pull-out" torque and a much better starting torque than was anticipated. Another indication of the test was that short-circuiting all the ends of the windings together was advantageous, and that the cage-type of secondary was a most effective type where starting conditions will permit.

LIGHTING AT THE WORLD'S FAIR.

The lighting system at the World's Fair in Chicago in 1893 provided for a 60 cycles single-phase 2200 V supply. Mr. Westinghouse accordingly proposed that the generating units, each of 1000 H.P., should be made with double fields and armatures, so that there were two single-phase machines on the same shaft, but displaced 90 deg. in phase with respect to each other. Then the general lighting could be from single-phase circuits, but by using two out-of-phase circuits, polyphase current would also be available. The exhibit included a 300 H.P., two-phase 220 V induction motor, to be operated from the polyphase lighting circuits, and a synchronous converter was also shown. Thus this was a true polyphase exhibit and it was very much ahead of its time, as neither induction motors nor synchronous converters were yet on the market. The 300 H.P. induction motor was apparently far ahead of anything yet built, in regard to capacity. This motor had a rotating primary with a stationary secondary, twelve poles and a distributed primary winding of cable threaded through partially closed slots. The stationary secondary also had partially closed slots. During starting the secondary circuits were closed through a series of long heavy carbon rods, placed in a basement beneath the exhibit, as starting resistance. As this carbon starting outfit would sometimes get red hot while the motor was being brought up to speed, it was not considered desirable to let the public see it. However, the arrangement was quite effective and, although crude, nobody knew anything better.

The A. E. G., of Berlin, also had a polyphase exhibit including a small polyphase generator, of about 100 kW capacity, and an induction motor of about 75 H.P., the latter with a distributed armature winding. Another interesting thing about this A. E. G. induction motor was the use of a water rheostat in the secondary, for starting purposes, which at one stage of the proceedings caught fire.

The Schuckert exhibit also included a polyphase induction motor of small capacity with distributed windings, and the General Electric Company also had certain polyphase apparatus on exhibition.

THE REAL START OF THE INDUCTION MOTOR.

It was not until 1893 that the induction motor business really got into motion. After consultation it was decided first to bring out a standard series of polyphase generators, which proved quite popular, and later a standard line of induction motors was authorised. The large demand for these meant that they had to be rather rushed on to the market without much development or experimental

* Abstract of Paper read before the American Institute of Electrical Engineers.

work. In fact, experimental data was obtained mainly on motors for customers' orders, as was not unusual in those days.

SOME EARLY COMMERCIAL TYPES.

In 1894 motors were being completed for the market, of the rotating and primary and stationary secondary type—a construction arising from the large bar conductors with low voltage and heavy current. Collector ring and brush problems were thus simplified. For the primary higher voltages and comparatively small currents were used. "Closed coil" two-circuit secondary winding were adopted. A cast-iron grid was connected across each phase, the grids being short-circuited by switches when speed was attained. Short-circuiting tests by the author led to the development of an improved secondary winding which combined resistance starting with the effects of a cage-winding at high speed. In the secondary there were iron grids connected between adjacent coils, sufficient in number to span practically one pole pitch, which gave very effective starting conditions. Short-circuiting at full speed was achieved by the circumferential motion of a ring surrounding the secondary winding. Motors of this type are still in use to-day, and gave such good results that at first they were considered to approach perfection. However, they were unduly expensive to construct and had various limitations. The rotating primary did not look well for voltages above 400. Small motors with rotating cage-type secondaries were already being built and promised well.

THE MONOCYCLIC SYSTEM.

The General Electric Company had meanwhile been developing polyphase motors with distributed primaries. In view of the patent position a "monocyclic system" was brought out, but, although devised to avoid the Tesla patents, it was simply a special case of the general polyphase system. These motors operated well, and the stationary primary adopted has proved to be the preferred type for induction motors. The Stanley-Kelly Company also put on the market an induction motor devised to avoid the Tesla patents, as the two magnetic fields used were assumed to be merely alternating in space and not rotating. However, on analysis this would also appear to be a special case of the general problem. This company also introduced split-phase motors using condensers, and reactances to get the desired phase relations. However, all such motors using condensers have dropped out of sight, largely owing to difficulties in condenser manufacture.

By 1895, the polyphase motor had become firmly established and was making progress. Except in very small sizes, resistance starting was exclusively used. The cage-type secondary was used only for small motors or for small starting torque.

The single-phase induction motor was also given consideration. It was discovered that the two-phase Tesla induction motor would operate well on single-phase by opening one phase after the motor was up to speed, also that the motor could be started up in either direction from rest by giving it a little push to the pulley. In certain positions the motor would start itself, with the current thrown on one primary phase only. These peculiar phenomena of the single-phase induction motor were recognised as early as 1888 and 1889.

From 1890 to 1894 the Westinghouse company built single-phase synchronous motors for mining power work. These motors were self-starting and were started by means of induction motors. The writer also made some fairly effective split-phase motors for starting the synchronous-type machines.

In this earlier period single-phase operation of the induction motor was thus fairly well understood, but it was only in special cases that such method of operation was practised commercially. It was not generally believed that the single-phase induction motor offered much commercial promise.

THE DEVELOPMENT OF THE "ARNOLD" MOTOR.

It was soon discovered that the accelerating torque of the polyphase induction motor was zero at standstill and increased rapidly with increase in speed. On the other hand, it was known that the series motor had just the opposite characteristics; it could develop accelerating torque which was high at start, but decreased rapidly with speed. Clearly a combination of these two characteristics would be very desirable for single-phase work. Prof. E. E. Arnold, of Karlsruhe, combined these properties in the Arnold motor, and in 1892 the writer accomplished experimentally very much the same results in connection with tests on an early synchronous converter.

Eventually, various forms of commutator-type induction motors were developed by different companies. A special type built by the Westinghouse company consisted of a 4-pole-8-pole primary winding and an 8-pole parallel-wound direct-current-type armature winding with equaliser connections connecting points of equal potential on the armature. The machine was started on the 8-pole combination,

with armature and field in series; when it came up to speed, the field was switched, by a centrifugal device, from 8 poles to 4 poles, and the armature automatically became a short-circuited 4-pole secondary. This motor operated satisfactorily on test, but objections were raised against it, such as relatively high first cost and the fact that the brushes were not lifted from the commutator during normal operations. Lifting of the brushes was claimed to be an absolute necessity, on alternating-current motors. Yet recent practice on alternating commutator-type induction motors has tended toward allowing brushes to remain on the commutator. However, the machine as constructed was of the series type during starting and was limited to voltages not exceeding 220. It could have been designed and used as a repulsion type machine, and thus rendered adaptable for various voltages, with the advantage that no mechanical short-circuiting device was needed on the armature.

Another type of single-phase induction motor with commutator, brought out later by the General Electric Company, was known as the repulsion-induction motor. This had a polyphase brush system, instead of single phase on the secondary. It was much used in small sizes and had no automatic short-circuiting device in its secondary, the circuits being closed through the commutator and the stationary brushes. Practically all these motors, except the Arnold type, belong to a much later period.

SOME "STUNTS."

The induction motor had by now received very close study both in Europe and America. In the period between 1894 and 1898 many odd "stunts" were tried. For instance, the half-speed operation obtained by operating the secondary on single phase was tried, but there was a relatively poor power factor. In 1894 attempts were made to obtain double speed by feeding the supply frequency to both the primary and secondary circuits of the motor. However, difficulty was encountered in attempting to carry any load and finally the test was abandoned. It was also recognised that an induction motor, mechanically driven, could act as a frequency changer, and that it would operate as a generator above synchronism. The above illustrations are mentioned to show that many now well-known actions of the induction motor were fairly well comprehended as early as 1894 and 1895.

In this earlier work there were two polyphase schools, namely, the two-phase and the three-phase. The Westinghouse Company advocated the two-phase polyphase systems, although it built both; whereas the General Electric Company was considered as favouring three-phase, although it also built both. However, with the coming of true transmission systems and the further growth of polyphase work, the three-phase system eventually dominated the market. The 25 cycle frequency was inaugurated in 1893 in connection with the first Niagara Falls power installation and was quickly adopted, especially for synchronous converter work. This step, however, did not have any controlling effect on the induction-motor development in the earlier years, although it did have a bearing on certain of the later work, such as industrial plant and steel-mill electrification.

THE "CAGE" MOTOR FOR POWER PURPOSES.

By 1896 apparently the induction motor had settled down to fairly standard practice, involving the use of secondary resistance for starting except in the case of very small motors. About this time the writer was working over the vector relations of the induction motor. While so doing he met with several cases where unexpectedly high torques with cage windings had been found, indicating the possibilities for the development of a cage-type motor for general power purposes. Further theoretical work convinced him that it was possible to produce commercial polyphase induction motors with pure cage-type secondary windings with starting torques up to two or three times the rated torques of the machines. It was accordingly decided to build commercial induction motors with cage secondaries. Motors of 20, 30 and 50 h.p. were first undertaken. All developed the expected starting torque conditions. The suggestion was also adopted of reducing the starting current by the introduction of a small transformer at start. This was the origin of the auto-transformer or "compensator" method of starting.

In these new motors the secondary or cage winding was naturally placed on the rotor, in order to do away with all collector rings or other rotor connections, the stator winding being placed on the primary. A few of these new motors were put in service in 1896, in order to obtain some practical experience, and a fairly complete series was developed in 1897. At first this type of motor was received with doubt by technical people, who could not believe that a cage-type motor would develop high starting torque. Operators, however, especially in industrial plants, took to this type of motor on account of its substantial simplicity.

Cage-type construction soon led to interesting developments. It was necessary to obtain definite resistances in the secondary winding for giving the required torque, current and speed conditions. As the secondary bars were usually of copper, it was necessary to vary the resistance of the end rings by using various alloys. Iron had usually harmful results. Various bronzes, brasses, &c., were also tried. It also became usual to vary the resistance of the end rings of individual motors by slotting one or both of the rings radially to a certain depth, thus virtually lengthening the current path.

A "NON-BURNABLE" MOTOR.

This type *C* motor was not quite as efficient as later types, but it was of such sturdy construction and has such a high thermal capacity, compared with former constructions, that it obtained an almost undesirably good reputation. It could be pulled to standstill momentarily by a heavy overload, and upon removal of the load would immediately recover to full speed with no apparent injury, except in extreme cases. Many people obtained an exaggerated notion of the motor's capabilities. For example, some of the Westinghouse people wanted to advertise that the type *C* motor could not be burned out!

These type *C* motors, in some cases, had pull-out torques of four times their rated capacity, and starting torques of three times their normal running torques. Owing to the general shape of the speed-torque curve, a sudden application of very heavy load would not easily jerk them out of step, as was the case with the earlier types. Rare instances were noted where the motor, when used where speed reversal was necessary, would not reverse, but would continue to run in the same direction as before (but at a much lower speed), when the primary terminals were reversed. The reason for this was not understood, but investigation in each case showed the relative resistance of the secondary end rings, compared with the secondary bars, was low. Hence the end rings of such motors were slotted to increase their resistance and the motor would then reverse in a satisfactory manner. This effect was noted as early as 1897 and 1898 and is now recognised as due to the well-known "cusps" in the speed-torque curves of such motors.

FRACTIONAL PITCH WINDINGS.

About this time the writer investigated the effect of "chorded" or fractional-pitch windings and found their influence upon the magnetic distributions, reactances, &c., and incorporated expressions in his formulas for covering such windings.

Among other advantages of chording were the saving in the length of the coils, better flux distribution of the main field and the ability to obtain the equivalent of a fractional number of turns. This improvement in induction motor windings was also patented about this period.

(To be concluded.)

Powdered Fuel for Electrical Purposes.

At a recent meeting of the Sheffield Sub-centre of the North Midland Centre of the Institution of Electrical Engineers, Mr. J. BIBBY gave a lecture on "POWDERED FUEL." The PRESIDENT OF THE INSTITUTION was present. Members of the Sheffield Society of Engineers and Metallurgists were invited, and the meeting was well attended.

Mr. BIBBY pointed out that powdered fuel had now been in use for some time, although in England there were very few installations. In America, many more installations had been put up, and were being run with every success. He set out very fairly the advantages and disadvantages of the use of powdered fuel. On the one side, it could be said that it gave greater efficiency, convenience and flexibility, whilst on the other hand were the disadvantages of the power consumed in pulverising, and the care which had to be taken to prevent caking and spontaneous combustion.

Describing briefly the various systems of using powdered fuel, he said he considered there was a large field for its use in metallurgical processes, and that it had been found that 40 per cent. reduction in time in some re-heating processes could be made, while the saving in fuel was considerable. He also pointed out that the drying of the coal was a very important point in the pulverising, and that a large saving in the power used for powdering could be obtained by quite a small reduction in the moisture content. He described the use of powdered fuel for railway locomotives, but pointed out that it would be necessary to have pulverising depots for re-filling the containers that were carried on the engine tenders.

POWDERED FUEL AND CEMENT MAKING.

Mr. LLEWELLYN ATKINSON, in opening the discussion, said that he had taken an interest in powdered fuel for many years, particularly in connection with the production of cement. He had first come into contact with it in America, and he himself had brought over one of the first rotary kilns to this country. He mentioned the fact that one of the disadvantages for the use of powdered fuel was the slagging which occurred, but this did not matter in cement manufacture. He thought one of the first applications to boiler work of powdered fuel was the Bettington boiler, in which it had been found that the intense heat generated was too great for the boiler tubes, while the slagging difficulty was not entirely overcome. This difficulty, however, seemed to disappear when the velocity of influx was low.

Mr. C. F. WADE, criticising some boiler test sheets shown by Mr. Bibby, said he would like to know by whom these tests had been carried out. He also said that in using powdered fuel the same indication could not be got as to when excess air was being used as with the ordinary coal fire. He thought the capital outlay required on the structural side would be excessive, and this would swamp any savings due to higher efficiency. He would like to have seen some figures in which the equivalent heat units used in pulverising and drying the coal were subtracted from the heat value of the coal itself. He thought that when this was done it would be found that the efficiency fell below what could now be got in good boiler practice.

SOME VIEWS ON THE OTHER SIDE.

Mr. W. J. WARDALE said that efficiencies of up to 83 per cent. had been obtained on ordinary chain grate fire boilers with a cheap fuel, and that it did not seem that powdered fuel was going to give any better results. He thought that as much as could be got was now being got from the boiler end of a power plant and that a more useful way of looking at the question of power production was that of first extracting the by-products from the coal. Going into the question of the auxiliaries required, he thought the screw pumps cited by Mr. Bibby would be expensive both in first cost and in upkeep.

Mr. MURGATROYD, of the Great Central Railway, speaking on the use of powdered fuel with locomotives, said that owing to the different type of furnace which was used with this system of fuel supply a locomotive could be run very much more economically. The fuel supply could be turned completely off at stops and started up again right away. Moreover, when going into the sheds at night, the heat could be kept in sufficiently to enable the furnace to be re-started in many instances by simply turning on a fuel supply the next morning.

Mr. S. E. FEDDEN said that he had seen on the Continent a type of crusher which did away with any drying of the coal. The horse-power used was not excessive. Slagging was entirely obviated by turning the flame down. This was also done to prevent it impinging directly on to the water tubes. He had also seen re-heating furnaces on the Continent in which any temperature required could be easily obtained and regulated. Fifty per cent. increase in the work put out could be got, and the coal used was decreased by about 30 per cent. as compared with a coal-fired furnace. On one boiler installation he had seen four different types of furnaces, one of which was using pulverised fuel and giving better results than the other three. He thought the relative net efficiencies of pulverised and coal-fired boilers were about 72 per cent. and 70 per cent. respectively. One of the drawbacks that he had noticed was that with a low volatile coal it was a difficult matter to start the furnaces. He pointed out that the cost of delivering coal to boilers was less for pulverised fuel than for ordinary coal.

POWDERED FUEL AND COPPER SMELTING.

Mr. W. M. SELVEY said he had also been interested in pulverised fuel in the manufacture of cement. Here the slagging became part of the cement, and hence no difficulty was experienced, in fact, the cement manufacturer found that up to a certain point the slagging increased his output. He said he understood there were some large copper-smelting furnaces in America which had been completely converted to the use of pulverised fuel, and which were entirely successful.

Mr. BOLSOVER, of the Sheffield Society of Engineers and Metallurgists, said he thought there were serious disadvantages in the use of pulverised fuel in metallurgical operations. Apparently the power engineer thought there was not much in pulverised fuel from his point of view, but that it seemed a very good thing for the metallurgical engineer. On the other hand, the metallurgical engineer could not see much in it for his work, but thought it ought to be good for the power engineer. It certainly could be used as a

substitute for gas, but he considered the high temperatures which appear to be obtained with it would be ruinous for steel processes. Localisation of the heat would burn the steel. As regards melting furnaces, the ash from the coal would go in and this would be a great drawback which would considerably deteriorate the metal.

Mr. F. MASON said that he did not think pulverised fuel could be used very successfully in non-ferrous metal operations, though he would have liked to have heard more on this point.

Mr. BERRY, in replying, dealt briefly with most of the points raised. He said that the question of ash was a point in favour of the use of pulverised fuel as there was no ash. It was so fine that it became distributed over a wide area of country as an impalpable powder, and could be even looked upon as a fertiliser. With regard to the metallurgical processes, he said that any temperatures could be obtained, and could be closely regulated so that there was no question of any localisation.

Ship Repairs and the Maintenance of Shipyard Machinery and Plant.

By C. W. BRETT.

(Managing Director, Barimar, Ltd.)

In few industries have post-war conditions been more adverse than in shipbuilding and shipping generally; fortunately signs are not lacking that far-reaching improvement is imminent, and that the long-looked-for reaction has set in. With greater financial stability and steadier industrial conditions there is no doubt that prospects are good, and the auguries point to a much needed revival.

But there is another important factor which must not be overlooked, and has a distinct bearing on the brighter outlook. Shipbuilding and ship repair work is being immensely facilitated by the increasing employment of electrically driven machinery. This alone is a step in the direction of the economy without which these trades cannot hope to meet and successfully combat keen foreign competition.

As a nation we are, at present, severely handicapped by the high cost of production, a state of affairs largely due to the abnormal price of raw material and labour. In the circumstances it is incumbent upon all who are directly or indirectly interested in the maintenance of our sea-traffic to practise every possible economy. Let us face the facts; the cost of production has got to be reduced, and reduced substantially, if we are to survive as a maritime nation or to hold our position as world carriers.

MODERN BUSINESS METHODS.

Now, in most prosperous businesses, organisation, system, and method have been exploited to the full in all departments, with the outstanding exception of the place where "the work is actually done," i.e., the workshop. In this matter a great many concerns

eminent engineer said recently, "it can be mixed with flings and escape detection!" This dictum, though extravagant, is nearer the truth than many imagine.

Replacement is not a repair, but the purchase or part-purchase of a new whole. A repair—which in 99 cases out of a 100 is all that any

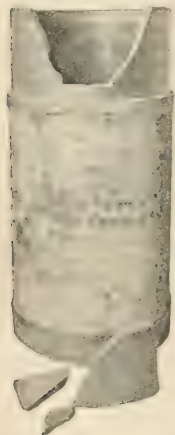


FIG. 1.

The fracture of a cast-iron liner was caused by the crankshaft breaking, and the connecting rod hitting the liner.



FIG. 2.

The same liner after repair by scientific welding. When machined, ground and cleaned up it was as good as a new casting.



FIG. 3.

This cast-iron member of a machine frame is broken (as shown in the illustration).



FIG. 4.

The same cast-iron member after repair by scientific welding. The part was built up and strengthened at point of fracture.

disabled or worn machine requires—implies the treatment of the original fabric in such a manner as shall restore it to its pristine condition, yielding exactly 100 per cent. efficiency.

From this point of view, having in mind the fact that only one method of metallic repair exists, whereby fractured, worn, damaged or defective industrial metal can be rapidly, economically, and permanently rehabilitated, the direction in which a reduction in maintenance charges must be sought is clearly indicated; in other words, the repair of plant, &c., fabricated of cast-iron, wrought-iron, cast-steel, alloy steel, aluminium, bronze, or gunmetal can only be satisfactorily effected by the employment of scientific welding.

WHAT HAS BEEN DONE.

It is obviously impossible, in the compass of a short article, to deal exhaustively with a scientific and highly technical subject—embracing, as it does, no fewer than six distinct processes. We shall, therefore, content ourselves by outlining the scope and utility of welding as it applies to shipbuilding yards, repair shops, and docks and harbour equipment.

The following list is, necessarily, incomplete, but it may serve to demonstrate the economic value of scientific welding in this direction. Each unit mentioned has been rehabilitated, tested in the laboratory and restored to full service:—

In shipyards, boilers of all kinds, furnace fittings, mechanical stokers, electric, steam, oil, gas and petrol power units of all sizes and makes, lathes, automatic machine tools, hydraulic machinery and presses, pneumatic machinery. Pumps (of all types), cranes (of all makes), gantries, derricks, winches, elevators, conveyors, runways, hoppers, forge and foundry equipment and products, graving dock apparatus, rails, joists, plates, as well as all types of

are open to criticism, if not censure. Machines, plant, and their components are, in many instances, ruthlessly and wantonly "scrapped" and replaced. A procedure which, in the light of modern scientific discovery, is nothing short of needless waste. No machine or part need be sent to the waste metal dealer until, as one

departmental and road transport units, including steam wagons, lorries, vans, industrial trucks, whether electrically or petrol driven, have been repaired by these methods. On board ship all engine parts, boilers, furnaces and all engine-room gear, dynamos, hydraulic plant, refrigerating plant, bulkheads, block-tackle, winches, donkey-engines, jibs, combings, grids, girders, stanchions, plates, tanks, bunkers, davits; rudder posts, frames, stern frames, tail shafts, pumps, binnacle pedestals, engine-room signal gear, bridge and wheel-house fittings, &c. have been so repaired. In fact, all metal parts from truck to keelson, and from stem to stern have been dealt with.

Docks and harbour equipment, dealt with in the same way, include lock and sluice machinery, filling rams, and extractors, dredgers (dipper and bucket, &c.), travelling, stationary, or floating cranes (electric or steam), grabs, capstans, dollies, tug and tank-steamer engines, boilers, &c., steel barges, hoppers, conveyors, gravity runways, overhead gear, dock locks, weighbridges, tanks, pontoons, caissons, coffer dams, floating dry docks, excavators, hoist drums, coaling elevators, &c., lighthouse apparatus and equipment, light-ship fittings, &c., buoys, bridge trusses and members, rails, tools, accessories, &c., &c.

WELDING NOT ANYBODY'S JOB.

To correct an erroneous impression that is all too prevalent in regard to the practice of autogenous fusion, we should like, at this juncture, to state unequivocally that "welding is not anybody's job." In support of which assertion we cannot do better than append the following analysis of recent investigations into the value of training and specialisation. One hundred welds were done by competent journeymen engineers, and a like number by qualified and experienced welders. Of the former a bare 20 per cent. were sound, 28 per cent. were unsound, and 52 per cent. were useless. Of those done by experienced craftsmen 92 per cent. were sound, 6 per cent. were unsound, and 2 per cent. were useless.

Such a comparison scarcely needs comment. It proves conclusively that if 100 per cent. efficiency is to be achieved in the restoration of disabled plant and machinery, the work must be entrusted to those whose qualifications admit of no debate—in short, to operators who work under the immediate direction of an expert metallurgist who has made the high temperature treatment of industrial metals his special study.

Scientific welding is the last word in the economic maintenance of all descriptions of plant and machinery—but, at all times, let the emphasis be upon the first word. More harm can be done by a well-intentioned amateur welder in half an hour, than can be put right by a specialist in a fortnight—if at all. Unless valuable machinery is in charge of competent craftsmen, its restoration to full commission is almost an impossibility—its destruction is almost a certainty.

Correspondence.

AN "ALL-ELECTRIC" CONVENTION.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I am much interested in your article on "An All-Electric Convention," as I have always been of opinion that in the interests of all concerned it is of the utmost importance that private and municipal electrical enterprise, and, in fact, every branch of the profession, should, if possible, meet once a year socially in order to discuss the various problems connected with the manufacture of electrical machinery and apparatus and the problems connected with the sale and use of electricity.

In these times, owing to the various electricity inquiries which are being held, and the general unrest in the country, it is difficult to find time to attend such conventions. I hope, however, that in the future, when things are more settled, that steps will be taken, possibly by the Institution of Electrical Engineers, to bring about such gatherings. The Old Country, which we are proud to represent and to have fought for, was the chief pioneer of the electricity supply and manufacturing industries, and it is only by bringing all interests together that different views connected with the industry can be expressed and debated upon.

The "All-Electric" Convention should, as you suggest, be of a social character and made as attractive as possible in order to secure the co-operation and attendance at meetings of all those interested in the discussion of problems akin to the art and questions connected with electricity's many spheres of

usefulness—not excepting, of course, the commercial side of the industry.

Much will, of course, depend in the early stages on the election of a president and committee who should be representative of all interests in order that the convention may have such an influential and popular opening as will secure its future success.—I am, &c.,

London, July 26.

G. W. PARTRIDGE.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I read with interest your editorial note on "An 'All Electric' Convention"—it certainly gives food for thought.

At a time when great problems affecting the Electrical Industry as a whole are being pressed to a solution it is a source of weakness, in my judgment, that there is no body capable or willing to speak for the industry as a whole in such a way as to make its voice heard.

I do not underate the important part which the Council of the Institution of Electrical Engineers might play and sometimes does play. The Council, however, is elected for internal domestic purposes and I cannot but feel that it would be of national advantage to have some body constituted that could initiate or weld fellow movements affecting the industry into one whole, a body not charged with the control and conduct of an Institution where trade interests are bound to play a part. We want some body which, besides being free of sectional interests, can rise above the continual struggle between public and private enterprise and which can act as a kind of Parliamentary Committee to the Industry. A long step in this direction might be taken were the Council of the Institution of Electrical Engineers to set up a Parliamentary Committee consisting of a few of the best qualified of its own members with the addition of two or three co-opted from outside on account of special qualifications which they might possess. Such a body might have been of great assistance during the last few years when the whole problem of Power Supply has come up for settlement.—I am, &c.,

County Hall, London,

GEO. H. HUME.

August 1st.

ELECTRICITY METERS VERSUS CURRENT LIMITERS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I notice in your issue of July 22nd that Mr. Miller claims that the use of a resistance automatically thrown into the circuit "for the limitation of current to a consumer on the mains of a supply authority," as is done by the Edison current limiter, is new.

If you will refer to the original Paper read by Mr. Handcock and myself before the Institution of Electrical Engineers in April, 1908, where the "contract demand or telephone system" was put forward and the use of current limiters, or "limit indicators," as we then called them, was proposed, we defined the function of the "limit indicator" as being "to throw a resistance into the circuit, and thus indicate to the consumer, by a reduction in the brilliancy of his lamps, when he is exceeding his contract limit."

It is satisfactory to find that the system then suggested is now being recognised as one of those best suited to meet the difficulty of high cost of service and small actual consumption of current on the part of most domestic lighting consumers.

It is interesting on reading this Paper again, after a lapse of thirteen years, to notice how the forecast of the effect of the introduction of high-efficiency lamps, and also of heating and cooking apparatus, has been borne out, making the necessity for an alteration in the official method of charging, based merely on the number of units consumed, more urgent than ever.

At the end of the Paper we stated:—

"The original method of charging for electrical energy was based on a false analogy with gas. During the quarter-century that has elapsed since it was formulated the conditions have completely changed, and the advent of the new lamp renders it absolutely necessary that the whole question should be reconsidered."

It is a matter for regret that the hope expressed in the next paragraph, that with the aid of the Board of Trade more equitable methods would be substituted, has not even yet been fulfilled; but the whole industry hopes that the Electricity Commissioners will soon succeed in inducing the Government to sanction the change.—I am, &c.,

A. H. DYKES.

London, July 27th.

A QUESTION OF NOMENCLATURE.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I would like to add the following to the discussion which has been carried on in your columns regarding an appropriate name for that type of telephony and telegraphy which has been variously designated as "wired radio," "high frequency," "carrier," &c.

The term "wired radio" is objectionable in that it ignores the fundamental difference between wire and radio transmission. The characteristic feature of wire transmission is that the electro-magnetic waves are guided by conducting wires, whereby the energy is prevented from spreading and is delivered to the one desired receiving point. The characteristic feature of radio is that the waves are unguided, and are permitted to spread out in all directions. If we speak of a "wired radio" or "wired wireless" system of transmission, we are, in effect, saying a "guided-unguided" system. The term contradicts itself.

"High frequency" is not sufficiently definite. For telegraph purposes the frequencies involved may be in the voice range.

An appropriate name for the art should not only suggest the mode of operation, but should also differentiate between it and the two most closely allied arts, namely, ordinary wire telephony and telegraphy, and radio telephony and telegraphy. We have already pointed out the principal distinction between it and radio.

The feature of the art which best distinguishes between it and ordinary telephony and telegraphy is that with it the signalling telephone or telegraph waves are modulated upon alternating currents higher in frequency than the signalling waves while with ordinary telephony and telegraphy the signals are transmitted at their own frequencies. An alternating current on which the signalling variations are impressed in such a system has come rather naturally to be regarded as the "carrier" of the signalling variations, and therefore to be designated as the "carrier" current.

I suggest, therefore, that we designate systems of this type as "wire-carrier" systems. "Wire" differentiates them from radio. "Carrier" differentiates them from ordinary wire transmission. The two words taken together are suggestive of the mode of operation.

While carrier currents are employed in radio transmission, the term "radio" so well identifies that art that the term "wire carrier" may be further abbreviated to "carrier" without confusion. This has happened in connection with the development and operation of circuits of this kind by the Bell Telephone System in the United States. Such circuits are already widely known not only to inventors and the engineers, but also to the operating people, as "carrier" circuits.—I am, &c.,

New York,
July 18.

OTTO B. BLACKWELL.

MECHANICAL ADVANTAGES OF ELECTRIC LOCOMOTIVES COMPARED WITH STEAM.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Referring to Mr. Durnall's letter in last week's ELECTRICIAN I must say I fail to see why my correction of a shorthand error which made me say "squirrel" instead of "quill" should lead Mr. Durnall to infer that I am under the impression that squirrel-cage motors cannot be used satisfactorily for electric traction.

As I have seen a number of squirrel-cage motor locomotives operating satisfactorily and am aware of a good many more it

would be strange if I were under this impression. I can very well concede to Mr. Durnall that if I had this impression, it would be quite wrong.

I was of course talking of mechanical construction whereas Mr. Durnall is speaking of electrical parts, and as a matter of fact there is obviously no reason why squirrel cage motors should not be used in conjunction with quill type mounting.

Mr. Durnall does not specify how his induction motor is to be mounted and its weight to be spring borne. Details of this would be particularly interesting if it is intended to use gearless motors with axle carried rotors, as might be inferred from Mr. Durnall's letter.

The details given of the electrical system and of the speed control are very interesting and the advantages claimed can no doubt be substantiated in practice. The point is, can they be obtained at a commercial price.

I can agree with Mr. Durnall that the single-phase system has many attractions and advantages particularly for main line work with not over dense traffic, but unfortunately there are drawbacks inherent in any single-phase system beyond those of the ordinary single-phase system referred to by Mr. Durnall which make themselves specially felt in this country and which point to the high tension direct current system as being more suitable for our use.—I am, &c.,

Derby, August 2nd.

J. DALZIEL.

The New I.M.E.A. President.

Mr. S. T. ALLEN, chief engineer and general manager of the Wolverhampton Electricity Department, who has just been elected President of the Incorporated Municipal Electrical Association, may not inaptly be described as belonging to the younger generation of



MR. S. T. ALLEN

(President, Incorporated Municipal Electrical Association).

electricity supply engineers. He commands a municipal department without an undue display of the trusted municipal spirit, and it is, therefore, not surprising to find that the development of the undertaking under his control in such fertile soil as exists at Wolverhampton has been extraordinarily rapid.

Mr. Allen, who was born in 1873, was educated at Plymouth and Mannam College and received his technical training at Cardiff University College. He subsequently served his articles under Messrs. S. F. Walker & Co., at the Cardiff Electrical Engineering Works, and at the end of this time entered the employment of the

firm as a draughtsman. He was then appointed electrical engineer for the Cardiff district by Messrs. Gilbert & Company of London, and after a short time with this firm became electrical engineer to the Ebbw Vale Steel, Iron & Coal Company, with whom he was engaged in designing and laying down their extensive electrical plant. Having thus gained early experience in commercial life he next turned to the haven of public enterprise, starting his municipal career as senior charge engineer at the Plymouth electricity works. He was afterwards promoted to chief assistant in the same, undertaking a position which he held for seven years, until in 1908 he was appointed city electrical engineer at Carlisle, while in 1913 he moved to his present position. Mr. Allen, as occurs to all who have risen to any eminence in their profession, is connected with a large number of interests in the industry itself. Besides being a member of the Institution of Electrical Engineers, he is a member of the British Engineering Standards Association, a past chairman of the South Midland Centre of the Institution of Electrical Engineers, and chairman of the Electrical Engineers Committee, which is preparing a joint scheme for the electricity supply in the North-West Midlands district. In his election to the Presidential Chair of the Incorporated Municipal Electrical Association, Mr. Allen has before him the example of many electricity supply engineers. We have no doubt that he will profit by that example and equally distinguish himself in this important position as they have done.

Foreign Radio-Telegraph Progress.

In fulfilment of a promise recently made in the House of Commons the ASSISTANT POSTMASTER-GENERAL (Mr. Pike Pease) has issued a statement on the wireless services of the United States, Germany and France. In these three countries wireless telegraphy is being worked, as in the United Kingdom, partly by private and partly by Government enterprise. It is stated that on the whole, though the high-power stations in the countries in question are more numerous, and in some cases more powerful, than the corresponding stations in this country, there is reason to think that the commercial development of wireless communication is as far advanced here as elsewhere. The position will be still more favourable to this country when the new Post Office stations near Oxford and Cairo are working and when the other stations in the Imperial chain are erected.

UNITED STATES.

In the United States the principal privately owned stations are those of the Radio Corporation of America and are as follows: New Brunswick (N.J.), Marion (Mass.), Tuckerton (N.J.), Bolinas (San Francisco), Kahuku (Hawaii). The first three stations are used for traffic between the United States and Great Britain, Norway, Germany and France. The Bolinas and Kahuku stations deal with traffic between the United States and Japan. Most of the Radio Corporation's stations have been, or are being, equipped with 200 kW alternators. It is claimed that the stations can work by automatic transmission up to 50 or 60 words a minute, but they are normally worked manually at a speed not exceeding 20 to 25 words, and the load probably does not exceed 15,000 paying words a day. The following high-power stations are worked by the United States Navy: Annapolis, Sayville, San Francisco, Honolulu, Guam, and Cavité (Philippines). These stations are equipped with arc sets and the last four are used for Government purposes. The stations are not open for general commercial work, but they are used (when not required for Government work) for the transmission of news at the same charge as that made by private stations. The service seems to be fairly satisfactory during the winter, but in the summer months it is subject to interference by atmospherics. Efforts have recently been made to receive news messages from Annapolis in this country, but the audibility of the signals is not sufficient to justify the institution of a regular service. The Radio Corporation of America have commenced the erection of a new radio station on Long Island, consisting of six separate installations (one spare) grouped round a common centre, each equipped with 200 kW alternators, and intended for communication with various European countries.

GERMANY.

The principal high-power stations are those at Nauen and Eilvese (owned by the Telefunken Company). The services with England, Italy and other European countries are carried on by the medium-power Government station at Königswusterhausen, near Berlin. The station at Nauen, which is equipped with three high-frequency alternators capable of furnishing 400 kW, is used for communication with the United States. The service is not very satisfactory during the summer owing to atmospherics, but during the winter the working is reported to be fair. The traffic handled averages about 10,000 words per day. It is understood that the power of the station is to be doubled in the near future.

FRANCE.

Wireless services are in operation between France and the following countries: United States, Great Britain, Spain, Hungary, Bulgaria, Roumania, and Yugo-Slavia. The services with Great Britain and Spain are conducted by the Société Française Radioélectrique, and the remainder by the French telegraph administration. The principal stations in France are Bordeaux, Lyons, Nantes and Eiffel Tower.

The Bordeaux station is equipped with arc transmitting apparatus, the nominal power of which is 1,000 kW, and it is used chiefly for communication with the United States. The amount of traffic exchanged averages about 14,000 words daily (including 1,000 for the United States Navy). The Bordeaux station is also used for the transmission of traffic to Central Africa (Rutisque), Congo (Brazzaville) and Shanghai. The amount of traffic is small (about 200 words a day), and is limited to the outward direction only, reception of messages being acknowledged by cable.

The Government services with European countries deal with a total traffic (inward and outward) of about 13,000 words a day in all. The service conducted by the Société Française Radioélectrique with this country is not largely used and the traffic with Spain is not known. The military authorities are erecting communicating stations in the French Colonies at Bamako (Soudan), Brazzaville (Congo), Tananariva (Madagascar) and Saigon (Indo-China); but the stations are far from completion. A new central wireless station has recently been commenced at Ste. Assise, near Paris, by the Compagnie Générale de T.S.F. It will comprise two sending installations, one of which will be used for European and the other for extra-European communication.

The Telephone Service.

THE SELECT COMMITTEE ON THE TELEPHONE SERVICE concluded on Wednesday last the taking of evidence for this session, and agreed to an interim report stating that they had been unable to complete the inquiry and asking that they may be reappointed next session. The chairman of the Committee (Mr. Evelyn Cecil) and the telephone adviser (Mr. W. W. Cook) have left for Norway, Sweden and Denmark to inquire into the telephone systems of those countries. Mr. Cook will subsequently visit Canada and the United States. Among recent witnesses examined were the following:—

Mr. W. B. PINCHING, on behalf of the technical staff of the Post Office engineering factories, stated that in the best interests of economy he thought the factories should be placed entirely under engineering control. With the introduction of automatic telephony there was a greater need for technical supervision and a greater knowledge of mechanics.

Sir DANIEL STEVENSON, a former Lord Provost of Glasgow, said the new telephone charges were excessive, and, with better management, unnecessary. The service was carried on in a way much more costly than it would be under private enterprise, and the staff was greatly in excess of its real needs.

Lieut.-Col. W. A. J. O'MEARA thought the main defects of the G.P.O. lay in the attempts which was made to combine under the administrative direction of a single permanent head (the Secretary) three undertakings so diverse in their main characteristics as the Post Office Savings Bank, the Post and a highly technical business like the telegraphs and telephones, and in the over-centralisation of control and in the considerable duplication of work owing to the peculiar organisation of the Secretary's Department and its large staff of officers. He advocated the separation of the telephones, which should be under the administration of a board. When he was in the Post Office he discovered officers in extremely high positions who had not the knowledge of their work that a sergeant-major in the Royal Engineers had.

Sir CHARLES OWENS, a director of the L. & S.W. Railway Company, in his evidence, said that if a commercial firm found its cost of production was approaching perilously near the market price of the article, the first step would be to investigate costs and not to rush on to the market with their product increased in price by what they considered a sufficient margin. He said that replies received from 100 business men showed that the Post Office were paying 64 per cent. more in wages and war bonuses than was being paid by commercial firms for services of a similar character.

Sir ISAAC CONNELL, secretary of the Scottish Chamber of Agriculture, urged that special facilities should be given for the extension of the telephone in rural districts and for a reduction of the increased charges, and especially of the charge of 25s. a furlong beyond the first mile from an exchange. Owing to the increased charges many subscribers in rural districts had dropped the telephone, and unless the charges were substantially reduced, it was hopeless to expect any extension in rural districts. It would have been a wiser course to make a smaller increase, because once a subscriber withdrew it was doubly difficult to bring him back. All work for new lines and extensions should be given out to open public competition—not merely among a selected list of contractors. Not only the cost but also the benefit should be taken into account in fixing charges. The town subscriber got double the benefit which the rural subscriber could get, whereas the former paid less than the latter.

Mr. THOS. H. RYLAND, of the National Farmers' Union, said that rural party lines had not been taken up as they should have been, and it was felt that if there were more propaganda and the attention of farmers were called to the facilities to the extent that prevailed in the Dominions and foreign countries, much greater use would be made of the service in this country. It would be of great service to farmers if there were greater telephone facilities. The variations that the charges had undergone had made rural people chary, and there was a growing feeling that there was so much uncertainty about the whole matter that it looked as though the Post Office were not very desirous of extending the system. The rural subscriber got a smaller benefit than the urban subscriber by reason of having fewer people with whom he could communicate.

London Electricity Inquiry.

This Inquiry, which has continued for seven weeks, was concluded on Friday last. We give below a report of the remainder of the evidence and speeches.

COST OF COAL AND ASHES.

To Mr. Henderson, Mr. MERZ said he had taken cost of disposal of ashes at 2s. 6d. a ton. The cost of a ton of road was 5s. The cost of coal at the Company's present stations was 0-534d. per unit in the first half of the current year. The average price of coal in 1920 was 48s. 10d. He would not advise that, even if the Barking station were to be erected so as to be working in 1925, the present stations should have new plant put into them and be linked up. The Barking station could be ready for working in three years. He doubted whether any linking up with the County of London Company's existing stations with other stations, to deal with any increase of load, could be done before the Barking station was ready. Even if it could, he thought it might be as cheap to put up temporary plant at Barking. He was certain that the railway companies could be supplied more cheaply from that station than the railways could supply themselves. Whether the Barking station were erected or not, there was no need for the Beckton station. A case might be made out for Chiswick as a peak station. There was no case for putting down modern plant at Bankside or Deptford. To make the Barking station capable of supplying a load of 200 000 kW would cost about 2½ millions in addition to the 3½ estimated for the 60 000 kW station. When he said he had received lower tenders for plant than were received before the war, he meant at a lower price per kilowatt, not per ton. Some of these were from British firms. He had had British tenders for a 30 000 kW set about a year ago. The largest sized set in the North-east coast installation was 20 000 kW. Coal distillation had not been carried out on a large scale. As all the coal would not be used for distillation probably there would not be more than 1 ton obtained from 10 tons of coal. He did not attach any importance to the Beckton site being adjacent to the gas works. The Romford area had practically no supply at present from the County of London Company.

To Mr. KENNEDY, witness said he thought railway engineers would not be enthusiastic about taking a supply from a station other than their own, unless the plans were settled, the foundation laid and the plant on order. He had placed contracts during the last three months at £3 per kW. for 15 000 kW turbo-alternators.

EVIDENCE FOR SURREY COUNTY COUNCIL.

Mr. C. B. EDGAR, M.P., Chairman of Surrey County Council, stated that a meeting of local authorities was held in December, and the opinion was generally expressed that a general supply of electricity for the county would be welcomed. A resolution had been passed that the Commissioners should be asked that no portion of the county should be connected to the central supply in the early stages of the scheme, but that provision should be made to permit of connecting up, on the application of the authorities concerned, when the Joint Authority was in a position to give a supply. He supported the principle that no part of the county should be included in the scheme unless the whole were included. The northern part of Surrey, which contained the greater part of the rateable value, was the very part which it was sought to take away.

To Mr. HENDERSON, witness said he did not suggest that a scheme for Surrey alone could supply as cheaply as a scheme connected up with a general London supply. Part of the county was already connected up with metropolitan areas. Surrey's objection to partition would be reduced if the county had direct representation on the Joint Authority. The county asked to be left out altogether for some time. He admitted that some part of the Northern Surrey could advantageously be taken into the area.

To Mr. TURNER, witness said he and many of his colleagues would prefer the Conference scheme to that of the L.C.C. Provided the contribution to be made by Surrey County Council to the administrative expenses of the Joint Authority in return for representation were nominal he thought there would be no objection to it.

Re-examined by Sir HERBERT NIELD, witness said Surrey preferred to get other supplies than that proposed by the Joint Authority. The main objection was that parts of Surrey would be sterilised if the county were included in either of the schemes.

To Sir JOHN SNELL he admitted that a county area was not the most economical area for electricity supply. If the Commissioners found it necessary to include a part of Surrey and allowed time for consideration of the proposal the Council would be pleased to give the matter earnest consideration.

THE COUNTY OF LONDON COMPANY'S CASE CONTINUED.

Mr. MERZ, whose cross-examination by Mr. Kennedy was then resumed, said he would be pleased to give the Commissioners particulars of the tenders which he had received for turbo-alternators and on which he based his statement that prices of plant had been considerably reduced. Taken as a whole the County of London Company's area was a good power district. Electricity supply ought to get the benefit of the by-products of the coal, but in the case of the Beckton site the gas company wanted to sell the fuel to the electricity authority after the by-products had been extracted.

To Mr. DONALD, witness said that the West End could afford to pay a higher price for current than an industrial area such as East London,

and he thought special consideration should be given to separate proposals for supplying such an area. The reduction in the price of plant to which he had referred was most noticeable in the case of units which gave or approached the maximum output for a given speed. That would apply to sets between 15 000 and 20 000 kW and from 30 000 to 35 000 kW. What he had particularly in mind when he mentioned the £3 per kW figure was plant f.o.b., not for installation in England. He could not say whether manufacturers were quoting lower prices for plant for abroad than for undertakers in this country. He did not suggest that all the existing stations should be scrapped at once. He did not agree that the chief advantage of the Company's site was that it afforded a means of "jumping a claim" in the sense that if the Company had started their works there it would militate against the success of a proposal by the local authorities in the vicinity if they came forward later with a proposal for a station. If a company offered to erect a station in which the coal consumption would be only half what was estimated in the schemes now before the inquiry it should be considered a public benefactor.

Re-examined by Mr. MORSE, Mr. Merz said the reason electricity supply was not in a satisfactory condition to-day was that the fundamental factor of coal consumption had not received full attention, but when it had this country would have a better electricity supply than any other. The County of London Company attached more importance to the fact that they had a demand to supply which would be many times their present output than to the strategic point of obtaining an extension of tenure. It was the undertakers particularly concerned with power business who objected most strongly to inclusion in the schemes for the larger area. He thought it would be a calamity if other railways, in addition to those which already had power stations, were to equip their own stations instead of taking current from a combined station.

In reply to Mr. Page, witness stated that the provision of modern plant was the best solution of the London problem to-day. He was always anxious to secure unity, but if it became a question of choosing between modern plant and unity, he was confident that modern plant was the more important. The development of the electric supply business at present was a particularly suitable subject for private enterprise, provided there were proper safeguards, and that the undertaking was not unduly over-capitalised. With regard to the carbonisation of coal, his view was that if coke was to be used under the boilers of generating stations, that coke would be better produced by the authority controlling the generating station than by being bought from somebody outside.

To Mr. LACKIE, who considered that the figure for maintenance at the Barking station, given as £14 400, was very low, Mr. Merz said that meant day to day maintenance of plant, apart from actual renewals. The figures were based on those obtained from other stations, and were the estimated maintenance charges for the first commercial year.

GROWTH OF THE COUNTY COMPANY.

Mr. C. P. SPARKS, of Messrs. Charles P. Sparks & Partners, and late Engineer-in-Chief to the County Company, handed in charts showing the actual growth of the demand on the Company's generating stations from 1909 to 1919, and the estimated demand up to 1924. At the end of 1919 the demand was 26 000 kW, and the estimated demand at the end of 1924 was 42 000 kW. There had been a gradual increase in the demand up to the time of the war, when there was a definite drop, but after the armistice the demand grew again very rapidly. In October, 1918, he reported on the rate of growth of the demand for the next five years, which he estimated at 3 300 kW per annum; the actual increase in the first three years was 9 300 kW. He referred to the impediment to the development of the Company's area due to lack of plant. The actual load last winter was 27 900 kW, which could have been greatly exceeded, but in order to keep down to that figure it had been found necessary to restrict supplies. They had an agreement with the City Company to supply them from the City-road station in bulk when they could do so, but they had not been able to get a supply from this source up to now. As it was, the new connections in 1920 accounted for 7 000 kW, and that was not brought about by intensive canvassing, but was a natural increase. This figure also could have been increased had there been sufficient plant, and he put in a diagram showing the additional demands on the Company's stations if sufficient plant were available. He estimated that if the Company had sufficient plant, they would be supplying 54 000 kW in 1924, instead of 42 000 kW. There was a considerable amount of private plant installed in the Romford area, and there was a large potential demand. As an instance of a supply which had actually existed in the Company's area, and had been lost to them, he mentioned an electro-chemical undertaking which had now been transferred to another area altogether.

In regard to the cost of plant, Mr. Sparks said there was a very substantial reduction in prices compared with those ruling last year, and he agreed with the figures given by Mr. Merz. His opinion was that a modern generating station should be put up at once, and he knew of no more suitable site than that at Barking. It was very desirable to get ready in advance to meet the demand.

In reply to Mr. CRAIG HENDERSON, witness agreed that if the correct policy was to spend money in advance, and go ahead at once with the erection of a capital station, the same principle would apply to the Joint Authority as to the Company, i.e., if the Joint Authority were anxious to get to business.

E.P.E.A. AND E.T.U.

On the 21st inst. evidence was given in support of statements handed to the Commissioners earlier by the Electrical Power Engineers' Association and the Electrical Trades Union.

Mr. W. A. JONES, General Secretary of the Electrical Power Engineers' Association, stated that the Association was asking for direct representation to enable the views of technical assistants to be put before the authority. The members of his Association had no personal interest in the matter, and the machinery already existing for dealing with remuneration and conditions of employment was adequate. The Association required direct representation rather than representation jointly with other bodies, because it was weaker numerically than a body such as the Electrical Trades Union, and would be out-voted every time.

The CHAIRMAN said that the responsibility entailed by representation on the joint board should carry with it financial support. As he understood it, the two reasons for the Association desiring representation were that they would be able to give technical assistance, and to improve the status of the technical assistants. With regard to the latter, there were three bodies already looking after their interests, namely, the Institution of Electrical Engineers, the Whitley Council for the industry and the Wages Board. A difficulty he foresaw was that an assistant engineer might be on the Board, and he would thus be in a position of authority over the Chief Engineer.

Mr. JONES replied that the representative of the Association on the Joint Authority would not necessarily be an employee, but a member of the Association.

Mr. WEBB (London District Secretary of the E.T.U.) also supported the statement previously forwarded to the Commissioners by that body on the question of representation.

Mr. CRAIG HENDERSON (Counsel for the L.C.C.) said that in the L.C.C. scheme provision was made for two seats on the Joint Authority in the labour interest, and he therefore asked what was adequate representation, in the opinion of the E.T.U.

A COOL REQUEST.

Mr. WEBB said at least half and added that he had been modest in making that request. In the course of a discussion about financial support Mr. Webb said that at present the Union was "nearly broke," but, in answer to Mr. Donald (for Poplar) he said that the Union could not consider the shouldering of half the financial burden "at the present moment." He preferred that representatives should be elected by the general body of workers in the industry.

Mr. SPARKS was recalled and said the item of £8 600 for rates, taxes and insurance represented what would have to be paid by the Company in 1925 if the Barking Station were erected and current supplied from there, minus the sum which would have to be paid if the same business had been dealt with at the Wandsworth and City-road stations.

Mr. TURNER (for the Conference of Local Authorities) referred to the letter sent to the Commissioners by the Islington Borough Council, raising objections to the scheme, and stated that they had now agreed to come in under the Conference scheme.

Mr. KENNEDY then continued his cross-examination of Mr. Sparks. Dealing with the railway load, which the County Company hoped to get by the erection of the Barking station, he suggested that if the station were erected, and the Company canvassed for the railway load, stating that they had, say, a 20 000-kW plant to deal with it, which could not be used for other purposes, the Company would be more or less in the hands of the railway people, and would have to accept almost any price offered.

OBJECTION TO THE BECKTON SITE.

Mr. SPARKS replied that the position was not quite as stated by Mr. Kennedy, as the plant could be used for other purposes. Another point raised was the difference in the figures estimated per kilowatt installed by the engineers for the County Company's scheme and the scheme promoted by the nine companies and other bodies, this being £20 in the first case and £25 in the other. The Chairman, however, pointed out that the figures produced by the two bodies of engineers were very much on a par in the first place, because they were estimated at about the same time, and the £20 in the case of the County Company was the revised figure based on reductions in price since the October enquiry. With regard to the Beckton site, Mr. Sparks said he would turn it down solely on the ground that it was too small. The question of crossing the river to the south side from Barking was not an easy matter, but he thought he would be able to do it in about two years. The river was crossed at present by London Bridge. It would prejudice the Company's position if they disclosed how the river was to be crossed, but they would put their plans before the Commissioners if desired.

The CHAIRMAN held that he must mete out the same justice to the Company as he had done to the promoters of the other schemes in connection with the options on sites for capital stations, and the plans of the County Company with regard to crossing the river were not therefore disclosed.

Mr. TURNER (for the Conference scheme), suggested in cross-examination that the County Company was anxious to secure the railway demand for themselves.

Mr. SPARKS said nobody else seemed to want it, and this led to a discussion on the proposals of the two schemes for dealing with the railway load.

The CHAIRMAN, summing up the position, said that the County Company were willing to take the risk of erecting a modern station in the faith that they would secure the railway load, whereas the promoters of the joint scheme were not taking that risk, and it was not their intention to

supply the railway load. The attitude of counsel for the schemes was that they could not pledge the joint authority as to its attitude. If the railway load came along sooner than the time fixed for the erection of the capital stations under their scheme they would be able to push forward the work in order to meet it. The joint authority should be in a safer position with regard to taking the risk of preparing for the railway load, because, if it were lost, they would be able to dispose of the extra load more easily owing to the large area which they would supply, and the estimated growth, whereas the County Company would be confined to their own particular area. He added that the question of whether the railway companies should erect their own generating stations was not for them to decide, but was in the hands of the Commissioners.

NEW PLANT AT £3 PER KILOWATT.

On the 26th ult. Sir JOHN SNELL announced that Mr. Lackie had examined the tenders referred to by Mr. Merz, and these showed that British manufacturers had tendered for turbo-alternators of 15 000 kW or over, 3 000 revs. per min. for supply f.o.b., without auxiliaries or erection, at £3 per kilowatt continuous rating. For home supply 10 per cent. was added, making £3 3s. For smaller sets 15 per cent. was added, making £4 14s. For auxiliaries a further 10 per cent. was added, making the total £4 55. All these were for plant for 50 cycles, but for 25 cycles another 10 per cent. was added, making £5, and for 1 500 revs. per min. another 15 per cent. was added, making £5 75.

COUNSELS' FINAL SPEECHES.

Mr. BAKER (for the North Metropolitan Company) argued that a Joint Electrical Authority was not necessary so far as the Company's area was concerned, and he also asked for the exclusion of Stoke Newington and the Company's Willesden power station. He had been unable to get an assurance from the L.C.C. witnesses that a supply would be given to the Company at a lower rate than their present cost, and no evidence had been given by the engineers as to any assistance that would be given in the Company's area. Mr. Fladgate, for the companies' scheme, was agreeable that the Company should stay outside, but under the other schemes it was proposed that it should be included, which was inconsistent, as the same engineers prepared the engineering details for all the schemes. By continuing its present policy and connecting up with the Metropolitan Company the Company would effect more improvement in its area than anything that might be contemplated under the schemes submitted. The Company objected to being asked to make a large contribution towards the Joint Authority's expenses.

THE NON-CONFERENCE COMPANIES.

Mr. MORSE said, on behalf of the City of London Company, they could not consent to any alteration of their statutory position which involved risk of pecuniary loss. The West Kent Company objected to the proposed schemes, because they did not provide for serving the area as efficiently as the Company could do it from the new power-house which they proposed to erect. For the County of London Company, Mr. Morse said the proposal in regard to the Barking station put before the Commissioners in March, 1920, was that two 33 000 kW turbo-alternators should be put in at the outset, further extensions to be subject to the approval of the Commissioners. The promoters of the schemes that had been considered did not propose, at any rate, for a considerable time, to provide for the railway supplies. All four schemes simply proposed linking up, but as Mr. Merz had said, the station and mains must be ready before the demand could be obtained. The County Company offered to proceed with a station without waiting for any signed contract. It was not the Company's fault that its existing stations were in the Provisional Order districts, and as it was impossible to extend them sufficiently, they had to look around for a means of establishing a larger and more efficient plant. The sanctioning of the Barking station could not injure the Joint Authority, as the Company had consented to optional purchase of the station by the Authority on terms to be settled by the Commissioners.

Sir JOHN SNELL asked what attitude the County of London Company would take in regard to either of the schemes, as to the formation of a Joint Authority, and as to extension of tenure.

Mr. MORSE said, in view of the fact that extension of life was a question put forward after the Company had accepted an alternative purchase clause in their Bill, viz., on such terms as the Commissioners thought fit, the Commissioners could not grant extension of life. It was a matter for statutory authority after agreement with the purchasing authority.

Sir JOHN SNELL said, supposing the Commissioners consented to the erection of the Barking station, what would be the Company's attitude towards a scheme for a Joint Electricity Authority, which would carry with it an extension of the Company's life?

Mr. MORSE said they would be in accord with it, provided consent for the station were not kept back until the Authority was formed.

Sir JOHN SNELL said a proposal had been put before the Commissioners that there should be a method of leasing the companies' stations to the Joint Authority. Would the County of London Company be prepared to lease their station?

Mr. MORSE replied that his clients had no objection to the principle of leasing. Whatever was decided upon, they hoped it would be settled for a considerable period—that there should not be a determination of the lease every 10 years, or something of that sort.

Mr. MOSELEY, for the Metropolitan Electric Supply Company, asked for the exclusion of the Company's bulk supply area and its Willesden station. The Company was extending its main through Ealing and Acton

to Willesden, and the needs of the area could be left to the Company to deal with. No witness had been able to show that any tangible benefit would accrue to the Company for a great number of years. He suggested that the sole reason the outer districts were brought in was to get contributions from them to enable the Joint Authority to put their house in order in the County of London.

THE POSITION OF THE RAILWAYS.

Mr. TYLOR, for the railway companies, said that to some extent the demand of the railway companies, for purposes other than traction, should receive consideration. Several companies were already taking considerable supplies from outside for such purposes. The railway companies had no predilection for spending money on generating stations. If they could get a supply from outside as cheaply as they could generate it they would be pleased to have it. Apart from taking current from a Joint Authority, the railway companies would be pleased to assist the carrying out of an electricity supply scheme in every way possible, by granting wayleaves and possibly supplying any surplus of energy that they might have to the Joint Authority. The railway companies, if specially represented on the Joint Authority, could give the Authority valuable assistance; but they would receive no benefit from the Joint Authority in the early stages, and therefore should not be asked to contribute to the administrative expenses. The L.C.C. scheme seemed to be the fairest, and he suggested that two members of the Joint Authority should be elected by the Railway Association. Supply at 25 cycles would be more satisfactory for traction than energy at 50 cycles.

SURREY AND HERTFORDSHIRE CLAIMS.

Sir HERBERT NIELD (for Herts and Surrey County Councils) said the policy of Surrey was not to obstruct the schemes; the county wished to be taken in as a whole. The proposals of the promoters did not provide for any supply in Surrey of a substantial character, except in Barnes, which could be supplied from Kingston. No part of Surrey could be called a manufacturing centre. He mentioned that on the 10th of the month (July) the local authorities passed a resolution requesting the Commissioners not to include in the Joint Authority's area any district in Surrey until such time as the particular district could be linked up with the central area. Surrey County Council claimed direct representation as well as London, and the local authorities who were not electricity undertakers would agree that the County Council should represent them on the Authority, as had been agreed in the case of Middlesex. The Electricity Supply (No. 2) Bill had died the previous night, and that would do away with a great deal of the utility of the proposals in the schemes. The case of Hertfordshire was stronger than that of Surrey. Middlesex intervened, and there was no considerable density of population on the border. There was no industrial load, except at Watford, and there was no evidence that the Joint Authority could do better than the present undertakings were doing in regard to electric supply in Hertfordshire for many years to come. If it were necessary to set up a Joint Authority to cover Hertfordshire, an amalgamation of the areas of the Metropolitan and North Metropolitan Companies would be preferable to joining Hertfordshire to a central body for London. If Hertfordshire had to come into the scheme, it claimed the right to appoint one member of the Joint Authority.

THE REPLIES FOR THE PROMOTERS.

Mr. DONALD, addressing the Commissioners in regard to the scheme of Poplar Council, pointed out that the discretion as to when a Joint Authority should be established by the Commissioners was unlimited, but a scheme could be carried out without establishing a Joint Authority. In his opinion, the Electricity Commissioners could, therefore, exercise their powers under sec. 19 of the 1919 Act for an indefinite period if they thought that the time had not arrived for the creation of a Joint Authority. It seemed impossible to set up one Joint Authority for the whole of the delimited area which would be equally acceptable to company and local authority undertakers. He asserted that local authorities sold current 25 per cent. cheaper than the companies, and that was a matter to take into consideration when dealing with the question of a cheap supply for the whole of London. The local authority undertakings were also in a sounder financial condition than the companies, because of the greater depreciation that had been made in their assets. The outstanding balance of the local authorities' capital (£7,335,000), compared with that of the companies (£17,232,000), was equal to £37 per kilowatt, against £60 per kilowatt of existing plant. That meant that the plant of the former had been depreciated by nearly twice the amount shown by the reserve funds of the companies. The incompatibility of those respective financial conditions would make the setting up of one Joint Authority, to include both interests, well-nigh impossible. The promoters of the Conference scheme were able to say that at least a dozen large local authorities, and probably as many as 20, would come into the scheme. The companies' scheme included nine, and probably more companies, but the L.C.C. had no undertaking from any local authority to support their scheme. The depreciation of the plant of local authorities was 39 per cent., and the companies' reserve funds only amounted to 14 per cent. He suggested the simplest solution of the difficulty would be to confine the financial operation of the companies' stations to the companies' area, and the financial operation of the local authorities' stations to the local authorities' area, and that the two groups should only be worked in conjunction so far as the electrical working was concerned. Mr. Donald said all the engineers who were considering the smaller areas pronounced for the earlier erection of capital stations. It was proposed that the East London area should be financially autonomous; but it had never been suggested that it should be separate electrically.

If each area was getting the benefits of its work applied to its own area it would deal with the business more efficiently than if the benefits were applied to the larger area. He thought that in the three larger schemes the capital station cost was unduly loaded, compared with the proposals for operating with the existing stations. In working out the cost per unit in the case of the existing stations advantage was taken of units produced by plant on which there were no longer any capital charges, which advantage would, of course, disappear when that plant had to be scrapped and the comparison was made with the capital stations at the most expensive (the £40 per kilowatt) stages. He suggested that the proposal to defer the erection of capital stations had been arrived at on wrong premises, that the time for the constitution of a Joint Authority was not yet, and that the Commissioners should delimit such an area as they thought fit and permit the constitution of such areas.

THE COMPANIES' SCHEME.

Mr. KENNEDY (for the companies' scheme) said no valid area had been suggested for separating the Poplar area entirely from the other parts of London. Dagenham was not a very advantageous site for a station, having regard to the cost of transmission, and the saving on ash disposal was problematical. The companies were being paid for their ash. No one had suggested that the North Metropolitan Company's efficient stations should be scrapped. It was contemplated that those stations might be given a better load factor by connection with the new capital stations and the inter-linked stations in the central area. If the engineers advising his clients were the engineers to the Joint Authority they would advise that a capital station should be commenced directly a railway company gave notice of its intention to take a large supply. On the other hand, if a railway company or combination of railway companies erected a large station, an arrangement could be arrived at for a supply from such station to the Joint Authority. If the railways were to be electrified and co-operated with the Joint Authority there would be no difficulty in extending the proposed area of supply outside the ten-mile radius. His clients were of opinion that until a Joint Authority could not give an economical supply to a given district from its own stations such district should not come under its jurisdiction. The area set out in the Joint Committee scheme was one which the Board of the Commissioners' Company had approved, and he was not in a position to say that they would approve a larger scheme. Mr. Kennedy then read a statement on behalf of the Joint Committee, that they had been impressed by Mr. Morse's statement that the station proposed to be erected at Barking by the County of London Company would be for the needs of the company's statutory obligations only, and the committee felt that it would not be proper for them to hamper the company in making such provision, and that it was a matter which could be left to the Commissioners. The County Company's scheme did not conflict with the scheme the committee were putting forward, and the committee were of opinion that both schemes could be put in hand side by side for the general benefit of the area.

Mr. MORSE said the County Company were prepared to co-operate with Mr. Kennedy's clients in every way possible. He added that the chairman of the County Company had approved of his previous intimation to the Commissioners that the Company would be prepared to consider a general scheme in which they would co-operate, on condition that their tenure was extended.

Mr. KENNEDY said the principle upon which the Committee wished the Joint Authority to be constituted was that those who undertook financial responsibility should be represented in the Authority. The terms of the lease of the generating stations were still the subject of negotiation between the Joint Committee and the L.C.C. He submitted that the Commissioners could not under the Act of 1919 impose compulsorily upon undertakers the control proposed by the L.C.C. The Joint Committee agreed to the reduction of the rent payable for the generating stations from 7 to 6 per cent. His clients had not seen their way to give up their claim to an alternate valuation of the company's stations by arbitration, as there might be cases in which it would be claimed that certain items were maintenance and not capital cost. Upon the suggestion of Sir Harry Haworth that means might be found for dealing with such exceptional cases that did not overthrow the whole basis of the first system of valuation, he would ask his clients to consider a suggestion that in such cases the particular items might be submitted to the Commissioners.

The differences between the companies and the L.C.C. had been largely overcome.

THE LOCAL AUTHORITIES' SCHEME.

Mr. TURNER (for the Conference of Local Authorities) read a resolution by Fulham Council agreeing with the Conference scheme in principle. He went on to say the companies' scheme promoters did not press strongly for the restriction of the area to that which they had indicated and Sir Alex. Kennedy agreed that the needs for industrial, domestic and other purposes outside that area had to be considered. Mr. Donald's scheme had really only Poplar behind it and the blessing of Bermondsey, and Poplar now only asked for a district committee, with a certain amount of control by the central authority. Therefore the promoters of those schemes were not very antagonistic to his scheme. As soon as plant became cheaper the Conference would consider the erection of a capital station. His clients took the same view as the Joint Committee with regard to the railway supply. At present some of the authorities in the Conference were not willing to part with their stations, but he hoped that in time they would change their view. The Conference would be willing to provide the £1,050,000 that would be necessary in the

early stages, on the security of the rates. According to the Conference scheme, the administration expenses of the Joint Authority in the first stage would be about £17,000 per annum. The Conference passed a resolution last week which, while confirming the previous resolution expressing the opinion that there need be no connection between the acquisition of the companies' generating stations and the extension of the term of their distribution powers, went on to state that the Conference was not opposed to the principle of an extension of the companies' tenure of their distributing rights. Local authorities should be treated not less liberally than the companies in regard to the terms of the transfer of their assets. The Conference method would involve the Joint Authority in less capital expenditure than any of the other proposed methods, and it provided for all plant being written off in 20 years. The companies' estimate of the residual value of their transferable assets was 1½ millions above that of the L.C.C. and more than 1½ millions above that of the Conference. This would mean an increase in the price per unit of 0.06d. over what it would be if the Conference estimate were adopted. If the same basis were adopted with regard to the acquisition of the local authorities' stations the increase would amount to 0.12d. in all. The Conference were willing that the local authorities should be represented through their County Councils. It was suggested that there should be one representative for each county. It was now proposed that the Port of London, the railway companies, other large consumers and labour should each have one representative. He would suggest that the L.C.C. should have less than three, the original number proposed, and the L.C.C. would better achieve their principal object if they had none. The L.C.C. asked for eight representatives because they claimed that they represented the consumers in the whole of the London area, but the consumer would be best protected by a body which remained outside and criticised the Joint Authority. The Conference did not assent to the principle that representation should depend upon financial assistance, and they also objected to the appointment of technical and finance committees.

Sir JOHN SNELL said he had every reason to believe the Minister of Transport would re-introduce the Electricity Supply Bill next Session and endeavour to secure its passing.

THE L.C.C. SCHEME.

Mr. CRAIG HENDERSON said in drawing up their scheme the L.C.C. had performed a difficult task and he thought the defined area was a proper one. Sir James Devonshire objected to being brought into any area of any Joint Authority, but the 1919 Act clearly contemplated that power companies should be included in such areas. If the Joint Authority supplied current at a loss, to undercut the power company, it would not be held by the Commissioners to comply with the requirement of the Act that to supply at a lower rate than the existing undertaker, it must be "able" to supply at such a rate. There was to-day linking up between the North Metropolitan Company and East London, and there would be connection in the west between the Metropolitan Company's power area and West London, and there was no justification for the companies objecting to the Joint Authority coming over the boundary. The companies would have greater grounds for objection if only part of their area were included. Hertfordshire looked with a certain amount of jealousy upon the County of London. The Commissioners should not deal with political issues, but solely with securing the best supply for the area they had selected. With regard to Mr. Edgar's statement that the Joint Authority would take away the profitable portion of Surrey, the provision of a cheaper supply of electricity would improve the ratable value of that portion, and the County would gain. The engineers in the original scheme proposed to erect capital stations at once, but when the supplementary particulars were drawn up it was found that the capital charges would be 40 per cent. of the cost of supply. Was it a fair criticism to say the L.C.C. had been timid and without vision in putting forward the revised scheme? The technical scheme did propose to supply the railway load, but the tables which dealt with the matter, excluding railways, were prepared because they understood that the railway companies were not disposed to take a supply from an outside authority. Since that time Mr. Tylor had informed them that the railways were not averse to taking a supply from outside, but they were not in the market at the moment. If the financial conditions were much improved at the time the Joint Authority was formed the Authority would be free to go ahead with a capital station, which it could do more cheaply than a company. It would be a mistake to allow companies to go on building capital stations which the Joint Authority would want. It was unfair for the County Company to put forward estimates showing great saving in capital and operating costs and not table their figures, as the promoters had done, to show how such estimates were arrived at. With regard to Poplar's claim, it would be open to the Commissioners at any time to appoint district committees, but he asked them not to tie themselves down at present by making that procedure a part of the constitution of the Joint Authority. He did not agree with the Conference resolution that there need be no connection between the acquisition of the companies' stations and the extension of the term of their distribution. If it were a question of the L.C.C. making a contribution to the Joint Authority's administration expenses that was not a matter they would stick at.

Sir JOHN SNELL expressed the Commissioners' appreciation of the help given them by the Counsel and witnesses, and he also expressed their indebtedness to the Institution of Electrical Engineers for granting them the use of their Hall without any charge to the Commissioners. The Institution had taken a very broad view of their responsibilities to the industry.

Poster Illumination.

The fact that an ordinary unlighted poster ceases to have any publicity value after night-fall should be a matter of concern to the advertiser or hoarding proprietor. In many districts the streets are almost empty in the daytime, while at night they are full of people, who cannot see the poster. There is, however, no need for this unhappy state of affairs, for with properly arranged appliances it is easily possible to light any hoarding so as to make it even more conspicuous by night than by day. For example, the poster shown in the accompanying illustration stands out in brilliant detachment from the surrounding gloom. It is not necessary to interfere with the posters; they can be illuminated to far better advantage by means of units placed at a distance than by troughs or other reflectors fixed to the hoarding. The poster shown was lighted by B.T.H. floodlight projectors from the other side of the road. Those who visited the Efficiency Exhibition at the Olympia some time ago may remember the poster, which was affixed to the hoarding opposite the main entrance. Five projectors, each equipped with a 1,000-W Mazda gasfilled lamp, were arranged in a single row on the roof of a shed in the Olympia grounds. The projectors were mounted on universal brackets and spaced at regular intervals, in order to produce an absolutely uniform illumination over the poster, which measured 55 ft. by 15 ft. Although the light was projected across the road, there was a total absence of glare. Owing to the hoarding being a few feet back from the road, while the projectors were mounted about 12 ft. above the pavement, the angle of the beams was such that no direct light rays impinged upon persons or vehicles in the roadway.



A considerably higher intensity of illumination was employed in lighting this poster than would be necessary in most cases, and no doubt the lighting would have been quite effective if lamps of half the size had been used. B.T.H. projectors consist essentially of a sheet steel cylindrical casing equipped with a powerful mirror reflector, and is designed for use with the gasfilled electric lamp. The lamp-holder can be moved in three directions, so that it is easy to adjust the focus and change the shape of the beam. For use on the ground a tripod mounting is supplied, but when it is desired to fix the projector to some portion of a building the universal bracket, faintly discernible in the illustration, should be employed. Both forms of mounting are adjustable in both horizontal or vertical directions. It is not always practicable to place the projectors exactly opposite the object to be illuminated, but equally good results may be achieved by fixing the projectors on an adjacent building or above or below the lighted surface.

Legal Intelligence.

An Electric Motor Contract.

On Saturday Mr. Justice Salter delivered judgment in the action brought by Mr. E. C. Brooks-Vos, of Birmingham, against Messrs. Charles Purden, Ltd., for the price of certain electric motors sold and delivered to defendants. The case was partly heard at Birmingham Assizes in March. It was stated that defendants had refused to complete the contract or take further instalments of the motors, on the ground that they were not of the horse-power specified in the contract. His lordship referred the matter to an engineer, who had reported in plaintiff's favour.

Accordingly his Lordship held that the goods had been wrongly returned by defendants, and he entered judgment for the plaintiff for the price of the instalment delivered (£573); but on the issue as to damages, he found no damage had been suffered by the refusal of defendants to take the balance of the contract quantity, and defendants would have the costs of that issue. The counterclaim was also dismissed.

Parliamentary Intelligence

EQUIPMENT OF WIRELESS STATIONS.

In reply to questions, the Assistant Postmaster General (Mr. Pike) stated in the House of Commons last week that the technical advisers of the Post office were satisfied that the type of aerial equipment at the Beachill wireless station was suitable for the purpose for which it was intended. The transmitting apparatus at the station consisted of two 200-kW. air installations, and was similar to the arc equipment installed at the French station at Lyons. The Post Office intended to continue the erection of a wireless station at Northholt, which was planned within the last 12 months, and he was advised that the wireless equipment embodied all the latest improvements. The station would be operated on the continuous wave system.

COUNTY OF LONDON BILL.

A Select Committee of the House of Commons, presided over by Sir W. Howell Davies, commenced the consideration of the Bill promoted by the County of London Electric Supply Company on the 27th ult.

Mr. EVAN CHARTERIS, K.C., for the promoters, outlined the main features of the Bill, and said the Company wanted to erect a generating station on a site at Barking, the initial capacity of which would be 120,000 kW and eventually 200,000 kW. For convenience it was proposed to make the new works a separate undertaking. There was a purchase clause providing for the transfer of the undertaking to any joint authority that might be constituted by the Electricity Commissioners under the Act of 1919. If the desired powers were granted the Company would not take a single step towards utilising them until they had gone to the Electricity Commissioners.

Giving evidence in favour of the Bill, the chairman of the Company (Sir HARRY RENWICK) said they had been trying to build the station for seven years, and it was urgently necessary. The Company's stations at City-road and Wandsworth had a capacity of 10,000 and 20,000 kW respectively, but they were in congested areas and could not be extended. It would be impossible to raise capital at present under the existing Acts, and they would therefore have to issue debentures with a first charge on the new work and pay interest on capital during construction.

In cross-examination witness said that when the Barking scheme was carried out it would be connected up by means of transmission cables with their London stations. The L.C.C. could purchase the company's undertakings in London in 1931, but the Council could not purchase the new station; there was no power taken to give a bulk supply from Barking to the London stations after 1931, and in those circumstances they would have to be disconnected. It was his contention that special compensation for severance would have to be paid; it was on that that he would raise his money.

In reply to the CHAIRMAN, Sir Harry Renwick said that assuming they got their Bill, and assuming that the Electricity Commissioners gave their consent, the Company were prepared to go ahead at once and erect the station. Funds were available, and it was a case of absolute necessity.

Mr. C. H. MERZ also stated, in answer to the Chairman, that he knew of no better site than the Barking one for the supply of London. The Company would be able to erect the station more cheaply than a public authority. If they had the powers and erected the station, and then were bought out by a new electricity authority, the latter would not be prejudiced by the Company having done the work.

Mr. CLODE, K.C., addressed the Committee in support of the case of the L.C.C., and said by making that a separate undertaking the Council were prejudiced and the powers of purchasing the existing undertakings rendered useless.

The CHAIRMAN said the Committee thought the L.C.C. were entitled to some protection in 1931. The Committee would like to know if the Company would agree to an amendment that they would supply the Council in 1931, assuming that the Council purchased and there was no Joint Authority established, such power and energy as they required on arbitration terms.

Mr. CHARTERIS said they would be very glad to do so. He also agreed that a period of five years from the passing of the Act should be fixed as the date for the transfer of the new station to the Joint Authority if formed.

Subject to these amendments the preamble was found proved.

Electricity Supply.

LOWESTOFT Corporation has been authorised to borrow money for the purchase of the undertaking of the Oulton Broad Electricity Company. BANGOR has applied for a loan of £4,630 for a 100-kW Diesel set at the electricity works.

KNARESBOROUGH Urban Council has authorised Harrogate Corporation to supply electricity in the parish of Parnall.

MANCHESTER Corporation has entered into an agreement with the Urban Council of Sale for giving a supply of electricity in bulk in the latter district.

A Special Order is to be applied for by the LIVERPOOL Electricity Committee to enable a bulk supply to be given to the Liverpool District Lighting Company.

A site for a sub-station at GIFFNOCK has been purchased by the Cydne Valley Electric Power Company, which is making arrangements for giving a supply of electricity in the district.

LEEK Urban Council has adopted a report of the electrical engineer recommending extensions of the generating plant. Application is to be made to the Electricity Commissioners for sanction to a loan of £18,500.

The Electricity Commissioners have extended the time for submitting schemes, &c., for the reorganisation of electricity supply in the EAST MIDLANDS and the MID-LANCAIRE ELECTRICITY DISTRICTS until October 31 next.

CHIPPING NORTON Lighting and Watch Committee will oppose the Chipping Norton Electric Supply Company's application for sanction to increase the maximum prices for electricity, as it is considered that the present time is one for decreases rather than increases in prices.

The WOLVERHAMPTON Corporation electricity undertaking shows a net profit of £27,064 for the past year, and it is proposed to place £5,000 to the relief of the rates, placing £22,064 to reserve. Further extensions of plant, at an estimated cost of £136,000, are recommended.

The NORTHAMPTON Electric Light & Power Company are in position to announce a reduction in the price of electric current for power by $\frac{1}{2}$ per unit, and the additional discount to high-pressure consumers for equipping their own transformer chamber will be increased by 5 per cent.

EDINBURGH Electricity Committee has decided to increase the charges for electric current as follows: Lighting, from 4d. to 5d., and power from 1d. to 2d. per unit. There was a deficit of £12,000 on the year's working of the Edinburgh and Leith undertakings, but the deficit will be met out of reserve and the increased prices will, it is estimated, make good the loss next year.

In connection with the development of the North bank of the Tees in the neighbourhood of Middlesbrough and Stockton, the CLEVELAND & DURHAM ELECTRIC POWER COMPANY propose to ensure an adequate supply of power by the erection of new generating plant on a site of about 60 acres. The station is designed for 54,000 H.P., but provision has been made for extensions when required.

Last week representatives of the Court of the Honourable Irish Society (London) visited COLERAINE and discussed with members of the Urban Council the water power rights of the Cutts on the Bann river. Mr. Christie, chairman of the Council, put the Council's case for using the water power for generating electric current, and the Deputy Governor of the Society promised to put the views of the Council before the Court.

Sanction has been received by COLWYN BAY Urban Council to the borrowing of £20,000 for the erection of an overhead transmission line from the hydro-electric works at Dolgarrog to Colwyn Bay, repayable in 25 years. The sum will be lent by the Council to the North Wales Power and Traction Company, which will erect the line, and will repay the capital, together with interest, in instalments during the period of the loan.

The Electricity Commissioners have intimated to the CHESTER Electricity Committee that it is better for the provisional committee for the NORTH WALES and CHESTER ELECTRICITY DISTRICT to be constituted locally, and they suggest that the Town Clerk and the Managing Director of the North Wales Power & Traction Company should issue a joint letter to the parties concerned and thus bring about the formation of a Committee.

The accounts of BRADFORD electricity department for the year ended March 31 show income £433,692 (increase £106,458), working expenses £331,972, capital charges £93,117, gross profit £103,720, and net profit £10,603. Units sold were 55,700,000 (increase 6,400,000). The average income was equal to 1.877d. per unit, compared with 1.603d. in previous year. The total costs, including capital charges (£425,089) were £92,437 in excess of last year's figure.

An electric supply scheme for TISBURY, submitted by Edmundson's Electricity Corporation, and estimated to cost £5,000, has been approved by the Council. A local committee has been formed for the purpose of promoting a limited company to carry out the scheme, and Messrs. Edmundson offered to take up half of the ordinary shares (£2,500). The Rural Council will not oppose the proposal of the Salisbury Electric Light and Supply Company to erect overhead wires in the district.

The accounts of LEYTON ELECTRICITY DEPARTMENT for the year ended March 31, 1920, show revenue £72,296, compared with £43,907 in the previous year, and the net result, after providing for working expenses and capital charges, was a deficit of £4,818 (compared with £13,064). Units generated were 6,445,553 (5,301,651) and sold 5,683,978 (4,570,628). Works cost per unit sold was 3.470d. (1.960d.) and total costs, including capital charges, were 3.25d. (2.934d.).

The British Vice-Consul at Viborg (Mr. R. C. King) announces that the Finnish Ministers of the Interior, Industry and Transport decided in M. 1920 to commence the work of developing the SEIKSJOEFVÄN FALLS known as the IMATRA group of rapids. It is calculated that, if fully developed, at least 150,000 H.P. of electrical energy will be available. It has been decided to expropriate the land that will have to be flooded and to begin work about 1922. In the meantime, 20,000,000 Finnish marks have been appropriated in the Budget for 1921, and this sum is being expended in connection with preliminary work. The total cost of the project, including land to be purchased, will amount to 267,000,000 Finnish marks. The rapids of Ritikka, Mansikka, Ranankoski, Linankoski, as well as the big Imatra falls, are included in the scheme. These rapids are distributed over a distance of 44 km., and have a fall of 24 metres. The Imatra provides a fall of slightly over 18 metres. Linankoski has a fall of about 5 metres, and 1 metre will be obtained from the other three falls.

The accounts of WALSALL ELECTRIC SUPPLY DEPT. for the year ended March 31 show income £96 062, compared with £78 251 in previous year, and working expenses £74 378 (£47 860). Interest required £11 718 (£10 567) and redemption of debt £8 351 (£7 593), and net profit was £1 614 (£10 524). Total cost per unit sold, including capital charges, was 2.70d. (2.19d.). Maximum load was 3 600 kW (3 150 kW). Units generated were 11 008 050 (9 884 420) and sold 8 397 868 (7 419 265).

The accounts of GLASGOW electricity department for the year ended May 31 show revenue £1 311 951, an increase of £334 465, and working expenses £902 424 (increase £188 974). Interest, sinking fund and depreciation amounted to £406 798 (increase £88 147), and the net surplus was £2 729 (compared with a deficit of £54 614). This result has been achieved in spite of the breakdown of the new generators at Dalmarrook at the time of the highest winter load, and of thereduction of demand for current due to the coal strike. The committee, hoping for an improvement in the state of trade, recommend that no increase be made in the charges for current.

In giving formal consent to the extension of the MIDDLESBROUGH generating station the Electricity Commissioners stated that they were of opinion that the Corporation should negotiate with the Cleveland and Durham County Electric Power Company with a view to arrangements being made by which the company would supply the whole of the electrical energy required by the Corporation. Such an arrangement would enable the Corporation to dispose of their steam plant, retaining only the gas engines as a standby. The Commissioners also thought it would be a mistake on the part of the Corporation to install further plant in the station, and, as the demand for electricity in the borough is increasing each year, the Corporation will sooner or later require to arrange with the Power Company for additional supplies of energy.

The Borough electrical engineer (Mr. R. H. Scotson), in commenting on this communication, stated that it would not be in the interest of the department to dispose of the plant. They had installed 1 500 kW of steam plant to meet the winter peak load, and to replace this by rotary converters would require at least three 700 kW sets. These would cost, with switchgear, transformers and cables, &c., approximately £8 000 each, or a total of £24 000. Although the Corporation plant was out of date, there was no other method by which the winter peak could be so economically met. With regard to the second portion of the letter, the Corporation already had an agreement with the Power Company, which is capable of being extended to meet the Corporation's needs for approximately six years, and it would be more advantageous to wait until the selling price of electrical energy became stable before approaching the company for a further supply.

The Corporation has approved Mr. Scotson's views, and the Commissioners have been informed that it is considered inadvisable to dispose of the steam plant at present.

Electric Traction.

The extension of the L.C.C. TRAMWAYS along Wandsworth High-street and East Hill was opened for traffic yesterday.

The Minister of Transport has confirmed the DEARNE DISTRICT LIGHT RAILWAYS (AMENDMENT) ORDER, 1921, authorising the construction of light railways in Wath-upon-Deane and Bolton-upon-Deane.

The Minister of Transport has extended for one year, from July 24th, 1921, the period limited by the BRISTOL TRAMWAYS ACT, 1915, for the compulsory purchase of lands and the completion of tramways.

The Minister of Transport has also extended for one year from July 29th, 1921, the time limited by the DEWSEBURY CORPORATION ACT, 1915, for the completion of the tramway authorised by that Act.

The Light Railway Commissioners have granted the application of NEWCASTLE-ON-TYNE Corporation for the construction of a light (electric) railway through High Gosforth Park. The estimated cost of construction has, however, been reduced from £60 000 to £50 000.

The general manager of the LIVERPOOL Corporation tramways (Mr. P. Priestley) has been instructed to obtain information about new types of and designs for tramcars and to submit it to the Rolling Stock Committee.

The experiment with penny fares on the BRIGHTON Corporation tramways has not proved as successful as was anticipated, and the Council has decided to revert to twopenny as the minimum. In his report the manager (Mr. W. Marsh) expressed the opinion that traffic had not improved under the penny fares, and that they could not be made to pay under existing conditions.

A SERIOUS TRAMCAR ACCIDENT occurred at NORTH SHIELDS on Sunday night last, resulting in the death of five persons and in injuries to 30 others. The car was laden with holiday passengers from Whitley Bay, and was on a journey to the ferry running to South Shields, when it got out of control on a steep gradient known as Borough Bank. The emergency brakes failed to act, and the car was overturned at a curve at the foot of the hill. A public inquiry was held yesterday.

The accounts of the WOLVERHAMPTON tramways department for the year ended March 31 show revenue from tramways £126 294, and working expenses £107 458, and net profit, after providing for interest, repayment of capital and income tax, was £2 934. Motor omnibus revenue was £25 528, working expenses £22 380, and after providing for interest and income tax the net balance was £347. On the tramcars 19 370 676 passengers were carried and on the omnibuses 2 572 032. Revenue per car mile on the tramcars was 23.881d., and on the buses 22.187d., and working expenses, including power, were 23.881d. and 21.835d. respectively.

Institution Notes.

Mr. J. Orringe, of Messrs. Gent & Hawley (Leicester), has been elected President of the ELECTRICAL CONTRACTORS' ASSOCIATION (INC.) for the ensuing year.

In the recent examinations of the INSTITUTE OF CHEMISTRY 16 candidates were successful, and have been duly elected Associates of the Institute, viz. eight in general chemistry, one in metallurgical chemistry, two in organic chemistry, three in the chemistry of foods and drugs, &c., one in chemical technology, and one in coke oven practice, &c.

The Council of the INSTITUTION OF ELECTRICAL ENGINEERS have decided that, beginning with next Session, the meetings will be held on alternate Thursdays (except at times of public holiday), beginning with the first Thursday in November.

The Council have at present under consideration the question whether the meetings should continue to begin at 6 p.m., as has been the case during the last few years, or whether the former hour of 8 p.m. should be reverted to.

THE BRITISH CAST IRON ASSOCIATION has been formed for the purpose of promoting and co-ordinating research work among firms engaged in the industries connected with the production and utilisation of cast iron in Great Britain. The association will be controlled by the industry, subject to the duties imposed upon it by the conditions of the Government grant, which for the first five years will be on the pound to pound basis conditionally up to £5 000 per annum. The registered office is at Central House, New-street, Birmingham, and the secretary is Mr. Thos. Vickers.

On the 22nd ult., under the auspices of the Southern Division of the ELECTRICAL POWER ENGINEERS' ASSOCIATION, an interesting lecture on "Boiler Design, Latest Developments," was given by Mr. J. Cauchery, at the Central Hall, Westminster. Mr. J. H. Parker, A.M.I.E.E., presided, and, in introducing the lecturer, said the E.P.E.A. had as its principal object the advancement of the interests of the electricity supply industry. One phase of this object was to enable members to secure information that was needed, and thus advance the interests of the industry in which they got their living.

Mr. CAUCHERY dealt with the various types of boilers, with special reference to the Sparring boiler, which, in his opinion, was the final word in the development of water-tube boilers. He described the Sparring boiler in detail, and diagrams illustrating the various points were projected on the screen. At the conclusion of the lecture an animated discussion ensued.

Business Items, &c.

The new telephone number of Messrs. JONES & PORDS, battery manufacturers, 8, Crawford-passage, E.C. 1, is Holborn 4774.

THE RAPID ACCUMULATOR COMPANY, LTD., Mount-road, Hayes, have been appointed sole selling agents for J. B. Bamps for the County of Middlesex.

Walter Hy. Taber and Wm. Osmond Fryer, trading as TABER & FRYER, incandescent lamp and hardware merchants, 41, Merion-street, Leeds, have dissolved partnership. Debts by Mr. Taber, who continues the business.

The partnership between Lawrence Massimo, Stanley C. Crocker and Ernest Wm. Bartlett, trading as the HEATH ELECTRICAL & MECHANICAL ENGINEERING COMPANY, 1, Pembroke-terrace, Cardiff, has been dissolved. Debts by Mr. Crocker and Mr. Bartlett, who continue the business under the old name and at the same address.

THE BENJAMIN ELECTRIC, LTD., notify that as from the 1st inst. the 15 per cent. advance to their lighting fittings and specialties (Sections I., II., III., IV. and VII., of Catalogue No. 6) has been withdrawn. No advance applies to section five (industrial signals), but the trade discount will be increased to 3½ per cent., and a discount of 25 per cent. applies to section six. All the lines in "Productive Illumination for Factories" will not carry any advance and will be subject to a trade discount of 3½ per cent.

The result of the competition organised by the SIMPLEX CONDUITS, LTD., Garrison-lane, Birmingham, in connection with the new SIMPLEX "X" CONTINUITY SYSTEM OF CONDUIT WIRING is announced. The conditions of the competition were given in the last number of "Installation News" and it was arranged in order to obtain suggestions for the new system, which, it is claimed, provides a cheaper means of effecting ample and permanent electrical conductivity in ordinary close-joint conduit than is possible with any other system on the market without any appreciable difference in cost. The originator of the word "Terra-Grip" was an easy winner, although well over 300 entries were made, most of which were very creditable attempts. It is considered that this word describes the system well, especially as marked attention is being called to the exceptional facilities offered for the earthing of the installation; further by sound (only) the word hints at something of the nature of "super-grip" or another meaning which is considered to be justified in practice. Mr. B. W. Southgate, 26, Old Heath-road, Colchester, has duly acknowledged receipt of the £5 5s. for his word. The new Simplex "Terra-Grip" continuity system has hardly been put on the market as yet, but its reputation is expected to range with other of the Simplex systems and be on the way to establishment in the course of the next two to three weeks, when literature dealing with its many quality features will be available.

Imperial and Foreign Notes.

THE EAST LONDON (South Africa) Municipality has recently decided to increase the efficiency of its fire brigade, and an order for two large motor fire engines has been let to Messrs. John Birch & Company, of London Fire-buildings, London, E.C.2.

In the latest report of the general manager of the Standard Bank of South Africa on TRADE CONDITIONS IN THE UNION it is stated that supplies of electrical goods, agricultural machinery and hardware are arriving from the Continent at prices below those quoted by British firms.

In consequence of the great success of ELECTRIC TRACTION on the MELBOURNE SUBURBAN RAILWAYS, the Victorian Railways Commissioners have decided to convert about 100 more miles of passenger line from steam to electric working, and the work is to be completed by February, 1923. In addition, a number of lines exclusively used for goods traffic are to be converted, while the electric system will also be adopted on several of the busier sections of the country lines. As customary in the case of Government work, Australian materials are to be used to the fullest extent. Much of the plant and material will, however, have to be obtained from this country or America.

It is announced that President Harding has approved the laying of a TRANS-PACIFIC SUBMARINE CABLE by the U.S.A. Government, should private enterprise be unwilling to undertake the task.

A new foundry is being built by large metal works in MILWAUKEE in which every operation will be performed electrically. The equipment has been designed for the intensive production of a new bronze.

The Italian Government has renamed the COLTANO (ITALY) HIGH-POWER WIRELESS STATION "Guglielmo Marconi" as a tangible and lasting proof of the country's gratitude for his meritorious discoveries in the field of radio-telegraphy.

Reports from BRAZIL indicate that the agents of German electrical firms are showing great activity. The prices quoted by them are in some cases 40 per cent. below those of competitors, and more liberal credit terms are also being offered.

Work was recently commenced on the electrification of the northern lines of the BERLIN METROPOLITAN RAILWAYS, and it is hoped that the first section (from the Stettiner terminus to Bernau) will be ready for opening in the Spring of 1923. The whole scheme will take nearly 10 years to complete, and energy will be supplied from the Berlin electricity works and from the Golpa station, near Halle, which is about 150 miles away.

THE CHINESE Minister of Communications has authorised the registration of the Ju An Electric Company and the formation of an electric company at Kao Yu by Mr. Liu Chien San. The Ministry of Communications and the Ministry of Agriculture and Commerce have also sanctioned the registration of the Haiming Electric Company and the Ta Tung Electric Light Company, Shansi, organised by Sung Fa-hsiang. TWO LONG-DISTANCE TELEPHONE LINES, one from Tientsin to Sinlungshan and the other from Paojing to Chochow, have been completed.

Notwithstanding steady progress with the electrification of the SWISS FEDERAL RAILWAYS, the financial position remains unsatisfactory, and the working expenses again exceed the traffic receipts. Between November, 1920, and January, 1921, the goods traffic fell off by nearly 20 per cent., and receipts decreased correspondingly, one reason being that, owing to the high value of the Swiss franc and the low value of the German mark, Austrian krone, French franc and Italian lira, Germany, Austria, France and Italy avoid carrying goods through Switzerland, preferring to take a longer route, and thus avoid payment of the railway charges in Swiss francs.

A recent ROYAL SWEDISH DECREE has been issued on the use of WIRELESS TELEGRAPH and TELEPHONE apparatus by foreign vessels. It lays down that wireless apparatus on foreign vessels may only be used in Swedish harbour areas by permission of the Telegraph Administration; and in Swedish territorial waters, within a radius of 10 nautical miles of a Swedish coastal wireless station, wireless apparatus on a foreign vessel may not be used except in cases of distress, or for communicating with the nearest coastal station. Penalties are laid down for the infringement of the Decree, and when wireless apparatus on foreign vessels is used in Swedish waters, except when otherwise prescribed, the provisions of the existing International Radio-Telegraph Convention must be observed.

Bankruptcies, Liquidations, &c.

Claims against the ARMORDUCT BRITISH COMPANY, LTD. (in vol. liq.), are to be sent to Mr. H. A. Pepper, 14, Temple-street, Birmingham, by Aug. 31.

In connection with the voluntary liquidation of the ALADDIN RENEW ELECTRIC LAMP CORP., LTD., for the purpose of reconstruction, a meeting of creditors will be held at 82, Victoria-street, Westminster, S.W.1, on Aug. 10.

A meeting of creditors of the WHOLESALE ELECTRICAL COMPANY, LTD. (in voluntary liquidation), will be held at the Institute of Chartered Accountants, 66, Swan-alley, Moorgate-street, London, E.C. Claims are to be sent by Sept. 30 to Mr. E. H. Hawkins, 4, Charterhouse-square, E.C.1.

Miscellaneous.

On the 28th ult. the ROYAL ASSENT was read to the Lochaber Water Power Act, Nelson Corporation and the Colne Corporation Acts.

MARCONI'S WIRELESS TELEGRAPH COMPANY announce that ordinary and deferred messages are now accepted for transmission via their transatlantic wireless system to Brazil.

The Peckham Truck and Engineering Company, Ltd., has applied for the RESTORATION OF PATENT No. 18215/1915, for "Improvements in or relating to trucks for railway or tramway vehicles," which expired on Dec. 31, 1920.

An order was made on July 22 RESTORING LETTERS P. TENT No. 19102/1910 granted to Jules Carpentier for "Improved transmitter for transmitting telegrams composed in perforations on a band by the Baudot system."

We regret to announce the death of Mr. JOSEPH WILKINSON, electrical and mechanical engineer, of Hull, formerly chief engineer of the Hull Corporation tramways department.

Those willing to help in the organisation of the St. Dunstan's NATIONAL WHIST DRIVE CHAMPIONSHIP, which is to be held in the autumn, are asked to communicate with the Organiser, at 306, Regent-street, London, W.1.

On Sunday evening a FIRE occurred at the Loughborough works of the BRUSH ELECTRICAL ENGINEERING COMPANY. A timber shed 100 yards in length was destroyed, and the damage is said to amount to some thousands of pounds. We understand that work on contracts will not be affected.

A machinist, named Brelsford, was killed at the STAVELEY IRONWORKS on the 25th inst. by coming into contact with an overhead electric cable carrying electric current at 6600 V. Owing to a defect in a porcelain insulator the overhead wire had sagged to within 2 ft. 6 in. of the ground, and deceased by touching the cable when passing received a FATAL ELECTRIC SHOCK. A verdict of accidental death was returned and in the course of the proceedings it was suggested that h.t. cables in works should be placed underground.

We are informed that B.T.H. MAGNETOS were fitted to the "Bamel" machine—Mar. 1,—piloted by Mr. J. H. James, the S.E.5a machine flown by Fl.-Lt. W. H. Longton, and Mr. A. S. Butler's Bristol "Tourer," which secured, respectively, first, second and third places in the AERIAL DERBY on the 16th inst. Mr. James and Mr. Butler also gaining first and second handicap prizes respectively. The machines gaining first and second places in 1919 and 1920 were also equipped with B.T.H. magnetos.

We regret that in our report of Mr. S. UTTING's remarks at the recent I.M.E.A. Convention we conveyed a wrong impression by stating that if an engineer decided he was going to get results at a reasonable cost per kilowatt, air heating had no chance. Mr. Utting's point was that the figures given by Mr. Wilson for the thermal efficiency of a complete boiler unit were insufficient and that for a given expenditure the flue gases leaving the boiler could be cooled to a very much lower temperature by means of air heaters than by using economisers. This is an advantage if the heat so abstracted can be utilised. If hot feed is available from other sources the reduced size of economiser possible would mean an increased exit temperature which could be dealt with by air heaters, so giving a combination which would result in a lower capital cost for a given duty.

The June issue of the "HENLEY TELEGRAPH," the house organ of W. T. Henley's Telegraph Works Company, maintains its reputation as a well-written journal and although, naturally, it contains a certain amount of domestic news, it is interspersed with some quite creditable literary efforts in prose and verse. We hope, however, that "A.M." will not persevere in his threat to go on strike, for though the compilers of the Board of Trade Food Price figures may be writers of fiction their literary merit is much below that of "A.M." and they would prove poor substitutes for him. We are glad to see from the list of recent Henley contracts that the company is receiving a very substantial share of the good things that are going, both at home and abroad, and we wish them increased success in their efforts to develop the export side of their business.

Personal and Appointments.

PROF. WALTER NERNST has been elected Rector of the Berlin University.

The Nobel Prize for Physics was recently awarded to Dr. J. A. BRAHL for his wireless telegraph inventions.

The John Fritz Medal for 1922 has been awarded to M. EUGENE SCHNEIDER, head of the well-known firm of Schneider & Company. M. Schneider is a past-president of the Iron and Steel Institute.

MR. DAVID DAVIES, upon whom the University of Wales conferred the honorary M.Sc. degree on the 20th ult., is agent for the Cambrian Combine Collieries at Giffach Goch, Glam. He began life as a door-boy in the pit at the age of twelve, assiduous evening study won him certificates in electricity, mining, geology, machine drawing and mathematics, and when twenty-one he obtained a first class diploma in electrical engineering.

Among the recipients of CIVIL LIST PENSIONS granted during the year ended March 31 last are the following: Mrs. J. A. McClelland, £100 in recognition of her husband's distinguished services as an investigator in physical science. W. R. Hodgkinson, £100, in recognition of his valuable scientific work in the public service; and Herbert Tomlinson, £100, in recognition of his services as a teacher and of his valuable contributions to physical science.

Catalogues, Price Lists, &c.

The Z Electric Lamp & Supplies Company, 73, Newman-street, W.1, are circulating a new SHOWCARD of the "ELECTROLUX" CLEANER. It can be supplied to the trade eyeleted or struted for standing on the counter.

A pamphlet on the STANTON-HUME REINFORCED CONCRETE PIPES has been issued by the Stanton Ironworks Company, which is manufacturing the pipes in this country under licence. Full information is given regarding the centrifugal process of manufacture, together with weights and methods of jointing the pipes.

In Messrs. McCURE & WHEATFIELD's revised price list particulars and prices are given of the "Mersey" line of motors, dynamos, motor generators and direct-coupled steam and oil engine sets. An interesting addition to the new edition is the drip-proof type of electric motor which is claimed to be filling a long-felt want.

Messrs. GEORGE ELLISON, Perry Barr, Birmingham, have recently issued two new lists of some of their manufactures. List No. 17 relates to totally enclosed, air break, "mill" type of circuit-breakers and No. 19 deals with trailing cable sockets and plugs for air-break gate end boxes. Both are well illustrated and contain full technical data, prices, dimensions and shipping particulars.

The recent trade literature of Messrs. ALFRED HERBERT, LTD., of Coventry, include three catalogue sheets relating to (1) "Coventry" self-opening diecasts, (2) the "Wickman" patent adjustable plain snap gauge and (3) the Coventry Gauge Company's hardened plug and ring screw gauges. The distinctive features, dimensions, prices and other particulars are clearly and succinctly stated.

Last month the GENERAL ELECTRIC COMPANY, LTD., Magnet House, Kingsway, W.C.2, reduced the prices of their "Magnet" electric heating and cooking appliances by 15 per cent., and a leaflet giving the revised prices has been issued by the Company. A useful item in the equipment of motorists is a spare lamp case, and the General Electric Company have prepared a leaflet giving prices and particulars of the special motorists' spare lamp cases, which they supply (in two sizes) to contain six Osram lamps.

A neat booklet, entitled "HOW TO GET TO MAGNET HOUSE," the palatial new home of the General Electric Company, in Kingsway, has been issued by the company, and shows the railway and omnibus routes, with the nearest stations and stopping places, &c. The offices have been specially designed to meet the needs of each department, and, as might be expected, the equipment is very complete. The stock-rooms contain 12 000 bins, there are 130 double iron fireproof doors, seven passenger and eight goods lifts, and there are 3 222 lighting points in the building.

The RHODES FITTINGS COMPANY, LTD., manufacturers of electric-light fittings, &c., 224, Upper Thames-street, E.C.4, have issued a pamphlet describing their "ADJUSTALITE" PENDANTS which they have placed upon the market. These pendants, which are supplied in various sizes and in a wide range of designs, present some novel features, and they should readily appeal to wiring contractors, &c. The "Adjustalite" pendant does all that is necessary for an adjustable pendant to do and dispenses with unsightly flexible cords, counterweights and pulley wheels.

Electric vehicles are now used extensively for urban transport purposes for refuse collection and many other services, and consequently those in charge of these vehicles must, from time to time, feel the need of a handy work dealing with the upkeep and maintenance of accumulators. For EDISON ACCUMULATORS an excellent guide of 43 pages has recently been provided by the EDISON ACCUMULATORS, LTD., 15, Upper George-street, W.1, which gives to Edison vehicle users all the information they are likely to want in a handy, tabloid form. The particulars given include operating data, instructions about filling, charging, cleaning, renewals, inspection, &c., and important points are printed in black type. The company will be pleased to supply a copy of the booklet to anyone using or interested in the subject of commercial electric vehicles or factory trucks.

Obituary.

We regret to record the death of Mr. FREDERICK GUSTAV BYNG, which took place on the 25th ult. Deceased, who was only 25 years of age, was a son of the late Mr. Gustav Byngswanger Byng, one of the founders of the General Electric Company. It will be remembered that the brother of deceased, Lieut. G. Byng, of the Grenadier Guards, died of wounds in August, 1918, while another brother, Lieut. Henry Byng, fell in battle at Festubert on May 16, 1915.

We regret to record the death of M. JULES CARPENTIER, which occurred recently as a result of a motor-car accident. M. Carpentier, who was one of the founders of our contemporary, "L'Industrie Electrique," was born in Paris in 1851, and after a course of study at the Ecole Polytechnique, entered the service of the P.L.M. Railway. The death of Ruhmkorff, however, turned his activities in another direction, that of devising new arrangements for rapidly and accurately measuring electrical quantities. He set about reorganising the Ruhmkorff workshops, and soon there emerged therefrom a collection of industrial instruments for the measurement of electric currents. He was, in fact, the inspiration of much of the work associated with the name of D'Arsonval, Marcel Duprez and Baudet. M. Carpentier was elected a member of the Académie des Sciences in 1907, and in the same year was appointed a Commander of the Légion d'Honneur.

Tenders Invited and Accepted.

Tenders are invited by DURBAN CORPORATION for supply of two 500-kW rotary converters, switchgear, &c. Tenders to Town Clerk's Office, Durban, by Sept. 8. Specifications at the Department of Overseas Trade.

LONDON County Council invite tenders for the supply and erection of h.t. and l.t. switchgear for sub-stations. Specifications from the Clerk of the Council, Spring-gardens, S.W.1, to whom tenders by Sept. 5.

Tenders are invited by Oct. 5 for the supply of bronze wire (schedule 536) to the Postmaster-General's Dept., State of QUEENSLAND. Specifications, &c., from the office of the High Commissioner for Australia, Room E 5, Australia House, Strand, W.C.2.

Tenders are invited by Aug. 15 for the supply and delivery to the Postmaster-General's Department, State of TASMANIA, of switchboard material. Tender forms, &c., from the High Commissioner for Australia, Room E 5, Australia House, Strand, London, W.C.2.

THE VICTORIAN GOVERNMENT RAILWAYS invite tenders (by Sept 28) for the supply and delivery of a lifting-magnet and generating set, with control apparatus and accessories (Contract No. 34241). Specifications at the Department of Overseas Trade, 35, Old Queen-street, S.W.1.

BRISTOL Electrical Committee invite tenders for the supply of a 3 000. kW single-phase and a 6 000-kW 3-phase turbo-alternators, with condensing plant and auxiliaries. Specifications and forms of tender from the chief engineer and general manager (Mr. H. Faraday Proctor, M.I.C.E., M.I.E.E.) to whom tenders are to be sent by noon, August 15.

BELFAST Corporation invites tenders for the manufacture and erection of one 12 500-kW turbo-alternator with condensing plant, accessories four water-tube boilers, with super-heaters and forced-draught fans four fuel-economisers, two steel chimneys, with four electrically-driven suction draught fans and one electrically-driven centrifugal pump. Specifications from Messrs. Preece, Cardew & Rider, 8, Queen Anne-gate, Westminster, S.W.1, or the city electrical engineer, Mr. T. W. Bloxam. Tenders to the Town Clerk, City Hall, Belfast, by Aug. 22.

The Commercial Secretary to H.M. Legation at MONTEVIDEO (Capt. E. C. Buxton) reports that the local authorities advertise for tenders (by Sept. 3) for the supply of 59 250 metallic filament lamps (from 10 to 300 c.p. for 225 V circuits) which are required by the State Power-House. Local representation is essential.

THE RAND WATER BOARD invites tenders (by September 28) for supply and erection at the intake pumping station, Vereeniging, of two centrifugal pumps, direct-coupled to electric motors, one 10-ton travelling crane, and the supply and erection at the main pumping station site of two centrifugal pumps coupled to electric motors. Specifications of the Department of Overseas Trade, 35, Old Queen-street, S.W.1.

COVENTRY Corporation invite tenders for the manufacture and erection at their new generating station of two 10 000 kW three-phase turbo-alternators, with condensing plant (Contract H 1), and four water-tube boilers, with chimneys, superheaters, mechanical stokers, economisers, &c. (Contract H 2). Specifications from Mr. Geo. Tough, engineer and manager, and tenders to the Chairman, Electricity Committee, Council House, Coventry, by Sept. 1.

THE NEW ZEALAND Public Works Department are calling for fresh tenders for the supply and erection of steel pipe lines and fittings required in connection with the Mangahao power plant. While the quantities, &c., are substantially the same as those specified in the original call for tenders, some of the conditions appear to have undergone modification. The closing date for the receipt of tenders in Wellington is Nov. 1, 1921. Specifications can be inspected at the Department of Overseas Trade.

Tenders are invited at the CHILEAN STATE RAILWAYS (by August 31) for various stores, including telegraph and telephone apparatus. Specifications (in Spanish) at the Department of Overseas Trade, 35, Old Queen-street, S.W.1. It is understood that the representative of the Railways in Paris (88 Boul. St. Michel) has been instructed to obtain prices in the United Kingdom and remit same by cable on the day previous to the opening of tenders.

NEWCASTLE-ON-TYNE Corporation has accepted the tender of Hadfields Ltd., for tramway turn-outs and cross-overs, £4 299, and that of the United States Steel Products Company, for tramway junctions, at £18 213.

MANCHESTER Corporation has accepted the following tenders: Park Royal Engineering Works, Ltd., three-phase 6 600 V switchgear; British Mannesmann Tube Company, lamp columns; A. Reyrolle & Company, and British Thomson-Houston Company, 33 000 V and 6 600 V switchgear; Maschinenfabrik Oerlikon, three voltage induction regulators; Maitland & Company and Electrical Maintenance Company, wiring of houses on Fallowfield and Catterick Hall estates, respectively.

It is announced that the LONDON COUNTY COUNCIL has placed an order with Messrs. Brown, Boveri & Company for an 8000/10000 kW turbo-alternator for the Greenwich power station at £46 000. The difference between the tenders of the English and the Swiss firms amounted to £6 000 or £7 000. English firms were asked to amend their tenders on the understanding that they could obtain their raw material abroad, and revised prices were accordingly submitted. The acceptance of the tender is subject to the condition that the alternator shall be made interchangeable with the existing Metropolitan-Vickers alternators, and this condition has been accepted by the company subject to reservations of a minor character.

Companies' Reports, &c.

An interim dividend at rate of 6 per cent. per annum has been declared by the LANARKSHIRE TRAMWAYS COMPANY.

The directors of the HONGKONG TRAMWAY COMPANY have declared an interim dividend of 1s. per share on account of the year 1921.

The directors of HADFIELD'S, LTD., have paid an interim dividend of 6d. per share (tax free) on the ordinary shares, as in 1920.

An interim dividend of 2½ per cent. (actual) has been declared by the NORTH LONDON RAILWAY COMPANY against 2½ per cent. last year.

The directors of the METROPOLITAN RAILWAY COMPANY have declared an interim dividend of 1½ per cent. per annum against 1 per cent. in 1920.

The BRISTOL TRAMWAYS AND CARRIAGE COMPANY has declared an interim dividend at the rate of 3 per cent. (tax free) on the ordinary shares for the half-year ended June 30.

The directors of the COUNTY OF LONDON ELECTRIC SUPPLY COMPANY, LTD., have declared an interim dividend on the ordinary shares at the rate of 5 per cent. per annum, as in 1920.

The directors of the CHATHAM & DISTRICT LIGHT RAILWAYS COMPANY, LTD., have declared a dividend at the rate of 4 per cent. per annum on the ordinary shares for the past half-year.

The directors of the ELECTRICAL DISTRIBUTION OF YORKSHIRE, LTD., have declared an interim dividend on the ordinary shares for the past half-year at the rate of 6 per cent. per annum, tax free.

The directors of the WESTMINSTER ELECTRIC SUPPLY CORPN., LTD., have declared an interim dividend at rate of 8 per cent. per annum (less tax), payable Sept. 1.

A dividend of 6 per cent. (less tax) has been declared by the SOUTH AMERICAN LIGHT AND POWER COMPANY after writing off £10,000 for scrapped machinery. A sum of £4,757 is carried forward.

The directors of HERBERT MORRIS (LTD.) state that the dividend warrants for the half-year's dividend to the 31st ult. on the six per cent. and the five per cent. cumulative preference shares have been posted.

The METROPOLITAN ELECTRIC SUPPLY COMPANY, LTD., announces a dividend at 4 per cent. per annum (less tax) on the ordinary shares for the half-year to June 30.

The LONDON ELECTRIC RAILWAY COMPANY has declared an interim dividend for the past half-year on the ordinary shares of 1½ per cent. compared with ½ per cent. for the same period of 1920.

An interim dividend of 2 per cent. has been declared by the CITY AND SOUTH LONDON RAILWAY COMPANY for the past half-year on the consolidated ordinary stock compared with ½ per cent. in 1920.

The recent issue of £300,000 7½ per cent. ten-year guaranteed convertible debentures at 97 by the SHROPSHIRE, WORCESTERSHIRE AND STAFFORDSHIRE ELECTRIC POWER COMPANY was largely oversubscribed.

The net profit of the HART ACCUMULATOR COMPANY, LTD., for the year 1920 was £24,022, and, with £27,652 brought in, the total is £51,674. A dividend of 8 per cent. (less tax) is proposed and a sum of £25,616 is to be carried forward.

The directors of the CHARING CROSS, WEST END & CITY ELECTRICITY SUPPLY COMPANY, LTD., have declared an interim dividend on the ordinary shares of the West End undertakings for the half-year ended June 30, at the rate of 3s. per share, and warrants will be posted on Aug. 15.

The interest on the six per cent. first cumulative income debenture stock of the UNDERGROUND ELECTRIC RAILWAYS COMPANY OF LONDON, LTD., will be paid on Sept. 1 (less tax) at 3 per cent. Coupon No. 27 of the six per cent. income bonds will be paid on the same date at 2 per cent. (tax free).

The directors of the CENTRAL LONDON RAILWAY COMPANY have declared an interim dividend for the past half-year on the undivided ordinary stock of 2 per cent., compared with ½ per cent., and on the preferred ordinary stock of 2 per cent., against ½ per cent. for 1920.

At the meeting of the YORKSHIRE (WOOLLEN DISTRICT) ELECTRIC TRAMWAYS, LTD., last week, it was stated that the amount available was £20,358. A sum of £8,000 was placed to reserve, and a dividend on the ordinary shares at the rate of 5 per cent. for the year was declared, the amount carried forward being £9,356.

The directors of the MOND NICKEL COMPANY, LTD., state that, owing to delay in final settlement of questions regarding taxation, they are unable to present accounts for year ended April 30 last. They have satisfied themselves that they are justified in recommending a dividend on the ordinary capital of 1s. per share, tax free.

The net profit of WARD & GOLDSTONE, LTD., for the year ended March 31 was £25,190, but of this amount excess profits duty, income tax and corporation profits tax will absorb £14,698. With £6,041 from 1920 the disposable balance is £16,533, of which £6,041 has been absorbed by interim dividends at rate of 7 per cent. on the preference and ordinary. The directors propose to pay a further 2 per cent. on the ordinary, making 9 per cent., a participating dividend of ½ per cent. on the preference, making 7½ per cent., to set aside £2,000 for reduction of preliminary expenses and to carry forward £6,867.

The gross revenue of the CHILI TELEPHONE COMPANY, LTD., for the year ended March 31 was £238,784, and after deducting the expenditure in Chili and London (£195,137) the balance was £43,647. With £19,843 brought in the amount available is £63,490. The directors recommend a final dividend of 3s. per share (tax free), making 6 per cent., placing £17,285 to general reserve, carrying forward £16,504. Difference on converting liquid assets and liabilities in Chili at lower rate of exchange was £12,785, and this amount has been debited to general reserve.

The profit of SUBMERSIBLE MOTORS, LTD., for the year 1920 was £1,291, and with £6,638 brought forward, the total available is £7,929, which is being carried forward, subject to taxation. Owing to the company being without the use of the main machine shop throughout the year, which was destroyed by fire, the profits were adversely affected.

The profit of SIR W. G. ARMSTRONG, WHITWORTH & COMPANY, LTD., for 1920 was £670,180, subject to corporation profits tax, and with £1,049,899 brought forward the total is £1,725,079. Deducting the interim dividends paid in October (£401,875) and in April last (£401,875), a sum of £921,329 remains to be carried forward. The dividends on the ordinary shares amount to 2s. per share, less tax.

Mr. E. Garcke presided over the annual meeting of the BARNSLEY AND DISTRICT ELECTRIC TRACTION COMPANY, LTD., 1st week, when it was reported that the available balance was £29,011. A sum of £1,500 was placed to reserve, and after the year's dividend on the 7 per cent. preference shares a dividend at rate of 14 per cent. per annum on the ordinary shares were paid, £23,166 being carried forward, subject to taxation claims.

The directors of VICKERS, LTD., announce interim dividends of 2½ per cent. for the half-year ended June 30 on the preferred stock and the preference and the cumulative preference shares. The delay in presenting the accounts is due to the fact that there are still outstanding questions of importance with Government Departments, the two chiefly concerned being the Inland Revenue and Admiralty. Some time must yet elapse before a settlement can be arrived at, and until then the accounts for 1920 cannot be completed.

The gross income of the ANGLIO-PORTUGUESE TELEPHONE COMPANY, LTD., for 1920 was £48,046, and the expenses were £42,023, leaving £6,023 against £29,797 for 1919. After taking into account the amount brought forward and paying income tax (£1,186), providing for debenture interest and sinking fund (£6,100), the amount for disposal is £7,564. In November an interim dividend of 3 per cent. (less tax) was paid and absorbed £7,778, or £213 in excess of amount now available. The amount of the corporation tax has not yet been ascertained, and the directors have not thought it necessary to encroach upon reserve to cover the small balance of £213, which is carried forward.

The accounts of FULLER'S UNITED ELECTRIC WORKS, LTD., for the year ended March show, after deducting £6,678 for loss on realisation of investments and £13,333 for interest on short term notes, and crediting £8,040 brought forward, a debit balance of £121,368. The amount reserved for excess profits duty (£14,000) will not be required, and this will provide for depreciation of plant and writing off the experimental and development expenditure, &c. The directors propose to create first mortgage debentures up to £150,000 and to reduce the capital from £500,000 to £378,794 by writing off as lost 16s. per share on the 151,507 issued ordinary shares.

At the annual meeting of the BRAZILIAN TRACTION, LIGHT AND POWER COMPANY, LTD., which was held in Toronto on the 20th inst., the chairman (Mr. Millar Lash) pointed out that, although the earnings in Brazilian currency continued to increase rapidly, the increase was more than offset by the fall in exchange, and as a result the estimated available net earnings for the first half of 1921, when converted into dollars would show a very small surplus after providing for the fixed charges, sinking funds and preference dividend. Construction work had been postponed, but a certain amount was essential in order to comply with the terms of the concessions. The board hoped that in due course the markets for securities would improve and make possible a public issue to provide funds for extensions and that exchange would gradually rise to a point which would justify the resumption of dividends. The condition of the properties was excellent and business was satisfactory.

The gross revenue of the MARCONI INTERNATIONAL MARINE COMMUNICATION COMPANY, LTD., for 1920 was £933,568, compared with £772,019 in 1919, and the profit was £117,570 against £198,141. The reduced profit is largely due to exceptional circumstances. These circumstances include a loss of £15,301 occasioned by payment of operators' salaries in India and consequent upon fluctuations in the value of the rupee, and there was a temporary loss of £67,596 owing to the depression in Government securities in December last. The Company's foreign business has shown expansion during the year, but the revenue at the rate of exchange on the 31st Dec. last only amounted to £21,985, compared with £51,109 in 1919. The money representing this profit has remained abroad but is treated in the accounts as having been brought home on the 31st Dec. On the 30th June last the capital represented by Government securities and moneys abroad had appreciated and the loss substantially diminished. Taking all circumstances into consideration, the directors feel justified in maintaining the rate of dividend and recommend a final distribution of 10 per cent., which, together with the interim dividend of 5 per cent. paid in January last, will make a total of 15 per cent. for the year. Since the last meeting Lieut.-Col. Adrian F. H. S. Simpson has been appointed a Director.

The profit of ROYCE, LTD., for the year ended March 31 last was £14,932 after providing for depreciation, estimated amount required for taxation, &c. With £14,403 brought forward the total is £29,335. After paying the preference dividend and 5 per cent. on the ordinary for year and placing £15,000 to reserve, £9,242 is to be carried forward.

At the meeting it was announced that the whole of the destroyed premises had been rebuilt and equipped with modern machine tools. There was a fair amount of work in hand and several submersible motor pumps for dewatering mines had been supplied and some large sets were going through the shops for a coal mine in China. The company has again taken up the manufacture of the non-submersible type of d.c. and a.c. motors, in which a good business was being done prior to the war.

The chairman of the **PERNAMBUCO TRAMWAYS AND POWER COMPANY, LTD.** (Mr. Follett Holt) stated at the recent meeting that the gross sterling receipts had increased, but, on account of the increase in working expenses, the net receipts showed a decrease of £20,000 compared with 1919. The net earnings were sufficient to meet the interest on the debentures and notes, the amortisation of capital, and renewals, but the balance was not sufficient to entitle the directors, in view of the present rate of exchange and the completion of the works in hand to pay a dividend on the preference or ordinary share capital. They were carrying forward £18,373. With the proceeds of the recently issued £500,000 eight per cent. prior lien debentures the company would be able within twelve months to extend its lighting and power supply, and also to complete the electrification of the steam tramway system and construct the extension to Tipipio, thus becoming entitled to a substantial increase in tramway fares. A new 3,000-kW generating set had been added to the power house and the lighting department was making good headway, with the result that fresh customers were being added daily. Ten new double-truck passenger cars had also been delivered.

The revenue of the **YORKSHIRE ELECTRIC POWER COMPANY** for the half-year ended June 30 shows an increase over the corresponding period in 1920 notwithstanding the set back caused by the three months' coal dispute. After payment of interest, the net profit was £28,284, compared with £30,146 in 1920, and £19,229 in 1919. Interim dividends will be paid upon the preference and ordinary shares at the same rate as last year—viz., 3 per cent. for the half-year. It is stated that the time and thoughts of the officers of the Company have been largely engaged upon the proposals of the Electricity Commissioners for the re-organisation of the area entrusted to the Company. A public inquiry has been held at Leeds; a second and possibly a third inquiry is proposed to be held for other portions of the Company's area. These inquiries involve a considerable expenditure of money, and an interruption to the regular development of the Company's business, but the directors hope that they may result in removing the legislative obstacles which have retarded the development of the Company's undertaking. During the half-year considerable extensions have been made to the plant and mains.

Col. O. C. Armstrong, who presided over the annual meeting of **GREENWOOD & BATLEY, LTD.** last week said the year's results had been adversely affected by strikes and labour unrest, though the company had been less affected than others. The components of the cost of production—namely, inflated overhead charges, profits, wages and output, must all be brought into suitable co-relation by a modification of existing standards. Given a fair and equitable adjustment on those points, more especially in regard to output, there was every hope that they should again be able to hold their own in foreign markets and keep their works going at full speed. That they would be called on to face hard and bitter competition for all foreign trade was certain. It was reported, and he believed, that German workmen in the engineering trade were working eight or more hours a day with an output even greater than in pre-war days. Similar reports had also been received from Belgium. In so far as their own works were concerned, they had in the current year been fairly busy in their textile, oil mill and the electrical and turbine departments. They had still a sufficiency of orders in those departments to keep them at work for some considerable time. Including £46,242 brought forward, they had a balance of £69,674, and after providing for depreciation and payment of dividends, £18,294 would be carried forward. The dividend this year was less than last year, and allowing for the free issue of bonus shares recently made it was equivalent to 10 per cent. compared with last year's dividend of 15 per cent.

The net profits of the **FELLOWS MAGNETO COMPANY, LTD.**, for the year 1920, after allowing for depreciation, &c., is £31,961, a considerable increase over the profit for 1919. It will be remembered that although during the first part of the year trade was brisk, towards the end of the year a depression in trade occurred which upset all ordinary calculations. With very large contracts in hand, and with every expectation that such contracts would be completed and replaced by new contracts from time to time, arrangements were made for further extensions of the building and machinery. The contracts referred to were sufficient to keep the factory fully engaged until the middle of 1921. There is still a considerable amount of money outstanding, some of which cannot be collected for some little time to come. A reserve is in existence to provide for any loss which might occur, but it is not anticipated that this will be required. A much more confident spirit is now prevailing in the motor trade. Contracts which were suspended or partly suspended are now being completed, and new contracts are being entered into. The weekly output of magnetos is steadily increasing, and it is hoped that very shortly the normal output of the factory will have been reached.

Interim dividends were paid on the 8 per cent. preferred and on the ordinary shares for the half year ending June, 1920, but in view of the tightness of money, and the necessity for keeping sufficient funds available to provide for immediate wants and for future development, the board does not recommend the distribution of any further dividends at present. It is proposed that the balance standing at credit of profit and loss account (£42,332) shall be carried forward to next year.

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New Companies.

The following list is compiled from information supplied by Messrs. Jordan & Sons, Ltd., Company Registration Agents, 116 and 117, Chancery-lane, London, W.C.2.

JEARY ELECTRICAL COMPANY, LTD. (175 830).—Reg. July 20, capital £15,000 in 12,000 cumulative participating preference and £3,000 ordinary £1 shares, to carry on business of electricians and general engineers. Director: F. O. Franks (Bradstone, Linden Gardens, Tunbridge Wells). Private company.

MALLEABLE FITTINGS, LTD. (175 707).—Reg. July 13, capital £500 in £1 ordinary shares, to acquire and carry on business of electrical conduit fittings makers. Directors: J. F. Forrester and Miriam Ravenhill. Reg. Office: 30, Catherine Wheel-yard, Brentford. Private company.

Forty Years Ago.

(THE ELECTRICIAN, AUGUST 6, 1881.)

ELECTRIC LIGHTING IN GLASGOW.—At the last meeting of the Town Council of Glasgow notice of motion of the desirability of considering the question of lighting some of the principal thoroughfares with a few of the best electric lights was given.

THE TELEPHONE AND "THE TIMES."—"The Times" has the speeches of the members of the House of Commons transmitted verbally by the United Telephone Company's line to Printing House-square, this system being the means of great saving of labour and expense.

ELECTRIC LIGHT AND IRONWORKS.—Messrs. Bolling and Lowe, in their report on the iron trade, say:—"Electric lighting of our large works is gaining ground rapidly and, unimportant as this may look at first glance, it yet adds to their productive power, for by means thereof many operations may now be carried on irrespective of day and night, all of which enable an increased production to take place."

THE FITZ-GERALD INCANDESCENT LAMP.—In accordance with invitations issued, a few gentlemen, interested in Electric Lighting, attended on Thursday, the 28th inst., at 80, Gray's Inn-road, Holborn, to witness in operation the Incandescent Light constructed on the system of Mr. Desmond G. Fitz-Gerald. From the simplicity of the principle and facility with which these lamps are manufactured, we are led to believe they will compete most satisfactorily with any hitherto in the field.

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"Cabinet Maker."—"Modern Painted Furniture"; "Sales Advertising in the Furniture Trade"; and "The Decoration of Furniture by Piercing."
"Chemical Age."—"Supplementary Report on Nitrogen Products"; "Mechanical and Process Dangers in Chemical Works"; and "Synthetic Alcohol and Liquid Fuels."
"Farm and Home."—"Lord Ernle on British Farming"; "The New Scheme for Wages"; and "Country Cottages."
"The Fruit-Grower."—"Biennialism in Apple Trees"; "Spraying against Potato Blight"; and "National Grading and Packing Scheme."
"Gardening Illustrated."—"Trees and Shrubs and the Long Drought"; "Red Spider on Peach Trees"; and "Some New Zealand Shrubs."

Prices of Metals, Chemicals, &c.

			TUESDAY, Aug. 2.	
			Inc.	Dec.
Copper—				
Best selected.....	per ton	£70 10 0	—	—
Electro Wirebars ...	..	£77 0 0	£1 10 0	—
H.C. wire, basis	per lb.	0s. 11½d.	¾d.	—
Sheet	..	0s. 11½d.	—	—
Phosphor Bronze Wire (Telephone)—				
Phosphor-bronze				
wire, basis	..	1s. 3¾d.	¾d.	—
Brass 60/40—				
Rod, basis	..	0s. 8d.	—	—
Sheet, basis	..	0s. 10½d.	—	—
Wire, basis	..	0s. 11½d.	—	—
Pig Iron—				
Cleveland Warrants .	per ton	£6 15 0	—	—
Galvanised steel				
wire, basis 8 SWG ..	..	£25 0 0	—	—
Lead Pig—				
English	..	£24 15 0	—	10s. 0d.
Foreign or Colonial ...	..	£23 7 6	—	10s. 0d.
Tin—				
Ingot	..	£160 0 0	—	£1 0 0
Wire, basis	per lb.	2s. 2½d.	—	¾d.
Salammoniac. —Per cwt. 65s.-60s.			Copper Sulphate. —Per ton £3c.	
Sulphur (Flowers).—Ton £13.			Boric Acid (Crystals).—Per ton	
" (Roll-Brimstone).—Per ton			£69.	
£13.			Sodium Bichromate. —Per lb. 7½d.	
Sulphuric Acid (Pyrites, 168°).—			Sodium Chlorate. —Per lb. 4d.	
Per ton, £9 17s. 6d.				
Rubber. —Para fine, 11½d.; plantation 1st latex, 8¾d. lb.				
The metal prices are supplied by British Insulated & Helsby Cables.				

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Notes.

Imperial Wireless.

ANOTHER small crystal has formed in the solution of the project for the Empire Wireless Chain. At first sight it now seems that some progress might be made, but, having regard to past history, we have grave doubts as to whether anything will really happen. We are told that the plans for an Imperial Wireless Chain, foreshadowed in the report of the Imperial Wireless Telegraphy Committee, have been adopted, and that the work of building the requisite stations is to be proceeded with as soon as possible. It may or may not be remembered that the Imperial Wireless Telegraphy Committee was appointed in November, 1919, under the chairmanship of Sir HENRY NORMAN, to consider what high-power stations the Empire should ultimately possess and, when it reported in July, 1920, besides doing this it championed the valve rather than the arc as a transmission apparatus. As a consequence, it recommended the reduction in the distance between stations from 4 000 to 2 000 miles. Meanwhile, in March, 1920, the Marconi Company had refused to give evidence before the Committee and had propounded a scheme of their own in which the use of the high-frequency alternator and valve were features and in which private or Marconi enterprise and Government control and ownership were subtly blended.

Direct Communication with Australia.

So much for past history! We are now told that the wireless chain is to be completed at a cost of £2 000 000, of which £800 000 will be included in next year's estimates, that the installation will consist of high-power stations so that it will be possible in the day time to communicate direct with Australia from this country, and that the stations will be so designed that wireless telephony can also be employed when its cost ceases to be prohibitive. Australia, however, does not like the scheme and reserves the right and the financial responsibility to arrange its own system of communication in its own way. As New Zealand, Canada and South Africa are also for one reason or another not full participating

parties the chain at its best will only be semi-Imperial, and a larger proportion of the cost than was originally intended will fall on this country. But past experience tells us that that often happens. The Radio Research Board are to investigate the problems of wireless telephony and the question of the reduction of Press rates, both cable and wireless, receive sympathetic mention.

A Lack of Technical Details.

ELECTRICAL engineers, however, will be more interested in the technical details of the scheme than in political principles. And of these we know little or nothing. This we suppose is the Post Office influence, but it is on a par with the fog that obscures all technical wireless matters. It is understood that in accordance with the terms of the report a Committee of four experts has been investigating the latest developments in wireless telegraphy and has arrived at important conclusions. A technical committee, which includes representatives of the five allied and associated powers, has also been sitting for over a month in Paris to discuss certain points in connection with international arrangements, which it is necessary to establish in order to promote the practical development of wireless telegraphy and telephony. We also understand that complete agreement was come to on the points under discussion, especially on the important question of the allotment of wavelengths. There should, therefore, be plenty of information available not only on the performance of the different types of receiving and transmitting apparatus, but on the effect of "atmospherics," and on the probable number of words that can be passed in 24 hours. But the question remains what is going to be done with all this information and by whom? Are we, as Mr. ROBERT DONALD would have us believe, to escape from the dangers of Post Office Control by the establishment of a British Radio Corporation under State parentage, or are the Post Office still to act *in loco parentis*, or is there to be another Committee to solve this difficulty and to create others of its own? While we are not among those who see in the forging of any Wireless Chain the dawning of a new and brighter day we have no doubt of the need for an early establishment of high-

power stations if we are to do our share in assisting the development of wireless science and technology. We hope, therefore, that whatever is done it will be something that makes for progress.

The Stepney Smoke Nuisance Case.

THE action brought against the Stepney Borough Council by a Mr. MORROW for smoke nuisance, upon which we commented at the time, has now been settled by the payment to the plaintiff of the sum of £800, and the withdrawal of the injunction. As the Council has also to pay the costs of both sides, it has not emerged without what is, in reality, a pretty stiff fine. It is, therefore, not surprising that it has decided to apply to the Electricity Commissioners for a Special Order for statutory relief from such occurrences in the future. This is a wise policy to adopt, as this sort of action has a way of breeding progeny. As will be remembered, the real cause of the trouble was the poor quality of the coal available. The Electricity Committee has taken steps to remove this ground of complaint by installing appropriate apparatus in the chimney shafts, and so to prevent the free distribution of matter, which, however beneficial to crops, is deleterious to the surrounding buildings. But even when this has been done a contingent liability remains, and it is to provide against this liability that a Special Order is required.

Inconsistencies of the Nuisance Law.

AT present it must be admitted the law relating to nuisance operates unfairly against those electricity supply undertakings which work under Provisional Orders, and we have recently suggested that the long overdue alteration recommended as far back as 1898 by Lord Cross's Committee should be made. This alteration would ensure that, where a generating station site has been acquired under compulsory powers and is specified in a Provisional Order or Special Act, no liability for nuisance will attach from its operations unless negligence in working can be proved. As it is, the Power Companies are not affected, because the operation of Clause 81 of the Electric Lighting (Clauses) Act, 1899, was excluded by their special Acts of incorporation and a few London and provincial undertakers are in the same position, having, with much forethought, gone to the expense of obtaining similar protection. But all other supply authorities, whether municipal or company, are liable to be proceeded against for nuisance. The risk is, of course, greater in residential than industrial districts, as fastidious residents, including judges, may object, not only to noise and vibration, but to the emission of grit, and by commencing legal proceedings may involve an undertaking in considerable expense and trouble. No doubt, as the reorganisation of electricity supply proceeds, and when and if capital stations have been erected in remote rural districts, this risk will gradually disappear. In any event, however, it will be a considerable time before this occurs, and in the meantime the only thing we can do is to sympathise with and support the Stepney Borough Council in its efforts to secure itself from the risk of further legal proceedings while carrying out its statutory obligation of giving a supply of electricity in its area. In equity, we do not see why a statutory authority should be put to this expense, and the easiest way to secure protection would be by the insertion of a clause in the Electricity Supply Bill, which we are once again promised shall appear and be passed next year.

The E.T.U. Again.

THE methods of the Electrical Trades Union pass all understanding. The only thing that can be safely predicted about it is that if there is the slightest chance of joining in

an industrial dispute, no matter whether it is connected with its normal activities or not, some policy will be adopted that will allow it to butt in and add to the confusion. This must be interesting for the Union, but its after effects are not likely to be different from those that occur to any other sower of wild oats. We recently had occasion to animadvert upon the high-handed action of certain E.T.U. members at Hackney, who refused to connect an intending consumer's premises because the wiring work had been carried out by non-union labour. Now trouble of a somewhat similar kind has occurred in Stepney, though, if possible, the facts are even sillier. Apparently the organisers of the E.T.U. are endeavouring to bring all operators at cinema theatres into their union, and they are seeking to use the Council's electricity undertaking as a means of forwarding his policy. The procedure is simple. You put a "ban" on every house in the district where union members are not employed as cinema operators and instruct your members who are employed by the Council not to carry out work of any kind on those premises.

The Council's Dilemma.

NATURALLY this makes the other side sit up and take notice. Thus a local music-hall proprietor is threatening legal proceedings against both the Council and the contractors, whom, he says, have left the premises without testing the fittings, which cost about £3 000. Gilbertian humour is added to the situation by the fact that the wiring of the music hall was done by members of the E.T.U. and the employees whose business it is to make the connection are also members of the union. Of course, the Council cannot legally decline to give a supply, and the Stepney Electricity Committee, therefore, recommends that the Borough Electrical Engineer and Manager be authorised to give the necessary instructions to the Council's employees, requiring them forthwith to connect up the music hall with the mains, and to maintain such supply when connected and to give similar instructions with regard to supplies to other places of amusement. We hope that these instructions will be carried out by the E.T.U., so that their accustomed ration of red-nosed comedians and "close ups" of tearful maidens can be restored to the residents of Stepney. But what will happen if the instructions are not carried out? We are not surprised that there is unemployment when work is held up like this without any valid excuse.

Economy for All.

THOUGH THE ELECTRICIAN is a technical journal it cannot be without interest to our readers to discuss the latest attempt of the Government to make a beginning in reducing public expenditure. It would be trite to point out that this expenditure and the taxation which is its natural sequel, are gradually strangling industry, but it is perhaps not so obvious that the proper circulation of the lifeblood of many of our other activities is similarly being prevented. Research associations, scientific bodies, educational institutions, propaganda, most of what is sometimes rather sneeringly called non-productive labour, and all those many persons engaged in the operations which go to make these activities alive and useful are being hampered and tied by the present waste and all that it implies. It should, therefore, be to the advantage of each one of us to see inaugurated, without delay, a new policy built on a more economic foundation. The appointment of a Committee of business men to advise the Government how best to deal with a reduction of expenditure is therefore a course which all electrical engineers will heartily welcome if it leads to the desired end. But there is much virtue in that if. For that end is so to free industry from the burdens of taxation that it may once more resume its old prosperity and, in its

turn, assist to stabilise the finances of the country. But that stabilisation is a matter which cannot be rushed. We have a task equal to the ascent of Mount Everest to perform. It must be performed slowly and after due preparation. It cannot be performed at all without a change of heart on the part of those who have landed us in the present mess.

Cutting the Gordian Knot.

On the other hand, the reduction of Government expenditure is a problem that is most urgent. In fact, its urgency cannot be exaggerated. But we cannot agree that the Business Men's Committee is the best means that could have been devised to deal with the question. Apart from any criticism of the constitutional aspects of this imposing body, with the best will in the world it cannot collect information and report quickly enough to save British industry. It must take evidence, it must examine statistics, it must make itself familiar with every facet of that complicated crystal which is a Government Department and it must do all this in the face of a very natural and very live opposition. To do all this at all, and especially successfully, will take time—six months is mentioned as a minimum. And while it is not to commence operations until October all that time post-war inflated expenditure is presumably to go on and all that time any chance of reduction in taxation will be fading into a still more distant future. In our view, therefore, the Government is once again attempting to do the right thing in the wrong way. Expenditure must be cut down. Surely the best way to do this is not to discover what is the minimum each department can be persuaded to spend and to attempt to raise revenue accordingly, but to determine what revenue the country can safely bear without strangulation and to share out that among the departments concerned. The necessary economies will perforce follow. "Grandiose" schemes will be abandoned, inflated staffs dismissed and moribund Ministries happily dispatched. And, incidentally, our business men will be free to look after their own businesses.

The Economics of Foreign Contracts.

THE argument which we used against the proposal of the Sheffield Corporation to place a contract for a turbo-generator abroad (a policy which as a matter of fact was changed at the last minute) can be applied with even greater weight to the determination of the Highways Committee of the London County Council to order an 8 000 kW turbine from Switzerland. We may be forgiven, therefore, for reiterating our views on the subject in a different way. Not the least of the reasons why it is possible for foreign firms to quote lower prices than English firms is the increasing burden of rates and taxes, a burden the responsibility for which the London County Council cannot be considered innocent. Now, while therefore at first sight it appears that any public body which buys in the cheapest market is doing the best for its ratepayers, as Mr. HUGO HIRST recently pointed out in a letter to the "Daily Express," such saving is largely chimerical. For while buying in Switzerland the County Council saves on paper £7 000, at the same time the country, which includes the County Council, loses at least £25 000 in direct wages to engineering trades and in wages spent upon raw materials. Such a loss must eventually mean increased unemployment and further demands on such bodies as the County Council for doles. And these demands are passed on to the ordinary consumer in the rates and make it, what with trade union restrictions and higher wages, increasingly difficult to quote a competitive price. A neater parallel to the attempt to make bricks without straw we have seldom seen. In normal times it may be argued the outcry that is sometimes raised when a big order is placed abroad is not of great

moment, but at the present time when stabilisation of our industries is a crying need there is everything to be said for public bodies adopting a bold course and making their first duty the re-establishment of the trade of this country. They should not need to be told how that can be done.

Dominion Students for British Technical Colleges.

AN interesting movement has been started in South Africa for the purpose of inducing young South African engineers to complete their training in British technical colleges and engineering establishments in the United Kingdom. Hitherto, though a number of young South Africans have come to England to complete their studies in the medical, law and arts faculties, the majority of the engineering and science students have gone to the United States of America or to Europe. Special inducements are held out to attract students to the United States because it is well understood that after they have completed their course of study and return to South Africa they will be imbued with American ideas, acquainted with American methods and standards, and consequently they will have a predilection for the use of American machinery when they start in business. We think, therefore, that the attempt to induce these young men to come to Great Britain should receive every encouragement, not only from the authorities of universities and technical colleges but from engineering firms and associations as well. Though British universities may be full at present, and there may be difficulty in accommodating overseas students, with a little effort something tangible might be done to increase the accommodation available.

American Methods.

It would be a good business to attract some of the future leaders of Colonial industries to British laboratories, even if it were necessary to provide maintenance scholarships for the purpose. Men who have been accustomed to handle British apparatus in laboratories and workshops during their training would no doubt return with a prejudice in favour of British methods and apparatus and in the long run this would be good not only for this country but for the Empire as a whole. As an illustration of the interest taken in this matter by America it may be stated that the American Consul-General in Cape Town has recently announced that he has literature dealing with over 100 American universities, engineering and other technical colleges, which may be consulted at the Consulate. The information given includes the entrance requirements, costs of tuition and living, the general opportunities for South African students in State and other institutions in America, &c. We should like to see similar steps taken in this country, and though H.M. Trade Commissioners in South Africa are endeavouring to assist and foster this new and most desirable movement, the big British firms and the leading educational institutions should also co-operate to the best of their ability.

Work of the Light Railway Commission.

CONSIDERING the adverse circumstances under which all transport undertakings have been working, the Report of the Light Railway Commissioners for 1920 is a fairly satisfactory document. Eleven orders were submitted to the Ministry of Transport, eight were confirmed and three were still under consideration. In addition, three of the five orders from 1919 were confirmed, the other two having been dropped by their promoters. Of the 13 outstanding applications, nine are for agricultural districts, where co-ordinated and organised systems of local transport are required for the transport of agricultural produce. But owing to the high cost of construction and working it is thought that, in the absence

of financial support from the Government or local authorities, there is no immediate prospect of financial success. The majority of the new schemes are to serve industrial areas, though it is interesting to note that two of the orders, those of South Shields and Brighton Corporations, authorise the extension of existing tramways beyond the borough boundaries to connect up with building estates.

Communication between Home and Work.

THE construction of the Dearne District Light Railway by four urban district councils, for the purpose of providing transport for workers between their homes and pits or factories, and between these towns and Barnsley was authorised before the war. The great increase in the cost of construction and working made it necessary, however, for the councils to obtain extended powers, both as to borrowing for capital purposes and as to fares and charges. By the Llantrisant Order the Rural District Council of Llantrisant and Llantwit Fardre are authorised to construct a line for similar purposes extending the Rhondda tramways through their district to the collieries at Giltfach Goch. The existing roads were unequal to the traffic of railless electric vehicles and an experiment by a company with that system entailed a heavy, unremunerative expenditure. In the last few months of the year the Tramways Charges Advisory Committee held over 50 applications for increased powers of charging made by tramway undertakings, and the Commissioners therefore think that some more flexible method of regulating charging than by statutory maxima should be devised. We agree. For not only is the assistance of existing undertakings advisable, but the encouragement of new construction in rural districts is necessary.

The Late S. A. Varley.

WITH the death of SAMUEL ALFRED VARLEY not only is another link with the earliest days of the electrical industry severed, but one who was probably the last of FARADAY'S pupils has left us. VARLEY'S connection with the father of the modern electrical industry was, in fact, particularly close. He not only attended the famous Royal Institution lectures, but was a member of the little chapel at which FARADAY was one of the elders. In other ways VARLEY'S career was not unlike that of his famous teacher. He possessed those qualities of enterprise and enthusiasm which have not only laid the foundation of progress, but have driven their owners, in spite of many failures, into new and wider fields of endeavour. S. A. VARLEY came of a family of electrical engineers, or perhaps it would be more correct to say of electricians, who between them had great influence on the progress of telegraphic science. But he himself had a wider claim to fame. For, though in these days there must be considerable hesitation in ascribing a successful electrical invention to any one person, there are many and weighty reasons why VARLEY should be considered as the deviser of the compound-wound dynamo. On this achievement his fame may well rest.

The Engineers' Club.

THE promoters of the idea of an Engineers' Club for London have every reason for congratulating themselves on the auspicious start they have made. The premises of the Road Club in Coventry-street, near Piccadilly Circus, have now, it is announced, been secured and the club will be opened at 9 a.m. on Thursday, September 1st. No doubt some appropriate formal house-warming will take place at a later date. The progress of such an institution as this is, as we have

pointed out, beset by many pitfalls, any one of which may mitigate against success. But with a ready-made club premises and, more, with a ready-made club staff under an efficient manager and an enterprising Committee, the new venture is in a commanding position from which it should not be difficult to secure success. The fact that the membership already exceeds 2 200 is sufficient indication that such a gathering place is required and whether the Institution continues to meet at 6 p.m. or retrogrades to the old hour of 8 p.m. (a step for which we should personally be sorry) we shall look forward to many pleasant gatherings on Thursday evenings, and, indeed, at other times in the Engineers' Club.

Charges for Electricity.

WE regret to see that both municipal and privately-owned electricity supply undertakings are still obtaining authority to increase the prices they may charge for electricity. This policy may be the result of regrettable necessity, but is none the less likely to be received with strong criticism by the public—criticism which, when turned into action, will react unfavourably against electrical development. It may be argued with truth that the sale of electricity cannot be compared with the sale of other articles of commerce. For a public utility of this kind, while not so sensitive to the minor operations of the market, is likely eventually to feel the effects more seriously than is the ordinary commodity. There is, therefore, some excuse for increasing the prices of electricity at a time when charges in other markets are falling. On the other hand, there are much stronger arguments in favour of keeping prices as they are, and, indeed, of reducing them, as has been done in one or two cases, notably at Edinburgh and St. Pancras. It is essential to develop our markets, to increase our production, and to stabilise our industries, and for these three purposes cheap power is necessary. We therefore hope that all electricity supply undertakings will consider carefully whether it is not to their interest to reduce their charges, even at the cost of financial stringency for a short period, in the hope that through the immediate provision of cheap power they will obtain future advantages which will more than compensate for any losses they may now incur.

Factory Inspection in 1920.

THE Annual Report of the CHIEF INSPECTOR OF FACTORIES is a publication of equal importance both to those engaged in industrial pursuits and to those who are interested in the development of manufacturing processes. It furnishes an expert record of the annual progress towards better working conditions and we may include in this term such matters as safety regulations, welfare work and other social activities. We have already commented upon the report of H.M. ELECTRICAL INSPECTOR OF FACTORIES, but as the electric drive is now used so extensively in factories and workshops features of interest to electrical engineers are of frequent occurrence in the various departmental communications of which the main report is largely made up.

SAFETY PRECAUTIONS.

As regards safety precautions we are gratified to learn that the Factory Department is continuing to aim at a standardisation of the methods adopted to reach this desirable end in the principal trades and that substantial progress has already been made as the result of conferences with representatives

of employers and employed, and more particularly with some of the Industrial Councils. In our opinion an Industrial Council is the best body to tackle this important question, as the workmen thereby become directly interested in discovering means of removing causes of accidents, both actual and potential. The fact that there were 138 773 accidents during the past year (including 1 404 fatalities), or 12 750 more than in 1919, shows not only that there is an urgent need for a reduction in the number of accidents, but for removing their cause.

IMPROVEMENT OF WORKING CONDITIONS.

From the exhaustive treatment of the subject of welfare work in the report it appears that it is not considered desirable to make statutory welfare orders in some industries, as the voluntary arrangements are succeeding so well. This is a good example of that modern spirit of co-operation between all concerned, which we hope will be further developed. For cordial inter-working between the Home Office and the representatives of the various industries is the surest and best way of improving existing conditions. Moreover, human nature being what it is, it is likely to be far more successful than legislation, which should only be employed in the last resort to bring recalcitrant employers into line with their more enlightened competitors when everything else has failed. It is also satisfactory to learn that the movement regarding Works and Safety Committees, though slow, is making progress and that in some districts the advance has been quite substantial.

LIGHTING CONDITIONS, ACCIDENTS AND OUTPUT.

As might be expected, the report contains numerous references to lighting, and there is even a special report on the subject by Miss R. E. SQUIRE. We learn, for instance, that the Departmental Committee on Lighting in Factories and Workshops is assisting the Home Office to prepare an explanatory booklet on the subject, which it is hoped will be of service to factory owners, works managers and others. Though some employers are fully alive to the importance of adequate and suitable illumination of the work upon which operatives are engaged, and also of each portion of the works and of the whole of the surroundings, a great deal of educational work still remains to be done. As is well known, bad lighting is the most fruitful cause of accidents, spoilages and bad workmanship, while it is also one of the most potent causes of ill-health. We hope therefore that every effort will be made to ensure that the importance of close attention to this subject is realised.

EXTENSION OF ELECTRIC LIGHTING.

In all districts, we are glad to learn, reports show that there is a wider adoption of electric lighting in place of gas, and although the results are generally satisfactory, in some of the installations there have been complaints of glare, owing to the use of gasfilled lamps with inadequate shades. This again is essentially a matter for education. As we have often pointed out, there is little difficulty in avoiding glare if properly designed shades and fittings are employed. Many electrical firms specialise in this branch of work, and are willing to give advice on the subject. There is, therefore, no excuse for defective lighting. Miss SQUIRE, who also deals briefly with the rival advantages of diffused and localised lighting, gives some instances of actually defective illumination, and comments particularly on the neglect to provide proper daylight facilities in certain factories. Such rooms as those to be found in Sheffield and Manchester, where the majority of the panes of glass were broken and covered with sacking or were obscured by dirt, paint, &c., reveal deplorable conditions, and show the need not only for education, but for condign punishment of the offending parties.

INDUSTRIAL DISEASES.

One of the most useful sections of the Report is that contributed by Dr. T. M. LEGGE on Industrial Diseases. This compares factory conditions in America and Belgium, and sets out statistics of the various diseases induced and the precautions taken as well as the industries affected. We note that lead poisoning was most prevalent in electric accumulator factories. This is partly due to the large amount of lead fumes and dust given off in the lead burning and chemical plumbing processes and to the considerable expansion in the manufacture of accumulators themselves, consequent upon the great development of the motor industry. The natural result of this is that some of the smaller firms, especially those who came into existence during the war, have been using factories quite unsuitable for the processes employed, and compliance with regulations has been difficult to enforce. We hope this state of things will soon cease to exist, as it is in everyone's interest and the truest economy that the conditions should be as hygienic as it is possible to make them. Fortunately, the Act passed last year forbids the employment of women and young persons on the mixing and pasting processes, both in the manufacture and repair of accumulators.

We also note that a case of mercurial poisoning occurred in the testing of electricity meters, and another in the manufacture of caustic potash by electrolysis. In the latter case a fortnightly medical examination of workers in the factory has been instituted. Dermatitis caused in electroplating works, and affections of the eye in electric arc welding were among the other subjects investigated, and in a report by Dr. BRIDGE some useful hints are furnished on the protection of the eyes in arc welding. Doubtless inflammation of the eyes in this work is due largely to exposure to intense ultra-violet light. It appears, however, that the cataract met with amongst glass workers must be ascribed to a different cause—i.e., the effect of constant exposure to extreme heat.

INDUSTRIAL FATIGUE.

Reference is made to the activities of the Industrial Fatigue Board, a body which has issued several useful pamphlets on various aspects of industrial and manufacturing methods. The scope of the Board's work has had to be curtailed in the interest of national economy, but we hope that further researches of the character which it has undertaken will be made later on. Indeed, the industries themselves might undertake the work, seeing that the health and efficiency of the human machine are at stake, two factors which under present industrial conditions it is necessary to conserve at the highest pitch of efficiency.

STAFF REORGANISATION.

Important changes in the reorganisation of the factory staff of the Department were effected during the year, and the areas of the inspection and divisions were reduced. We are glad to notice that the number of scientific and technical officers is to be increased, while the special engineering staff, which is more particularly concerned with problems of safety, ventilation, &c., is to be reconstituted and enlarged; and, in view of the great growth in the use of electricity for industrial purposes, four additional electrical inspectors are to be appointed to enforce the safety requirements of the electricity regulations. The changes involve considerable redistribution of the staff, but the total number will remain about the same. The salaries have been revised in view of the increase in the remuneration which technical qualifications command. All these changes are steps in the right direction, and will, we think, increase the efficiency of factory inspection, and thus diminish the risk of accidents and industrial disease. The Factory Department is to be congratulated on its activities, which form an example that might well be followed by other Ministries.

Leader Cables in Navigation.

By J. J. BENNETT.

A leader cable may, for practical purposes, be considered as complementary to the direction finding wireless system which was described in *THE ELECTRICIAN* of July 29th, since the functions of both devices are to eliminate dangers from sea-navigation. Direction finding wireless picks up the ship when she is in doubt as to her position in open waters, and gives her the information that enables her to shape course for port. The leader cable comes to her aid as she approaches her haven, and guides her safely into it. But the system is capable of a wider application than this, for a leader cable may be employed to conduct vessels from open water to open water past sunken reefs and other obstacles to safe navigation. So far, however, the system has been adopted in harbour approaches only, as at New York, Brest, Cherbourg and at Portsmouth, where the Admiralty have laid a leader cable which all shipping is permitted to use. The Admiralty have, in fact, done a great deal of experimental work to perfect the technical development of the apparatus, and have on various occasions given demonstrations of its working for the information of those connected with our mercantile marine.

Up to the present no leader cable has been laid in a greater water depth than 180 ft., and the longest cable in use runs a distance of 40 miles. It is not considered practicable to exceed this length, at the moment, owing to the fact that in a longer

cable becomes attenuated. A power-operated signalling key is fitted into the cable inside the transmitting station, and signals are sent along the cable by making and breaking the current with this key. Any given Morse code letter or any other pre-arranged signal may be transmitted in this way. On board ship the signals are received in wire coils hung over her sides and connected to telephones on the navigating bridge. The methods of receiving will be more fully explained later. But we will first consider briefly the principle upon which the cable itself works.

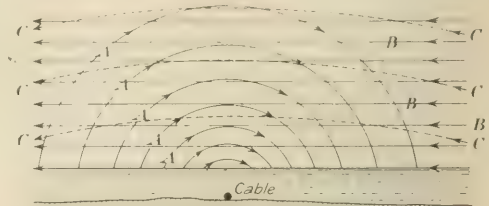


FIG. 2.

- A.—Lines of force (circular) due to unvarying current in cable.
- B.—Lines of force (horizontal) due to return current through sea water.
- C.—Lines of force due to induced currents when alternating is used in cable.

THE OPERATION OF THE MAGNETIC FIELD.

The magnetic field which surrounds the charged cable will be most intense in the vicinity of the cable. If the strength of the current does not vary, and its return path is a considerable distance away the direction of the lines of force in the magnetic field is shown by the concentric circles in Fig. 1.

In a leader cable the current is continually altering in intensity, and its return path is through the sea water in the immediate vicinity of the cable. As a result the magnetic field about the cable becomes modified both in shape and intensity. When the electric current does not vary in strength,

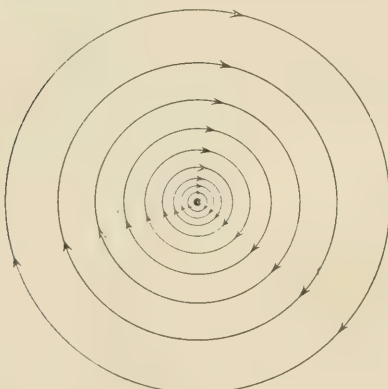


FIG. 1.

cable current attenuation would prevent sufficiently strong signals from being given out. But with more experience this limitation may be overcome. Wherever it may be installed a leader cable system varies only in such details as the length of cable employed, and the power of the transmitting plant connected to it.

THE PRINCIPLE OF THE SYSTEM.

For the purpose of explaining the principle upon which the system works let us take the case of a leader cable installation that extends to about 20 miles seaward. A specially made cable is not required. One similar to the E.T.C. twin-core 130/130 cable, which has a current capacity of 13 A, and a resistance of 3.3 Ω per mile would be quite suitable.

We will, however, assume the cable to be a seven-core one, with all cores joined in parallel, giving an ohmic resistance of 27 Ω total. One end of this cable is carried into a transmitting station on shore and there connected to one terminal of an alternating dynamo, the other terminal of the alternator being connected to the earth or preferably to the sea. The motor-alternator will provide normally 9 A at 220 V, and at a frequency of 500 cycles per second. In practice this frequency is found the most suitable, as the ear is not so sensitive to lower frequencies and with higher frequencies the current along the

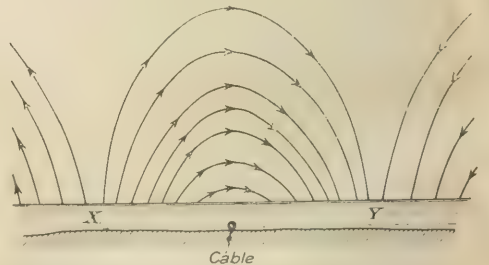


FIG. 3.—RESULTANT LINES OF FORCE DUE TO A AND B OF FIG. 2.

but the return path is through sea water in the vicinity of the cable the approximate shape of the resultant magnetic field in the air above the water is shown in Fig. 3. The circular lines of force in Fig. 2 are those due to the constant current in the cable, and the horizontal lines of force are those due to the return current in the sea water. Assuming this return current to be uniformly distributed, and thus to form a sheet of current, the magnetic field of which is horizontal and at right angles to the cable, the resultant field (Fig. 3) will be horizontal over the cable, vertical some distance away, and again approximately horizontal, but in the reverse direction, at a considerable distance from the cable. If instead of a current of constant intensity an alternating current is passed through the cable,

electric currents opposed to those in the cable will be induced in the sea water, and the intensity of these induced currents will be greatest near the cable. Above the surface of the water the magnetic lines of force due to these induced currents will be slightly curved to the surface, such as the lines *C*, Fig. 2, but the general direction of the field will be opposed to that due to the current in the cable. Therefore the final resultant field will be of the same general shape as that shown in Fig. 3, but the points of inversion, *XY*, are moved towards the cable. With increase in the frequency of alternation the induced currents increase in intensity and, as a result, the points *XY* move closer together as the frequency increases. The general shape of the field over a considerable distance is shown in Fig. 4. When an alternating current passes through the cable a loop

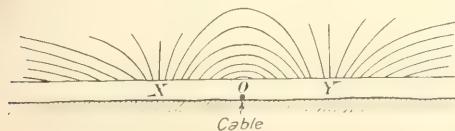


FIG. 4.

or coil of wire suitably placed in the field will have an alternating current induced in it, and the intensity of this current will depend upon the change in the number of lines of force embraced by the loop. In other words, the principle of the leader cable may be summarised thus: An alternating current in a cable laid at the bottom of the sea is associated with an alternating magnetic field which can be made to produce an alternating current in a loop or coil placed in the field, *i.e.*, carried by a ship near the cable.

AUDIBLE OR VISUAL SIGNALS.

Signals received from a leader cable by a ship may be either audible or visual. In the latter case the current induced in the ship's receiving apparatus by the cable current lights lamps, red on her port side, green on her starboard, and thus indicates upon which hand of the vessel the cable lies. But this method is still in an experimental stage and may therefore be dismissed with a brief mention. The audible

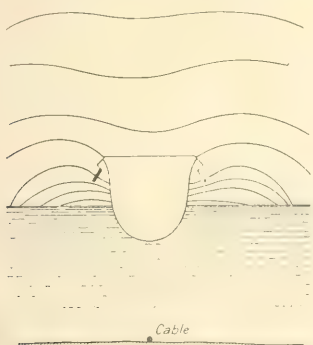


FIG. 5.

system is the one employed in all the leader cable systems now working. In the audible signals system the ship is fitted with two hollow wooden frames placed one on each side of her near the bridge. These frames are each wound with 350 turns of No. 24 gauge double cotton-covered wire, the turns being all laid up together by insulating tape in a groove cut in the frames. These constitute the receiving coils, and are hung over the ship's side with the centre of the coil at least 18 in. from her hull, and the bottom edge inclined outward at an angle of 15 degrees to the vertical. From each coil two leads are taken to a change-over switch on the vessel's bridge, and two leads run from the switch to a thermionic valve amplifier which acts as a relay and strengthens the signals

received through the coils. The amplifier is necessary because the E.M.F. induced in the coils is so small that it gives only weak signals, and if these were not amplified no signals could be heard at all unless the ship was quite close to the cable. In fact, the amplifier is so vital a part of the installation that although a leader-cable system was devised as far back as 1901 it could not be put to practical use until the thermionic valve amplifier had been invented. For a ship's receiving set a 3-valve amplifier with a 4 V accumulator battery to heat the valve filaments and a 60 V dry cell battery to supply the necessary potential to the anodes of the valves is sufficient.

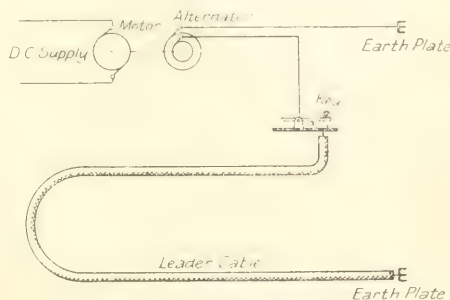


FIG. 6.—DIAGRAM SHOWING THE ARRANGEMENT OF TRANSMITTING STATION ON SHORE.

Telephones are connected directly to the amplifier, and by listening at these the navigating officer hears the signals from the cable. By operating the change-over switch he is able to determine by the strength of the signals received the position of his ship in relation to the cable. For a vessel to make use of a leader cable system it is not absolutely necessary that she should be equipped with a receiving apparatus. A portable set can be taken aboard her by the pilot.



FIG. 7.—NAVIGATING OFFICER OPERATING THE CHANGE-OVER SWITCH ON THE BRIDGE.

THE ACTION OF THE SHIP.

When picking up a leader cable a ship lays her course so that she will cross the cable at its seaward end. The range at which it is possible for her to pick up signals will be largely increased if at this point towed electrodes are used in place of the port and starboard coils. These electrodes consist of two lengths of insulated flexible wire with the insulation

at the outboard end of each stripped back for a distance of 6 ft., so as to make good electrical connection with the sea. The inboard ends of the electrodes are connected to the receiving apparatus on the bridge by a twin cable led from the vessel's stern. The electrodes work on a similar principle to

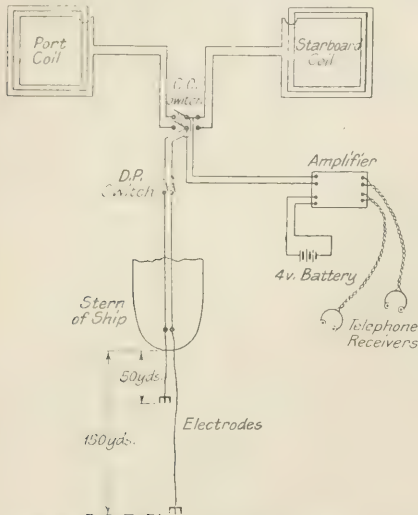


FIG. 8.—ARRANGEMENT OF THE RECEIVING APPARATUS ABOARD SHIP.

the coils, except that with them there is no screening. After it has been ascertained that the ship is nearing the cable the coils may be brought into use in place of the towed electrodes. The hull of a steel or iron ship exercises a screening

equal and the strength of the signals in each coil will be equal also. But as she moves to either port or starboard the electro-magnetic screening action of her hull and the consequent distortion of the magnetic field will prevent an equal number of lines of force from passing through each coil, with the result that the signals received from the coil nearest the cable will be the louder. By operating the change-over switch the officer can ascertain which coil is giving the louder signals, and by this means tell which side of the cable the ship is on. But as the ship moves farther away from the cable the difference in the port and starboard signals grows less and finally disappears.

The distribution of the lines of force shown diagrammatically in Figs. 1 to 5 illustrates the principle upon which the screening effect is based. When a ship is crossing the cable at right angles the maximum strength of the signals received from it is obtained just before the coils are vertically over the cable and just after they have passed that position, but no confusion can arise from this as the distance between the points of maximum strength is so short. With the coils screening is good up to 400 yards distance from the cable, and fairly good signals may be received up to 600 yards distance from it. From the foregoing it will be clear that after the cable has once been picked up it will be comparatively easy for the navigator to know which side of the cable his ship is on by the way in which the signal note varies in strength in the coils.

The practice is for incoming vessels to proceed down one side of the cable whilst outgoing vessels proceed up the other side. If the navigator keeps his bridge telephones switched over to the coil farthest from the cable he will be able to judge to within a comparatively few yards the position of the cable. The reason for keeping the switch in the position indicated is that as signals in the coil farthest away are weakest any variation in them may be readily detected, whereas slight variations in loud signals are more difficult to discern. Leader-cable systems are of great utility in hazy weather, as they then enable ships to proceed in and out of port free from risk of collision or grounding. In the same way such cables laid in dangerous localities outside will conduct shipping past the zone of peril when all the ordinary navigation marks placed there for the guidance of the mariner are obscured. The value of the system has now been amply proved and the use of it is gradually extending.

British Standard Specification for Tramway Tyres.

A British Standard Specification for Tramway Tyres has been published by the BRITISH ENGINEERING STANDARDS ASSOCIATION. In the new specification the profile of tread and flange originally standardised and issued in the British Standard Specification for tramway rails in 1903 has been retained, but in place of the varying widths of tyre then provided to suit the British Standard Sections Nos. 1 to 5, one uniform width has been adopted suitable for rails having a tread of $2\frac{1}{2}$ in., which dimension, we understand, is being recommended for the revised rail sections now under consideration and approaching issue. This width is that of the B.S. Section No. 4, probably the most extensively used of the standard sections. Three diameters of tyre are provided for, namely, 32 in. and 33 in. (with thicknesses of $2\frac{1}{2}$ in. and 3 in. respectively), for tramway driving wheels, and 22 in. (with a thickness of $2\frac{1}{2}$ in.) for pony wheels. A plate attached to the specification gives the finished sizes of these wheels and the rolling allowances for machining.

For the convenience of purchasers in countries in which the metric system has been generally adopted approximate metric equivalents of the British measures are given, but a note to the specification makes it clear that the latter are to be regarded as the standard.

The Specification may be obtained from the offices of the British Engineering Standards Association, 28, Victoria-street, S.W. 1, or from Crosby, Lockwood & Son, Stationers' Hall-court, E.C. 4, price 1s. 2d., post free.



FIG. 9. COIL IN POSITION IN A SHIP'S SIDE.

effect, the consequence of which is that the side of the vessel farthest from the cable will be screened to some extent. When a ship is directly over the cable the number of lines of force passing through the port and starboard coils will be

Note on the Low-Frequency Voltage Factor of an Oscillating Triode.

By MARY TAYLOR.

In a recent Paper by Prof. Eccles and Miss Leyshon,* the voltage factor (ν) of a thermionic tube was defined as the change in the anode voltage (v_a) required to maintain the anode current (i_a) constant, when unit additional E.M.F. is applied between the grid and filament. This note deals with the determination of the voltage factor as so defined (i.e. $\frac{\partial v_a}{\partial v_g}$), where v_g is the grid potential) in the case of a tube actually generating high-frequency oscillations. In this case it is found that ν can be made greater or less than its value when the triode

is in the anode circuit and naturally depends on the mean potential of the grid. The characteristic curve exhibiting the relation between mean grid potential and mean anode current for such a case is found to be quite different from that obtained when the triode is not oscillating. Fig. 2 indicates the type of characteristic obtained in two cases, for different values of v_a . The oscillation characteristics are the dotted lines in the figure.

The voltage factor of an oscillating triode may be deduced from two characteristic curves for different values of v_a . These curves are very nearly parallel at low grid voltages but,

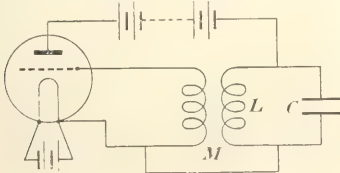


FIG. 1.

is not oscillating and, in some cases, can be made very great indeed. From the definition of ν given above, it will be seen that we can bring about an increase of ν either by an increase of mutual inductance $\partial i_a / \partial v_g$ or by a decrease in anode conductance $\partial i_a / \partial v_a$. A state of affairs can be produced with one triode generator maintained in the condition represented by point E in Fig. 2, where the increase of ν can be brought about in both these ways. Here the grid control is most marked and the anode control is practically negligible. The resulting gain in voltage factor is thus very great.

TYPICAL SCHEME OF CONNECTIONS.

A typical scheme of connections for the production of oscillations is shown in Fig. 1, and it is to this type of generator that all references will be made.

Frequencies of the order of 10^5 per second were used, but the results obtained were found to be practically independent of the frequency.

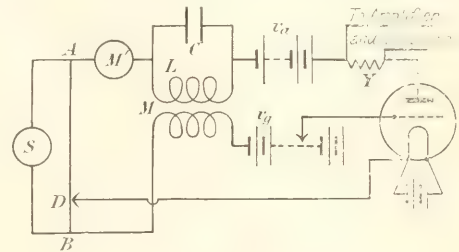


FIG. 3.

at high values of v_g , the curves are very close together and may even cross. This indicates that the value of ν in this region is extremely high. For points on the lower halves of the characteristics, such as D, ν is found to be much lower than the natural value. Typical values of ν , for various grid voltages, taken from the horizontal lines in Fig. 2, are given below:—

$v_a = 80V.$	ν	ν	ν	ν	ν	ν
10V	1.7	23	2.2	33.5	5	
15	1.8	27	2.6	36.8	11.4	
19	1.9	30	3.3	37.6	40	

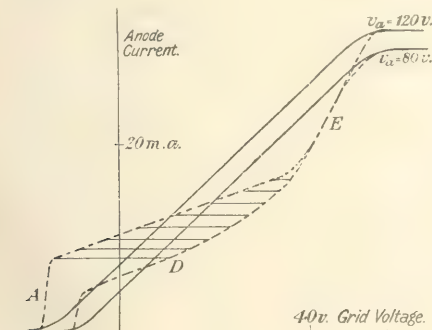


FIG. 2.

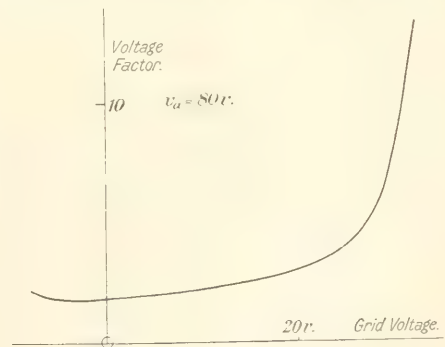


FIG. 4.

It is well known that, in such a generator, although the changes of v_a and v_g are practically sinusoidal, the anode current changes are, in general, far from being so. Thus we may expand i_a as follows:—

$$i_a = i_{a0} + i_{a1} \sin pt + \dots + i'_{a1} \cos pt + \dots$$

The value of i_{a0} is the reading of a direct-current instrument

It is possible to account for these abnormally large values of ν in the following way. The oscillations are more vigorous the nearer the representative point is to the centre of the characteristic; thus the oscillations are bigger at D than at E. An increase of anode voltage means an increase of anode current, but also an increase in the amplitude of the oscillation. Now an increase in the amplitude means a bigger departure from the stationary value when not oscillating, i.e. tends to decrease the mean anode current at E. Thus, when the triode is oscillating, the net increase of anode current is

* See THE ELECTRICIAN, Vol. LXXXVI., p. 754.

less, for a given increase of anode voltage, that is, the value of $\partial i_a / \partial v_a$ is small. This may be compared with the point on the left-hand side of the characteristic, where an increase in v_g (a) increases the value of the anode current and (b) increases the amplitude of the oscillations and so the departure from the normal value; (a) and (b) are here in the same direction.

LAG BETWEEN GRID VOLTAGE AND ANODE CURRENT.

The question next arises: Is there any temporal lag between the grid voltage variation and the mean anode current response? Some experiments by Capt. P. P. Eckersley indicate that the response of an oscillating triode to short high-tension pulses applied to it is non-instantaneous.*

So far this point has only been approached by examining the voltage factor when the changes of grid voltage have a frequency of 90 cycles per second, using the ordinary alternating-current method of measuring ν ; the circuit is shown in Fig. 3.

S is a source of alternating E.M.F. of frequency about 90 cycles per second, giving a fall of potential along the wire AB

of the order of half a volt; M' , a milliammeter measuring i_{ao} ; Y, a non-reactive resistance of 200 Ω from which P.D. is taken to an amplifier.

When the current through Y is unaltered, as indicated by minimum telephone response, $\nu = -\partial v_a / \partial v_g$ is given by the ratio AD/DB ; with this circuit the variation of ν with v_g was obtained. The values of the low-frequency voltage factor showed general agreement with those to be expected from the shape of the characteristic curves. The type of curve obtained is shown in Fig. 4.

The above results also assist in the elucidation of the action of the well-known auto-heterodyne receiver circuit, using a grid condenser, in which the net result of the signal is to produce low-frequency variations of grid potential, which produce variations in the mean anode current. The actual voltage factor for such cases is of the type investigated here and not the one dependent on the geometry of the electrodes.

I am grateful to Mr. E. V. Appleton for his kindness in suggesting this problem to me.

The Story of the Induction Motor.†

By B. G. LAMME

(Chief Engineer, Westinghouse Electric and Manufacturing Co.)

(Concluded from page 181.)

During 1894 to 1898, the writer actually constructed multispeed motors, by changing the number of poles in a given frame, as distinguished from cascade-parallel operation. On one occasion he also arranged special railway pole-changing motors across one phase of the supply circuit and from it, as a phase converter, fed polyphase current to the four-pole-eight-pole motor. The tests showed that this latter machine, operating as a polyphase motor, acted quite satisfactorily on both four-pole and eight-pole combinations. This, therefore, was an anticipation, experimentally of the split-phase traction system, which came out many years later.

The introduction of the cage type secondary directly influenced the development of multi-speed motors. A properly proportioned cage secondary could operate fairly well with various combinations of poles; whereas with the "polar" type of secondary, one winding was suitable for only one speed, without considerable reconnection, which was not convenient with the small motors in common use in those days.

Shortly after the above experiments with the two sets of poles on a railway motor, the writer designed various two-speed and three-speed induction motors for special purposes, some of which are in operation at the present time, after more than twenty years.

THE "GOLDEN AGE."

The period from 1894 to 1900 might be called the "Golden Age" of induction motor development. Nearly all the things that have been developed since originated or were first put into practical use during this brief period. In this period the polyphase motor became so thoroughly established that it was already taking the offensive against its direct-current rival. The methods of calculation, developed in that time, hold with slight modification until to-day. The method of analysis and calculation derived by the writer, and the closely related methods devised by Dr. C. P. Steinmetz, during this period, are also very generally used. Again Mr. B. A. Behrend's early book on the induction motor is well worthy of study now, after 20 years, in spite of the great subsequent advances. More recent investigations have led to refinements in machines, but not to any new principles which have allowed any radical departures in types.

ELECTRIC TRACTION APPLICATIONS.

By 1900, the induction motor had become thoroughly established, with the cage type of construction far ahead of all others, and the period of application began. In Europe, the Ganz Company was applying the induction motor to locomotive work in Italy. Mr. Westinghouse bought the American rights of the Ganz patents, but never used them. However, one early attempt was made at electric traction by polyphase current, namely, on the Miami & Erie Canal near Cincinnati. The polyphase electric locomotive did all that it

was expected to do, but the installation was a failure, due to reasons outside of electric operation.

Some years later, the General Electric Company installed polyphase locomotives in the Cascade Tunnel of the Great Northern Railway. These were three-phase, 25 cycle, 1 200 to 1 500 h.p. equipments, and were used primarily for hauling trains through the tunnel. A single speed, with rheostatic control, was used on this electrification. An interesting feature was the use of 6 000 V on the two overhead wires.

At a still later period, three-phase locomotives were installed by the General Electric Company along the Panama Canal, for towing purposes. This latter is the largest application of polyphase current to traction in America.

From 1896 and 1897 onwards, steps were taken to apply induction motors to crane and hoist work. Induction motors quite early were applied to elevator service, especially for freight elevators.

About 1900 induction motors began to extend to quite large sizes, e.g., of 500, 1 000 and 2 000 h.p., sometimes of the cage secondary type, but frequently with wound secondaries. The starting problem was then of controlling importance, for the present huge power plants were not even dreamed of, and generators of 2 000 or 3 000 kVA capacity were considered quite large. Hence, the starting of a 2 000 h.p. motor of considerable torque was of importance, and the reactive effects on the generator were liable to be serious.

POWER FACTORS.

It was early recognised that the induction motor would always have a power factor less than 100 per cent. It was soon recognised that 25 cycle motors, with their smaller number of poles, would require less magnetising current than 60 cycle motors, and would naturally show higher power factors, due both to the smaller magnetising current and the low reactance voltages. Consequently a frequency of 25 cycles was favoured for industrial plants. However, in time, cases came up where gearing was desirable. With the development of good reliable gears there has not been the same necessity for the low-speed induction motor as formerly. The tendency has been toward higher speeds and conditions which could be well met by 60 cycles.

Naturally, engineers early turned to the question of eliminating the reactive component in the induction motor. The reduction of the magnetising current quickly forced manufacturers to use very small air-gaps. Eventually 1/32 in. clearance on each side was considered satisfactory even in large motors.

Many attempts have been made in connection with correction of power factor of induction motors, but none have come into general use, for all involve the commutation of alternating current, and due complexity in design. Gisbert Kapp and Miles Walker, in England, have developed practical types of "phase advancers."

DEVELOPMENTS FROM 1900 TO 1910.

The decade following 1900 was largely one of growth as distinguished from development. Manufacturing companies were extending standard lines rather than producing new types.

* See Eckersley, "Duplex Wireless Telephony," "Radio Review," April, 1920.

† Abstract of Paper read before the American Institute of Electrical Engineers.

During the period from 1895 to 1905, the Westinghouse company, as well as other companies, had built many alternators with partially closed slots.

The open type of primary slot eventually then came into general use in later constructions of induction motors owing to the greater ease in executing repairs; but in the small sizes the gains, due to partially closed slots, have been so great as to more than offset the problems of repair, so that the trade has accepted the partially-closed slot for the smaller motors. In attempting to combine the advantages of both methods, many manufacturers of induction motors have sought to develop and use some form of magnetic-retaining wedge, which would serve to hold the primary coils in place and, at the same time, partially close the slot magnetically. Within their limitations, several forms of wedges have given quite satisfactory results. In fact, this is still one of the active development problems in several of the manufacturing companies.

SPEED CONTROL OF THE INDUCTION MOTOR.

In applying the induction motor to steel mill work, new problems occurred, *e.g.*, that of obtaining economical speed adjustments or variations. Inherently the induction motor is a constant speed machine. Adjustments in speed must be obtained either by the use of some other kind of motor or by mechanical means. However, in steel mill work, where large powers are involved, these indirect means are often not applicable. Direct-current motors in large sizes are not desirable on account of voltage limitations, and mechanical speed-changing devices on a large scale do not appear feasible. Adjustable speeds, of course, are obtainable with induction motors by varying the supply frequency, but this is not a general solution. Speed control is also obtainable by varying the number of poles in the motor, but this is limited to a small number of combinations, and fine graduations in speed are not obtainable. Speed control is also possible by means of a resistance in the secondary circuit, but speed changes so obtained are uneconomical, and the speed varies with changes in torque. However, if such energy is expended in some useful way an economic speed control becomes possible.

In some of the earlier mill work, where only two speeds were called for, either cascade operation of two motors or pole changing in one motor was resorted to.

The cascade arrangements proved to be expensive compared with the use of two combinations of poles on one frame and in later work.

Methods of speed control by utilising the loss in the secondary comprise: (1) converting the secondary frequency and power to direct current; or (2) to mechanical power; and (3) converting the variable secondary frequency to some definite constant frequency, such as the primary, by means of a frequency-changer.

The first Kraemer method utilises a synchronous converter in the secondary circuit, converting to direct current, but at a variable voltage. This power can then be utilised by an adjustable-voltage direct-current motor. The second method (Scherbius) involves the use of a variable frequency motor, *i.e.*, a commutating type alternating-current machine. The variable-frequency secondary power is thus converted directly to mechanical power, in which form it can be utilised in various ways. The third method involves the use of a frequency changer, which is also a commutating type machine. All three methods have been used by American companies.

All these methods involve the use of extraneous devices for regulating the speed. The need for adjustable speed has thus not affected induction motor development itself, but has simply extended its field of operation, and has given to it some of the flexible characteristics of the direct-current machine, but at the expense of considerable complication.

HEAVY POWER APPLICATIONS.

Originally the steel mill applications were largely direct current, which, however, the power requirements tended to overtax the direct-current motor unless abnormal voltages were used. Hence the trend was soon toward the use of alternating current. This tendency was found in many other lines, such as power station work, railway work, &c. The direct-current system in spite of its greater flexibility in speed control, &c., has not been able to hold its own against the alternating system with its greater flexibility in voltage transformation. In the steel mill business, motors up to 6 000, 8 000 and 10 000 kW came into use many years ago. In some cases very low speeds are used. An 8 000 H.P., 75 revs. per min. mill motor represents almost the acme of design in induction motor work. Here the mechanical problems of construction may dominate the electrical. A total gap of $\frac{1}{4}$ in. would seem prohibitive in induction motors, yet such gaps and even larger have been used in some of these huge steel mill motors. Such machines are especially inter-

esting when constructed for two speeds, usually involving two sets of windings in both the primary and the secondary elements.

INDUCTION MOTORS IN RAILWAY WORK.

A recent application of induction motors to railway work is on the Norfolk and Western Railway at Bluefield, West Virginia. Here the induction motor appears in two radically different functions; one as a generator of power, in the main locomotive motors themselves, and the other as "phase generators" in the so-called "phase converters," which serve to transform from the single-phase trolley system to the three-phase circuits for the motors. In these locomotives, the phase converters are simply high-capacity induction motors connected to the circuit in such a manner as to transform from a single-phase supply system to a practically balanced three-phase motor system.

INDUCTION MOTORS IN SHIP PROPULSION.

Another recent application of the induction motor is in the propulsion of battleships. This started in the collier "Jupiter." At the present time there are 19 large battleships and battle cruisers under contract for propulsion by electric motors.

In the "Tennessee" the main propulsion motors form the only load for the generators. Hence the frequency can be fixed by design conditions, and can be varied over a wide range by simply varying the speeds of the driving turbine.

As the desired steam economies cannot be obtained at the lowest required speed with this arrangement, a change in speed by means of pole changing, or its equivalent, in the motors themselves is obtained.

In ship propulsion by electric motors there are several conditions very favourable to the electrical equipment. The motor is not tied rigidly to its load, as, for instance, in locomotive work, *i.e.*, the motor can start and come up to speed long before the ship has reached its full speed. Hence, secondary losses, rheostatic or otherwise, can be made very low. Moreover, the switching of the motors can be done without power. The excitation can be cut off from the generator when it is desired to switch the circuits, for it is not necessary to maintain the driving torque at all times, as in locomotive work. A third favourable condition in ship propulsion is that there is no need for parallel operation of the generators.

In the "New Mexico" and the "Tennessee," there are two generating units and four motors. For the higher speeds two motors are operated from each generator and, for lower speeds, four motors are operated from one generator. In the larger units, such as the battle cruisers, there are four generators and four pairs of propeller motors. At the highest speed there is one pair of motors on each generator. At intermediate speeds there are two pairs of motors on each of two generators, while at the low speeds there are four pairs of motors on one generator, but at no time is there any occasion for paralleling.

On the "New Mexico," the "Tennessee," and vessels of the same class, there are four main motors of about 7 000 H.P. each, operated from two generators of suitable capacity. The size of these equipments necessitates a maximum operating voltage of about 3 500. This voltage, of course, decreases with reduction of frequency in speed control.

In the battle cruisers, however, where there are four pairs of motors, each pair consisting of two 23 000 H.P. motors on one propeller shaft, a maximum operating voltage of about 5 500 is needed.

On the speed control of the motors themselves, during starting, two radically different arrangements have been devised by the General Electric and Westinghouse Companies. In the "New Mexico," equipped by the General Electric Company, the two-phase motors are of the double-cage secondary type. The secondaries of the motors are equipped with two cage windings, the outer one, that is the one next the air-gap, being of relatively high resistance for starting and accelerating and the inner one being of relatively low resistance. Between the two windings is a magnetic bridge to introduce sufficient reactance for the bottom winding. The high resistance winding furnishes a great part of the torque during starting and acceleration; at full speed the low-resistance winding becomes effective.

In the super-dreadnoughts four motors of about 15 000 H.P. each are required with two generators of suitable capacity. The general arrangements are similar to those for battleships except that power requirements are practically double. Thus it will be seen that the electrical propulsion of ships is not a very radical departure. The capacity of the motors is large, but their speeds are such that, from the mechanical standpoint, they are not so large as some of the steel mill motors in operation for many years. One of the chief problems is ventilation. In view of the confined space artificial cooling is invariably adopted.

Multiple Unit Shunts for the Measurement of Very Heavy Currents.*

By M. B. FIELD, O.B.E.

The design of shunts for very heavy currents presents special problems. Thus in the case of a shunt for, say, 50 000 A the usual design comprising two short cast metal palms bridged by a number of high resistance strips is impracticable, owing to the difficulty of making adequate contact at the palms for such a high current, the uncertainty of the distribution of current in the mass, and the inability to test the unit at full load.

In the author's opinion 6 000 A is about the practicable limit for a single unit. In a 10 000-A shunt it was recently found that the P.D. drop between terminals could be varied 4 per cent. by altering the method of clamping the circuit conductors to the palms. In this Paper a multiple-unit shunt, in preference to the single unit, is discussed.

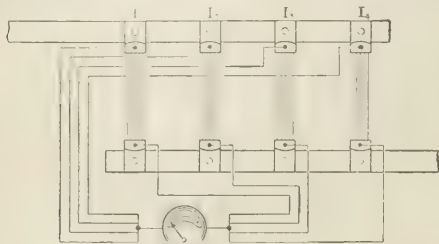


FIG. 1.

A number of standardised units are connected in parallel to a single milliammeter, the total current being registered irrespective of the distribution among the various shunts. The method involves a number of sub-shunts. Like potential terminals are connected to star-points by leads of equal resistance, termed equalisers, and the milliammeter is connected between the star-points. In these circumstances the P.D. at the star-points is proportional and very nearly equal to the average P.D. existing at the potential terminals of all the sub-shunts. Fig. 1 shows a simple four unit system, Fig. 2 a variation of this arrangement.

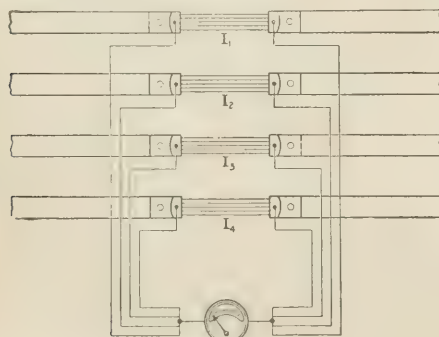


FIG. 2.

Multiple unit shunts can be readily inserted in a run of bus bars without loss of space; the total heat is distributed over a large region; each sub-shunt is readily accessible and independently standardised. Each bus bar conductor with its corresponding shunt may be assumed to take 1 000 to 1 500 A. As these sub-shunts replace a section of the circuit conductor cast palms the necessary machining is avoided, and the usual jointing difficulties are overcome. Fig. 3 shows a special design for a 32 000-A shunt made for mounting on the wall of a generating station. There are eight 4 000-A sub-shunts, S. Two copper tubes (from which the sub-shunts are not insulated) are supported on wall brackets, but are insulated therefrom by micanite bushes and form the framework.

In the original Paper the author presents the results of tests on a number of shunts and it is shown that with various arrangements the summation current remains substantially constant and equal to the addition of the individual currents in each sub-shunt. The author also undertakes a theoretical treatment of the effect of variations in distribution in ordinary and multiple shunts, the three factors of importance being the constant of the shunt (K), its terminal resistance (R) and the electrical symmetry. R is the resistance that would be measured on a Wheatstone bridge applied to the potential terminals of the shunt. R and K , both physical constants expressed in ohms, may either be practically equal in value or very different according to the design of the shunt. The potential difference (P.D.) across the terminals, with I amps. passed through the shunt from palm to palm, is KI . If we pass I amps. through the shunt via the potential terminals the P.D. is RI . K may be effected by the method of connection to the circuit, but R cannot. On the other hand R may be affected by the length of the potential terminal posts, but such variation would have little effect on K .

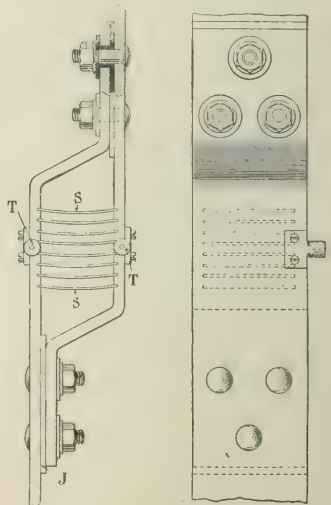


FIG. 3.

The reason for the difference between K and R is that current passed through the ordinary shunt via the potential terminals assumes a different distribution from that existing when the current passes from palm to palm. In the original Paper the author discusses the general case from the point of view of a network, first for the ordinary type of shunt, and next for the multiple shunt, and shows how, in the latter, the current side-tracked is independent of the actual distribution in the shunt units. In an Appendix an account of some supplementary tests conducted at the Manchester College of Technology is given. These also led to satisfactory results.

Books Received.

(Copies of the undermentioned works can be had from THE ELECTRICIAN Offices of receipt of published price, plus postage.)

"Automatic Telephone Systems," by William Aitken. (London: Benn Brothers, Ltd.) Vol. I. Pp. xv. + 282. 26s. post free.

"The Engineer" Directory and Buyers' Guide. (London: The Engineer, Ltd.) Pp. 176.

"The Electric Furnace." By J. N. Pring, M.B.E., D.Sc. (London: Longmans, Green & Co.) Pp. xii. + 485. 32s. net.

"Principles of Radio Communication." By J. H. Morecroft, assisted by A. Pinto and W. A. Curry. (London: Chapman & Hall.) Pp. x. + 935. 45s. net.

"Programme for the Session 1921-1922 of the City & Guilds of London Institute, Technology Department." (London: John Murray. Pp. viii + 368. 3s. 6d. net.

* Abstract of a Paper read before the Institution of Electrical Engineers.

Industry and Society.

By ERNEST J. P. BENN.

To understand the differences between industrial problems in America and in Great Britain it is necessary to go deep down into the foundations of the social structure of both countries. If industrial difficulties were concerned only with the manufacture and the marketing of goods, if in the discussions between the various parties it were possible to sweep aside all considerations other than those which have a direct bearing upon the business of production, if wages and hours and conditions were really the only things that mattered, then there would be very little trouble in the industrial field. Our difficulties in England are rendered greater from the fact that these things are to some extent merely reactions from greater forces working in a wider field. When the British trade unionist meets the British employer he starts with a prejudice arising from the fact that he belongs to a different social class; but when the American workman meets the American employer it never occurs to him that there is any social difference, and, indeed, he can never dismiss from his mind that fact that the employer was once a workman himself, and that he will, in the ordinary course of events, himself become an employer. It is undoubtedly ten times as easy to pass from one social class to another in America as it is here. The barriers between the classes either do not exist at all, or are so flimsy as to present few difficulties to those who would pass over them.

A SACRED WORD.

The Americans make great use of the word "citizen," and attach an almost sacred importance to it. From the President downwards, everybody is a "citizen," and there is no attempt to classify "citizens" as we should do. There is, of course, an American aristocracy, but it does not depend upon a House of Lords, upon an elaborate system of precedence, upon titles and coats of arms, and least of all has it anything to do with heredity. These things must be understood if the point of view of the American labourer is to be appreciated. He will not join in a revolution to pull society down, for the very simple reason that to him society is a convenient and sensible arrangement which enables him, humble labourer that he is, to climb a little higher, or, in the view of most of them, a great deal higher.

AN ABSENCE OF SOCIAL DISTINCTION.

The European visitor to the United States is at first a little embarrassed by the absence of those social distinctions upon which he can always rely in Europe to ensure him a comfortable passage and to flatter his sense of importance. It is a little disconcerting to be addressed by a porter in a Customs-shed as if one were a social equal, if not a social inferior. We can tolerate rudeness on the part of an English porter, because we feel after all that it is merely his way of balancing a social inferiority of which he is the victim. But to saunter out of the luxurious state rooms of the "Aquatania" and to hear a nigger truckman explain to a colleague that "this man wants his baggage checked" gives us at first sense of shock. The nigger might surely say gentleman. He will presently expect a tip, and a tip to an Englishman is the reward of servility. The American nigger, however, is not servile. When, as you become more accustomed to the ways of America, you discover the railway porter lurching by your side in one of the popular restaurants, and distributing his tips with the same liberality that he has extracted them from you, you acquire by degrees a sense of the fitness of things, but not of the same sort as exists in this country.

REASONS FOR THE ABSENCE OF SOCIALISTS.

Little things—or rather big things—like this are the whole explanation of the absence of a Socialist Labour Party in America; and while we in England are never going to part with those refinements of habits and customs which have come to us from history, we can learn something from the other extreme as exhibited in the United States. Indeed, I think we are learning something. Our economic difficulties will get less and less acute as we succeed in ridding ourselves of that which is stupid in our social arrangements. Without losing all those finishing touches which add so much to the joys of life, we can surely dispense with social distinctions which are merely used as barriers to emphasise class differences and inflame class antagonism. A great deal is already going on in this direction. The Duke of York's camp at Littlestone is merely an indication of a great movement which will, it is to be hoped, transform our way of looking at these things. The Industrial League week-end movement is yet another example of the same sort of effort, and wherever one looks one sees a desire to break down social distinctions and substitute social equality.

The effect in the United States of a perfect social equality is to create a universal desire to build up. The lowest of the citizens

has a vested interest in the social order. On the other hand, the effect of rigid social barriers and definite social classification in England is to make large masses of the people believe that they are the enemies of the social order and desire to break it down. Industry has to bear the brunt of this trouble, and the social order is attacked through wages and "ca-canny," and the interest of industrialists in the manners and customs of society thus becomes rather more apparent than is often recognised.

Knife Switches and Fuses for Ship Installations.

It has generally been an accepted axiom that ordinary apparatus designed for land work is good enough for ship work, but a little clear thinking will soon show that the tests to which apparatus in the latter case are subjected to are more exacting. The chief points to be considered in designing apparatus to fulfil marine conditions are that all parts should be of a very robust design to ensure a perfect and lasting functioning of the apparatus. To withstand breakage or damage, they must be of the most suitable material it is possible to use for the purpose, parts must be simple, few in number, and the need for eliminating repairs and renewals must be carefully studied.

The fuses and knife switches which we illustrate in Figs. 1 and 2 claim to fulfil all these requirements as the result of many years of careful study in their design, and are manufactured by SPRECHER &



FIG. 1.

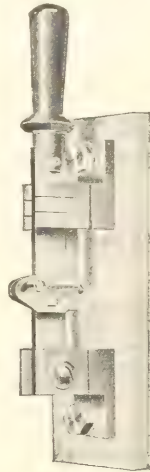


FIG. 2.

SCHUH Company, of Aarau, Switzerland. The fixed contacts are of massive brass having hard-drawn copper spring clips driven tight into slots cut in them and well riveted. This form of construction gives good electrical contact and a rigid fixing for the copper clips, enables them to retain their shape and pressure against the knife blade. The blades of the knife switches themselves are made of hard brass, as experience shows that this is the most suitable metal to use for this purpose to ensure ease of operation, good contact with the copper clips and freedom from binding or cutting to which copper is liable. To give high conductivity, the blades are of extra large sectional area. The flicker blade is of a very simple design, being easily removable and held in good contact against the main blades by means of springs, no screws being used.

FUSE DESIGN IMPORTANT.

The question of fuses for ship installations whether used for protecting the main or sub-circuits is of paramount importance inasmuch as in several respects the conditions are even more exacting and the consequences of faulty operation are fraught with more serious results than that of land installations. These are well known to those acquainted with marine service, but of late years little advance has been made in the way of improvements on vital points, and the situation has generally been accepted that the imperfections of the ordinary porcelain fuses have to be endured rather than cured.

These sets are supplied in two patterns. The "Bungalyste" fixed pattern, which is shown in Fig. 3, weighs 85 lb. and measures 25½ in. by 14 in. by 21 in.; the portable pattern weighs 55 lb. and measures 20 in. by 10 in. by 18 in. The makers have aimed at producing an inexpensive plant of the very simplest type, in which every wearing part can be renewed easily and cheaply. In other words, they have attempted to satisfy the needs of the man of moderate means who wants a generating set, but who wants neither to expend his life's savings thereon nor to reconstruct his house for its reception.

Judging from the specification, Messrs. Lyons have succeeded in this ambition. The fixed pattern is intended for permanent installation, while the portable set, although, of course, it may be used quite satisfactorily for lighting work, is chiefly suitable for charging accumulators—especially in connection with breakdown jobs on outdoor battery installations.

In each set the engine is of the four-stroke type, is air-cooled, fitted with overhead valves, renewable brushes to rocker arms and has an output of 1½ h.p. The crankshaft is of heat-treated steel, hardened and ground, running in a seven-diameter length phosphor-bronze bearing. The set is fitted with a Hardy disc flexible coupling and mechanical hand starter, similar to a motor-cycle kick starter. The dynamo, which has a rating of 300 W at 24 V when running at 1 700 revs. per min., is fitted with laminated poles and ball bearings throughout. The switchboard is equipped with an ammeter, voltmeter, charging switch, and single-pole switch and fuses, as well as a shunt regulator for final charge. The petrol tank holds 1½ galls., sufficient for 15 hours' running. The oil storage is sufficient for several weeks, as the plant only uses three drops of oil per minute. The weight of the fixed pattern is 85 lb. and of the portable pattern 55 lb. The dimensions of the fixed pattern are 25½ in. by 14 in. by 21 in. and of the portable pattern 20 in. by 10 in. by 18 in. The fixed-pattern set is supplied complete with either a 50 Ah or a 100 Ah Chloride battery.

It will be noted that these sets are entirely free from the automatic and semi-automatic contrivances which complicate the average lighting set. Now these things are undoubtedly good, and are undoubtedly worth the money of the man who can afford them, in the same way as a Rolls-Royce is an excellent investment for the millionaire motorist. There is, however, a very much larger demand for inexpensive cars, from which every superfluous complication and luxury has been stripped, and we are convinced

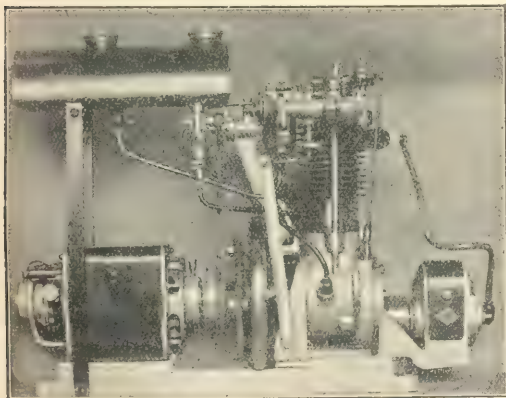


FIG. 3.—"BUNGALYTE" GENERATING SET 300 WATTS 24 V.

that this is also true of lighting plants. Messrs. Arthur Lyons & Company have, we think, produced a generating set which should find a ready market in these exigent and indigent days.

POCKET GENERATING SETS.

- Flash-lamps, in which current is provided by a hand-operated dynamo, are both useful and fascinating. For it certainly is fascinating to witness the instantaneous conversion of finger pressure into light—the *apothesis*, so to speak, of an unreciprocated hand-shake. (No pun was, is, or ever will be intended by the compiler of these notes, although the fact that this note is concerned with the products of Messrs. THEO & COMPANY, of 6, Hatton Garden, Liverpool, might suggest the contrary.)

Messrs. Theo & Company supply "Electro-Automate" flash-lamps in four patterns, viz., a pocket lamp with side lever; a strap lamp, equipped with neck strap and a poll ring at bottom, as shown in Fig. 4; a signalling lamp with side lever, spare lamp in handle, and



FIG. 4.—"ELECTRO-AUTOMATE" STRAP LAMP.

One of four patterns of hand-operated flash lamps supplied by Messrs. Theo & Company.

a two-colour slide; and a combined pocket lamp and laryngoscope for medical use. This last pattern is particularly ingenious. The pocket lamp is complete in itself with ordinary bulb and lens. In the side of the case, however, there is a plug hole. When the plug of the laryngoscope extension is inserted in this hole the pocket-lamp bulb is automatically thrown out of circuit and the current is diverted to the bulb of the laryngoscope. This equipment is supplied complete with the following accessories: concave mirror, tongue depressor, three magnifying bulbs, ebonite contact plug. All bright parts are silver plated.

"COSMOS" DOMESTIC ELECTRICAL DEVICES.

When giants unite one may expect miracles, and certainly the Vickers-Westinghouse conjunction has produced many notable developments. Although only a short time has elapsed since the two firms combined their electrical departments under the joint style of METROPOLITAN-VICKERS ELECTRICAL COMPANY, LTD., the new Company has already consolidated its position in several important fields of manufacture wherein neither firm was previously represented.

In the domestic appliance field, where the individual Companies had achieved valuable reputations, the combined organisation has expedited progress in a remarkable manner. The products of Westinghouse and Vickers were good, but those of the Metropolitan-Vickers Company are better, and are made in a wider range of designs.

These appliances—kettles, irons, jugs, hotplates, grills, toasters, urns and radiant fires—are being sold under the trade name of "Cosmos," and a number of them were illustrated and described in THE ELECTRICIAN of April 8, 1921. The present reference is inspired by a new catalogue recently received from the Company.

In the accessory section of this catalogue there is, however, one item of entirely novel and meritorious design which has not been previously mentioned. This is the M.V. Super Switch Plug (Fig. 5). It consists essentially of a double-pole rotary switch, actuated by an interlocking three-pin plug top. The plug pins are solid, the third one being for an earth connection. The switch can only be closed by inserting the plug top and turning it, and the plug top cannot be withdrawn until the switch has been turned off.

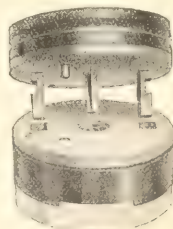


FIG. 5.—THE M.V. SWITCH PLUG.

When the switch is in the "off" position, any heating or cooking appliance connected to it is dead on *both* poles. This is a great (and rare) advantage. No live parts can be seen or touched whether the plug is in or out, and when the plug is in the device may be used as an ordinary double-pole switch. The plug can only be inserted in one way, so that there is no possibility of the polarity being reversed.

In every respect the M.V. Switch Plug appears to be completely fool-proof.

Reviews.

A Course in Electrical Engineering. Vol. I.: Direct Currents.
By C. L. Dawes. (London: Hill Publishing Company.) Pp.
xiv.+496. 25s. net.

The author of this book is assistant professor of electrical engineering in the Harvard Engineering School. The general character of the contents are indicated fairly well by the following quotation: "For some time past the editors of the McGraw-Hill electrical engineering texts have experienced a demand for a comprehensive text covering in a simple manner the general field of electrical engineering. The book begins with the most elementary conceptions of magnetism and current flow, and gradually advances to a more or less thorough discussion of the many types of machinery, &c., which are met in practice." There is, presumably, a sister book—Volume II.—on alternating currents.

At a first glance one is reminded of the well-known and widely-used book on "Elementary Lessons on Magnetism and Electricity," by S. P. Thompson, as we pass in rapid survey the principles of magnetism and magnets, electro-magnetism, resistance, Ohm's and Kirchhoff's laws, batteries, instruments, electrostatics and the more important applications in machines and transmission.

The author keeps a close eye on practice the whole time. Thus, as early as p. 14 we read about the magneto, on p. 22 about the plunger magnet, and so on throughout the book. The result is a first-rate introductory text-book on electrical technology.

Having said this, we shall now try to find faults in order that the reader may not deem our criticism to be one-sided. On p. 38 we read: "In the *English* and American wire tables the circular mil is the standard unit of wire cross-section." The italics are ours. The author is not alone in the way he deals with the temperature coefficient of resistance. After pointing out the inconvenience of working back to 0°C ., he shows how this can be avoided by using the coefficient $1/(234.5+t)$, and gives a table similar to that in B.E.S.A. Report No. 72. Yet

at the same time he gives the simple formula $\frac{R_2}{R_1} = \frac{234.5+t_2}{234.5+t_1}$

and remarks that 234.5 is an easy number to remember. Now, surely it would have been much better to advocate the latter outright and reject the more laborious method given in the standard rules.

Our next quarrel is with the author's definition of the international units. Not only are we given the correct definitions of the international ampere (in terms of the amount of silver deposited per second, though to be in strict fashion the author should add two noughts after 0.001118) and the international ohm (in terms of a column of mercury), but the international volt is also defined in terms of a normal Weston cell. Now, this is too hard on Ohm's law. When the I.E.C. in 1908 replaced the volt specification by the ohm specification the international volt was then defined as the P.D. across an international ohm when carrying an international ampere. In passing, it may be said that few authors seem to take the trouble to keep up-to-date with the progress of international units; and in this respect it would be well if the excellent example in Ayrton and Mather's "Practical Electricity" were more widely followed. The last point upon which we shall animadvert is the treatment of armature windings. To our mind, in a book of this nature, this subject ought to be dealt with in a purely practical way. Thus, instead of giving

all manner of multiplicities and re-entrancies, it seems to us to be much better to tell the beginner that the two windings used in practice are the lap-connected winding, with as many circuits as there are poles, and the two-circuit wave-connected winding. In addition, a wave-connected winding with more than two circuits, and subject to severe limitations, is occasionally used by certain bold (at one time, foolhardy) designers, who value their art more than their job. The limit of 200 A per path is obviously a slip.

Well, we have said our worst, and the book remains a good book. A student is being well taught when he is told that air is not a particularly good dielectric, but it is one of the best insulators. Throughout the book examples are worked out and the last 70 pages are occupied with questions and problems on the several chapters. The book is attractively bound, and remains open when opened. S. PARKER SMITH.

Lichttechnik. Edited by L. Bloch. (Munich: R. Oldenbourg.) Pp. xix.+591. Mk. 126.

This volume, compiled by a committee of members of the German Illuminating Engineering Society, and edited by Dr. L. Bloch, contains a useful survey of developments in regard to photometry, illuminants and practical lighting problems. An introductory summary is contributed by Dr. Wedding. The first section of the work deals with scientific principles underlying light production, the second with photometry and the third with hygienic aspects of lighting. Following this we have chapters devoted to gas and electric lighting, acetylene, oil and other illuminants, and shades and reflectors. Dr. Bloch himself deals with the planning of lighting installations, and the final sections deal with various problems such as the lighting of streets, schools, railways, &c. There are also special sections relating to searchlights and the use of artificial light for photography. The volume is completed by a comprehensive series of tables and an index. Each section is by an expert in his particular field and the work as a whole is well worth study by English readers, though naturally the developments described are chiefly confined to those occurring in Germany.

It is naturally impossible to do more than single out a few points for special mention. Germany, it will be noted, still holds fast to the Hefner unit of light candle, and looks askance at the "international unit" adopted in common by Britain, France and the United States. The illumination-photometers illustrated are of a more elaborate, though possibly more accurate type than those usual in this country and the United States. The data given relating to vacuum and gas-filled glow lamps resemble generally those applying in this country, but it may be noted that a 25 W 100 to 130 V type is listed; as this operates at approximately 1.1 W per horizontal candle (Hefner) its utility as compared with vacuum type lamps seems somewhat doubtful. The review of arc lamps and vapour lamps is interesting. A new enclosed flame arc lamp has been evolved which seems to have promising features, and it is evident that considerable progress has been made in the development of neon lamps. The section on searchlights also contains some interesting data. The Goerz (Beck) searchlight is credited with a crater-brightness of 115 000 c.p. (Hefner) per square centimeter—approximately equivalent to 600 000 candles per square inch. Even this value is exceeded by the enormous brightness (of the order of 1 500 000 candles per square inch) said to have been obtained by Lummer with an arc working under 22 atmospheres pressure, though we gather that this method has not yet proved serviceable in practice.

J. S. D.

Germination in its Electrical Aspect. By A. E. BAINES. (London: George Routledge & Sons.) Pp. xxi.+185. Price 12s. 6d. net.

Mr. Baines, the author of this book, has already published two other volumes, on what he calls Electro-Pathology and Electro-Physiology. In the present work he attempts, and he believes probably correctly that it is the first time it has been attempted, to give a consecutive account of the electro-physiological processes concerned in evolution, from the formation of the pollen grain to the completion of the young plant. In addition, he pursues his studies into electro-physiology generally,

with a view still further to establishing his opinion "that nerve force is generated in the lungs, with every inspiration, by the combination oxy-hemoglobin, and that the E.M.F. is dependent upon there being a normal quantity of iron in the blood and of oxygen in the air." The book is dedicated to the "educated men and women of the world," and the hope is expressed that some of them will come forward and assist in the dissemination of a "great truth." C. P.

Shorter Notices.

Elements of Illuminating Engineering. By A. P. TROTTER. (London: Sir Isaac Pitman & Sons, Ltd.) Pp. xii + 103. 2s. 6d. net.

In this little booklet Mr. Trotter sets out to provide a brief summary of the elements of illuminating engineering, such as will usefully supplement the rule-of-thumb commonly used by engineers. Much of the information available in the author's previous work on "Illumination, its Distribution and Measurement," is presented in a condensed and revised form and additions have been made in the form of further information on electric lamps and hints on planning installations. There is also a section on natural lighting. The values of illumination desirable for various purposes are arranged in a somewhat novel way, the figures being set out in progressively increasing foot-candles, and the processes for which each range of values is suitable, tabulated underneath. This seems preferable to the unwieldy and unduly detailed schedules sometimes presented. We notice that the author concludes that carbon filament lamps are only preferable to metal filament lamps when energy can be purchased at $\frac{1}{4}$ d. or less per kilowatt-hour. Mr. Trotter shows characteristic lucidity and skill in the selection of matter. The figures are clear and simple, and the book forms a useful introduction to illuminating engineering.

Electrification of Railways. By H. F. TREWMAN, M.A. (London: Sir Isaac Pitman & Sons.) Pp. ix + 78. 2s. 6d. net.

No one will deny that electric traction is one of the most important and interesting of present day electrical problems, but the fact that it is being increasingly discussed and its methods and practice are exciting increasing interest are hardly reasons for composing a primer on the subject. This book, however, is written not only for electrical engineers, but for railway men and non-technical readers generally, and it is designed to fill the hiatus which exists in the commercial aspects of the question. This is a laudable endeavour, but it is one that is very difficult of fulfilment and not over useful when it has been fulfilled, for the conditions are so different not only on each railway, but on each section of each railway, that no general solution can be laid down for most of the problems which arise, a condition which necessitates each part of any electrification scheme, whether it be engineering or commercial, being considered by itself. This the author not only recognises, but rightly emphasises in discussing such questions as the problems of production, and in giving figures which show clearly the financial advantages of electrifying lines where the traffic is dense. Such questions as traction requirements, the relative advantages of direct-current and alternating-current motors, the various systems and types of electric railways and the great question of steam versus electric traction generally are also discussed. The value of the book would be greatly increased, especially for the public for whom it is designed, if a short bibliography were added.

Tramway Motorman's Handbook. By W. S. IBBETSON. (London: E. & F. N. Spon.) Pp. vi + 208. 6s. 6d. net.

The Fireman's Handbook and Guide to Fuel Economy. By CHAS. F. WADE. (London: Longmans, Green & Company.) Pp. 84. 2s. 6d. net.

These two books form a new class of educational text-book. They are not designed for the student in a technical college or school but for what, for want of a better term, may be called the intelligent artisan who is anxious to add to his practical knowledge a little information on the why and wherefore of the operations he is daily carrying out. Mr. Ibbetson's book is apparently written mainly for tramway drivers on the L.C.C. system, and, although he apologises in his introduction for having to use certain amount of theory, the percentage of this powder is so small to the large quantity of practical jam that no one need be afraid of taking the mixture. The book is well got up and illustrated and should be of great use not only to those for whom it is primarily intended, but also to the beginner in electric traction matters.

In these days of coal troubles the more that is known about fuel economy by the largest number of the population the better, and this is particularly necessary for those whose work is the handling of coal in boiler houses. Mr. C. F. Wade is a well-known

expert on this subject, and has produced in a few pages of simple matter a large amount of information. He deals at some length with the thermal qualities of coal, the way in which coal is and should be burned, the objects that should be aimed at in boiler design and the care of such apparatus as feed pumps, economisers, steam mains, drains and traps, as well as the boilers themselves. The book is well illustrated with practical drawings, and there is a useful chapter on boiler efficiency, boiler tests and trials, and another on rules for the working and care of boilers and furnaces.

Bibliotheca Chemico-Mathematica. Vols. I. and II. (London: Sotheran & Company.) Pp. xii. 964. 43 3s.

A catalogue from Sotheran's is not a publication to be glanced at and lightly cast aside, and when that catalogue relates to old and rare books in mathematics, astronomy, physics and chemistry it is deserving of close study, not only from the instructional point of view, but for historical reasons, even if such close study does lead to that envy of other people's possessions which is the most degrading of all emotions. These two large volumes contain, as far as we have been able to ascertain, every work of importance now procurable, but they rightly exclude all that numerous series of books which are not books but merely compilations, and of which perhaps more examples are to be found in electrical engineering than in any other branch of literature. To the person who, like ourselves, is often asked to recommend books such a publication as this will be of the greatest value and for this purpose a very carefully arranged index will be found not the least useful part. On the other hand, the most interesting part of the book are undoubtedly the notes which, when occasion requires, are added to the description of each volume and which written in an incisive and informative way add a touch of humour and life to what easily might be a dry-as-dust compilation. The volumes are marred by a few obvious misprints which seem inseparable now-a-days from the publication of any work, but in general the get up is excellent, and this applies particularly to the reproductions of title pages and other parts of the rare and interesting books which are in Messrs. Sotheran's possession.

Correspondence.

ELECTRICITY METERS *versus* CURRENT LIMITERS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I note that in the current issue of THE ELECTRICIAN Mr. A. H. Dykes refers to a Paper presented by Mr. Hancock and himself before the Institution of Electrical Engineers in 1908, and that in this Paper it was suggested that a current limiter similar to the one that we are manufacturing should be used.

Although apparently the possibility of such an apparatus had been discussed before ours was put upon the market, yet I think I can claim that the Edison limiter is the first one of its type to be put on the market and under these circumstances I still think that I am right in claiming it as a new device.—I am, &c.,

FOR THE EDISON SWAN ELECTRIC CO., LTD.,
London, E. H. MILLER,
August 5th. Sales Manager, Inst. and Meter Dept.

AN "ALL-ELECTRIC" CONVENTION.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Regarding the "All-Electric" Convention, our view is that, whereas such a Convention would have certain advantages from a date fixing point of view, these would be more than outweighed by: The necessarily restricted programme of Papers and the difficulty of securing adequate accommodation. You will find yourself confined to seaside towns in the off season; and last, but not least, we think that the social element, which is such a pleasant feature of some of these meetings, would certainly suffer. In this respect you will observe that we differ from your Editorial note.—I am, &c.,

METROPOLITAN-VICKERS ELECTRICAL CO., LTD.,
A. E. DU PASQUIER,
Manager, Publicity Department.
Trafford Park, Manchester, August 5th.

Obituary.

Samuel Alfred Varley.

We regret to record the death of Mr. SAMUEL ALFRED VARLEY, A.M.Inst.C.E., which occurred recently at Winchester at the advanced age of 90. By his death one of the last living links with the early pioneer days of electricity has been severed, as it is recorded that at an early age he used to accompany his father to a little chapel where one of the leading elders was Michael Faraday, to whom he was taught to look up in the two-fold capacity of religious teacher and scientific exemplar. With such early beginnings it is not unnatural that Mr. Varley's thoughts were turned in scientific directions and that at the age of 14 he commenced to study chemistry and to attend every scientific lecture to which he could obtain access.

In 1849, when electric illumination was being publicly advocated by Staiter, Mr. Varley, in conjunction with his elder brothers, made numerous experiments on the subject and in the course of these experiments constructed with his own hands some hundreds of battery cells. Fortunately, or unfortunately, the troublesome manipulation attendant on the use of this apparatus caused him to turn his attention to magnetism. As a result of his researches into this subject he partly constructed a machine whose leading features were field magnets of bundles of tempered steel wires, but, chiefly through not having command of engineering tools, the apparatus was left in an unfinished condition and was never completed.

In 1852 Mr. Varley entered the service of the Electric Telegraph Company and assisted in some experiments on the retardation of electric signals through underground and submarine cables. In 1853 he was appointed to the charge of the telegraphs of the Liverpool district and about this time constructed an electric chronograph to measure the small intervals of time occupied by the passage of the electric signals through time balls, and the time lost in the discharging apparatus. Mr. Varley also made the time ball to record automatically the fact of its having been discharged, so that the station whence the signal emanated could see that the apparatus had acted properly. As a result of this invention he was subsequently entrusted with the design of time ball apparatus at various places abroad, and in the Spring of 1855 was placed in charge of the first field telegraph used in war. This, of course, was in the Crimea, and after the fall of Sebastopol he took charge of the submarine telegraphs connecting Constantinople and Varna.

He took a great interest in the electrical problems connected with the Atlantic cable and his views were embodied in a Paper read before the Institution of Civil Engineers on "The Electrical Qualifications Required in Laying Submarine Cables." In this Paper he took up an attitude of opposition to the electrical advisers of the Telegraph Company in which attitude he was supported by Faraday. In a Paper read before the Royal Society of Arts in 1859 he suggested the use of artificial lines which have since proved of such value in connection with duplex working.

In 1866 he constructed the first machine which might correctly be termed a dynamo. This machine is now in the museum at South Kensington, and for its invention Mr. Varley was awarded the gold medal of the Inventions Exhibition in 1885.

In 1876 he patented a compound wound dynamo which landed him in trouble with the Scotch law courts on a patent question, but after the case had been fought to the House of Lords, judgment was given in his favour. The commercial value of this invention was not realised at the time and the patents were allowed to lapse. But some years after when a claim was made by the Brush Corporation for priority of patent rights as regards the compound wound machine the priority of Varley's patent was recognised.

On the recommendation of Earl Rosebery a Civil List pension was awarded to Mr. Varley in 1894 and on the recommendation of Mr. Balfour this was increased two years later.

Prize For An Electricity Scheme.

The Local Government of the Province of LIEGE, Belgium, have been closely considering how best to re-organise their existing and projected generating stations in order that the electrification of the Province may be most advantageously effected. In order to assist them in the solution of this problem they are offering four prizes, one of 25 000 francs, one of 15 000 francs and two of 10 000 francs, for the four best schemes which may be submitted on or before March 1, 1922. Full conditions as to this competition and details of the present position of electricity supply in the province may be obtained from the Governor, Place St. Lambert, Liege, or from the headquarters of the Technical Department, 33, Rue Derchis, in the same town.

Wireless Communication Between Power Stations and Sub-Stations.*

By COUNT ARCO.

Telephonic communication with sub-stations is complicated by considerations of expense, and the disturbances caused by the high-tension overhead lines must also be taken into account. The outlines of wireless telephony are well known. Undamped oscillations are best used with free radiation. But the amount of power that is required increases approximately with the 1/7th power of the distance, and further difficulties arise owing to the number of stations that must be erected.

In order to avoid this, it has been proposed to use the existing overhead wires, and to transmit the energy of oscillation along them. This has great advantages from different points of view. It might be thought at first that this method would be subject to the ordinary telephonic disturbances. Consequently communication might break down just at the moment when it was most wanted. But it has been found by experiment that this is not the case, unless all the transmission lines are simultaneously broken; in all other cases, communication by wireless means can be carried out in spite of any disturbance. The slow loss of intensity along the line gives the great advantage of being able to work with much greater intensities at the receiving end, and therefore with a higher factor of safety than with free radiation. The great intensity at the receiving end enables the bell, calling attention to the coming message, to be constructed in quite a simple fashion, and atmospheric disturbances are practically of no account. No doubt other difficulties arise, but they can be overcome in the present state of our knowledge. The windings of an ordinary transformer are a kind of short circuit of the nature of a capacity, and thus offer little resistance. The trouble from lightning arrester coils is more serious. Their high resistance can be neutralised by antennas arranged along the line in such way as to be in tune with the high frequency system. The waves pass over these electric "frogs" in such a way as to return to the transmission lines.

THE GOLPA-RUMMELSBURG INSTALLATION.

The German Company for Wireless Telegraphy has dealt with a number of power stations in the country districts in the last six months, and the installations work quite satisfactorily. The most important of these are that at Golpa-Rummelsburg, dealing with a radius of 135 km., and that at the Schichau works at Elbing, dealing with rather more than 50 km. The periodicity of the power transmission lines is 50, and that of the high-frequency oscillations 150 000 or 200 000; owing to this difference it was possible to diminish the disturbances by the use of special compensating devices at the receiving end.

For supplying power to the cathode-tube generators a small battery is used for giving a small current at 10 V to the incandescent filament, and another source of power, generally a rotary converter, giving about 600 V on direct current, supplies energy to the anode. The cathode-tube is then connected up on Meissner's principle, and delivers an absolutely constant amount of energy at a known amplitude and frequency. From this oscillating circuit the power is transmitted to the line, preferably on the Lecher system. This consists of two wires, about 100 metres long, which are mounted on the masts of the transmission lines, and run parallel to the lines for a few metres. Both wires are coupled through a coil to the oscillating circuit of the generator. The efficiency of this kind of transmission is only high when the two wires are more closely coupled to two of the transmitting lines than to the rest. With the ordinary system of transmission lines, it is easily possible to arrange them so as to be nearer to two of them than to the third. Thus there is very little free radiation, and most of the energy is communicated to the two transmission lines. A similar arrangement is used at the receiving end. The direct current is, if necessary, intensified by a low-frequency cathode-tube and then transmitted to the telephone. It is especially necessary to see that at the receiving end there are no upper vibrations superimposed on the direct current, as frequently happens with dynamos, commutators, and brushes, and special arrangements must be made with this object in view. By using different transmitting wave-lengths at the two ends it is possible for both persons to speak at the same time, and this has undoubted advantages. The difference in wave-length must be fairly considerable. Any disturbance due to such a cause can be obviated by the use of a tuned choking-coil circuit. The wave-lengths cause certain complications if there are a number of sub-stations; but it is possible to deal with this by automatic appa-

* Lecture delivered before the German Institution of Electrical Engineers at Hanover. Abstract from the "Elektrotechnische Zeitschrift."

ratu. Modern cathode-tubes have a very high vacuum, and give absolutely constant results, if the auxiliary apparatus is kept in good order. Slight changes may be due to alterations in the dielectric, but the factor of safety is so high that this produces very little result. With this directional telephony, the intensity at the receiving end is very high; therefore, if a simple rectifier is used it is possible to employ an ordinary moving-coil instrument or a polarised relay of high sensitiveness, which can be provided with contacts and serve as a relay to work the local bell circuit.

COMMUNICATION IN CASE OF BREAKDOWN.

When the line itself is injured and repairs have to be executed it is important to get these repairs done in the shortest possible time. Under such conditions it is necessary to have some certain method of communicating with the power station. Special apparatus has therefore been designed for this purpose.

This is either portable, or can be conveyed in a motor car. An emergency antenna is used similar to that employed under ordinary conditions.

Under these circumstances it will be found that the ordinary telephonic method is much more expensive than the wireless one without being in any way superior in case of emergency. But this is not the case if the distance is less than 20 km.; principally owing to the fact that as yet it has been impossible to devote much attention to the cheaper design of small apparatus. Apparatus has usually been designed for stations of a given size, so that in passing from one size to the next, there is generally a considerable difference in cost. In the cost of maintenance, the expense of new tubes is the greatest item. The main thing is only to use the tubes when they are wanted and to get tubes that have the longest possible life. The lives of tubes have been much improved of late, and further improvements are likely. If they are kept at a low temperature the life is correspondingly improved. No doubt the tubes are then less efficient, but the cost of a little extra current is not so great as the cost of the new tube. As a rough estimate it can be stated that if there are 20 conversations a day, each lasting 3 minutes, the annual working costs will only be about 2 per cent. of the initial capital outlay.

B.A. Edinburgh Meeting.

Details of the Edinburgh meeting of the BRITISH ASSOCIATION, which is to begin on Wednesday, Sept. 7, have now been issued. At the inaugural meeting on that day, Sir Edward Thorpe will deliver his presidential address on "Some Aspects and Problems of Post-War Science—Pure and Applied." The work of the sections will begin on the following morning, when among the addresses to be delivered by the sectional presidents will be the following: *Section A*, "Problems of Physics," by Prof. O. W. Richardson, F.R.S.; *Section F*, "The Principles by which Wages are Determined," by Mr. W. L. Hichens; *Section G*, "On Water Power," by Prof. A. H. Gibson.

A number of evening discussions and public lectures will be given during the course of the meeting, among them being one by Sir Oliver Lodge on "Speech through the Ether; or, The Scientific Principles Underlying Wireless Telephony." Several interesting excursions in the neighbourhood have been arranged.

The "Lamlok" Sealed Locking Ring.

The rapid development of electricity supply to small houses at a fixed charge per lamp per week has perforce necessitated the introduction of some device for preventing the consumer from replacing the lamps originally installed by those of a higher wattage, and so improving his illumination at the supply undertaking's expense. A device which, it is claimed, meets this want has recently been introduced by Messrs. LAMLOK, LTD., of 36, Rust-hall-avenue, Chiswick. This device, which we illustrate herewith, is an adaptation of the ordinary "Lamlok" locking ring, and consists in using a square boss instead of the ordinary round boss on the ring. Through this boss holes are drilled for the insertion of a wire to which a lead seal can be attached. So long as the seal and wire are intact it is certain that the original lamp is still in place and all is well, a fact which the inspector can ascertain at a glance.



THE "LAMLOK"
SEALED RING.

The Kent Electricity Area.

In July, 1920, a committee of six engineers, elected by undertakings in Kent, outside the area of the London & Home Counties Electricity District, was appointed to investigate the existing position and the potential requirements of electricity supply. The Committee's report was presented to the Electricity Commissioners in November, but the Commissioners have hitherto been too busy to give the matter consideration and so they have not yet come to a decision on the recommendations made. The report states that the bulk of the existing demand in the western portion of the area is for manufacturing, for lighting and colliery purposes in the eastern portion, while in the central area, being mainly agricultural, electrical developments are practically non-existent. The manufacturing area is defined as that lying approximately to the north-west of a line drawn through Tunbridge Wells, Maidstone, Sittingbourne and the coast. The eastern area lies approximately east of a line drawn a little west of Whitstable, Canterbury and Folkestone. The only generating plants in the central area are one of 500 kW at Ashford, belonging to the South-Eastern & Chatham Railway, and one of 250 kW at Faversham.

The demand for electricity for manufacturing purposes in the western area is a very rapidly increasing one, whereas in the eastern area the lighting demand is increasing at a more normal rate. In neither area has the development of electricity supply attained proportions in any way comparable with the more highly industrialised districts of Great Britain. The existing position of affairs in the eastern area, however, is likely to be entirely altered as the existing colliery undertakings in the south-east Kent coalfield become fully developed, and when new collieries are sunk in the undeveloped portion of the coalfield. Another important factor which may in the future influence the scope and direction of electrical development is the electrification of the South-Eastern & Chatham Railway. The materialisation of this project might influence general electrical development not only in the western and eastern areas, but also in the intervening agricultural area, altogether apart from the possible construction of the Channel Tunnel.

CONTROL OF DISTRICT.

In regard to the immediate problems, the Committee think that the existing arrangements are not adequate to deal with the future requirements of the district, which should be controlled by one Joint Electricity Authority, although in the first instance there will probably be two independent areas of supply, situate in east and west Kent, respectively. As development matures, however, it may become desirable to link up these two areas. Up to the end of 1919, the actual demand on the stations of the western area was about 6 458 kW, whereas the demand for 1923 may approximate to 15 120 kW; when the S.E. & C. Railway has been electrified, however, the demand may reach 27 420 kW. The total generating plant in the area approximates to 15 725 kW, and the amount of three-phase 50-cycle plant totals 12 220 kW of which a considerable proportion is of modern efficiency. In addition, there are important units of generating plant in private and other stations, e.g., Chatham Dockyard, &c. Ignoring the financial side of the matter, it would appear desirable to consider whether as a preliminary step the Maidstone and Chatham generating stations should be linked up to form the nucleus of an interlinking system for the western area, which might gradually be developed from this basis.

The major portion of the electricity in the eastern area will probably in the future be consumed at the collieries and generated by means of coal produced from them. A preliminary survey indicates that considerable benefits might accrue if the four existing collieries were linked up, and also connected with some of the more important towns in their vicinity, such as Dover, Canterbury and Folkestone. The effect of linking up, with the benefits of improved load factor and increased stand-by plant to which it would give rise, would probably go a long way towards meeting any increased demands.

ELECTRIFICATION OF S.E. AND C. RAILWAY.

The S. E. & C. Railway has prepared a scheme for the electrification of the lines to Chatham and Tonbridge, and in the not far future electrical operation of the main and Kent coast lines will be considered. The demand for electricity which would arise in the event of railway electrification would be some 12 300-kW in the Western area, and 13 200-kW in the Eastern area. For railway operating, a supply of three-phase current at 25 cycles is desirable, because at this frequency it is possible to use, for the production of direct current at the required pressure of 1 500 V, rotary converters of proved reliability, and of comparatively efficient and inexpensive design. On the other hand, the whole of the modern three-phase plant in the district is designed for the generation of current at 50 cycles, and in order to convert of this frequency to direct current at 1 500 V, it is necessary to use either comparatively costly and inefficient motor generators, or comparatively unstable and consequently unreliable rotary converters. The Committee feel, therefore, in view of the advantage to the general body of consumers, of the railway being supplied from the same source as the other demands if this is found to be practicable, that the Joint Electricity Authority should examine the conditions and quantities involved before coming to a decision as to the frequency of supply to be ultimately adopted as standard in the District.

CONCLUSIONS.

It is obvious that the electricity supply of the district as a whole would be very much improved if the more efficient stations were interlinked, the out-of-date ones scrapped, and further demands supplied by additions to those stations most favourably situated for fuel, water and access

or by a new generating station altogether, which combined these advantages. The question of finance is, however, the dominating factor. Before any scheme or schemes on the lines suggested are entered upon it would be necessary to know where the money is coming from to carry them out, and upon what terms it would be provided.

The following is a summary of the conclusions arrived at:—(1) The district under review is at present inadequately supplied with electricity, and insufficiently organised in view of modern developments. There is an urgent call for some form of control to be set up to supervise and mould the individual undertakings into a well organised whole.

(2) To enable this to be done a joint electricity authority should be set up forthwith for the district.

(3) To commence with the district should be divided into two main supply areas, viz., the Western area and the Eastern area, with the ultimate aim in view of their becoming interlinked and forming one complete whole as far as transmission is concerned.

(4) The most promising line of development at present would appear to take the form of interlinking the best of the three-phase stations, on lines leading to an ultimate general district supply.

(5) If any organisation is to be set up to deal with the matter, it is important it should be formed at an early date, and thereby avoid as far as possible further independent action in capital expenditure tending to prejudice the success of a joint comprehensive scheme.

(6) It should be left to the Joint Electricity Authority to decide upon what periodicity the district as a whole should ultimately be developed.

The members of the Committee were:—Messrs. E. O. Forster Brown, E. E. Hoadley, H. B. Harvey, J. A. Forde, A. Raworth, and Thos. Hosketh (acting secretary). An appendix to the Report gives particulars of the yearly maximum demand of the stations, the existing plant, &c.

Hydro-Electric Works in Formosa.

The first hydro-electric undertaking in Formosa was started in 1905, but as the Government decided to control the supply of electricity it took over the station, which was on the Shanten River in Taihoku Province. A second station was opened in 1909, the capacity of the two being about 4 000 H.P. Between 1909 and 1917 three other works were inaugurated bringing the total capacity of the generating sets to 11 200 H.P. H. M. Consul at Tamsui, Formosa (Mr. G. H. Phipps), in a recent report states that the war caused an increased demand for electric power and a project has been formed for utilising the waters of the Dakusui River and of Lake Candidius. To facilitate the carrying out of the scheme, the Formosan Government decided in 1919 to float a semi-official, limited liability company to take over all the Government's electrical undertakings. This company received a franchise for the Lake Candidius scheme and commenced work in 1920, though it will not be completed before 1924 or 1925. The estimated cost is 48 000 000 yen, of which the civil engineering construction work will take 19 900 000, and the electrical work 26 500 000 yen.

HYDRAULIC DETAILS.

The scheme provides for leading water from the Dakusui-kei (river) from an intake in the Shimagaigahara region into Lake Candidius, a mountain lake some 6 sq. miles in area, at a height of 2 400 ft. above sea level. At present it is gradually drying up, but when waters of the river are let in its surface will be raised 75 ft. The waterway from the Dakusui River to the lake will be 12½ miles in length, in the course of which there will be 12 tunnels, five covered and 11 open cuttings, &c. The volume of water at the intake on the Dakusui River will vary between a minimum of 300 cubic ft. per second and a maximum of 1 600 cubic ft., or an average of 954 cubic ft. This will allow a steady flow at the exit from the lake of 900 cubic ft. per second, by means of which it is expected to generate a maximum of 140 000 H.P., or 100 000 kW with a minimum of 65 000 kW. It is hoped eventually to construct a second power station some 4 miles below the first. A fall will be obtained of 465 ft., and it is hoped to generate a maximum of 62 000 H.P. The two stations together would thus produce 202 000 H.P., or a maximum of about 145 000 kW. On the completion of the first part of the scheme energy for light and power will be transmitted all over the island and the entire electrification of the Government railway system is even spoken of.

MODERN CONSTRUCTIVE METHODS.

In order to carry the plant and materials required for the works a railway is being built from Nisui to Monpaitan on the same gauge as the Formosan Government lines (3ft. 6 in.) and from Gaishtatei, about 1 mile below Monpaitan, an aerial railway will run to a point above the western shore of Lake Candidius. From there connection will be made with a light electric railway to Suma-an, 2 miles from the lake. A network of other light railways will also be constructed for the transport of plant and materials, and altogether 33 miles of light electric railway, 20 miles of push-car lines and 10 miles of aerial wireways are being constructed. For the supply of electric power for running the light railways and wireways, for working the rock-drills for piercing the tunnels, &c., a power station has been erected at Hokusanko, 4 or 5 miles below the town of Horisha, in the gorge of the Nanko River. A concrete dam has been constructed with an intake on the right bank of the river, and the water will be led through tunnels a mile in length to the power station. The fall of water at the station will be 172 ft. The station building is completed and the plant (two turbines of 1 200 H.P. each and two electric generators) was to have been ready by June, and the aerial wireway and light railway lines are all expected to be completed by the end of this month.

Pending the completion of the big scheme, steam power stations are to be constructed at Keelung and Shokwa to furnish additional supplies of light and power for the needs of those towns and vicinity. The Keelung station has been begun and work will soon be commenced on that at Shokwa. Keelung enjoys the advantage of cheap fuel, the principal coalfields in the island being situated in its immediate vicinity.

FORMOSA ELECTRIC POWER COMPANY.

On a much smaller scale than the Lake Candidius project and requiring less time for completion is the installation now under construction in the Giran district of Taihoku Province on the east coast. This was begun as a private enterprise of the Tainan Sugar Company, but the big Taiwan Electric Power Company is to take a share. Owing to financial stringency it was decided to form an independent company under the name of the Taiwan Denki Kogyo (Formosa Electrical Enterprise Company), with a capital of 6 000 000 yen in 50 yen shares, of which some were taken up by the Tainan Sugar Company, some by the Taiwan Electric Power Company, some by individual promoters, and the remainder by the general public. The company may eventually be amalgamated with the Taiwan Electric Power Company. The scheme provides for conducting water from the upper course of the Dakuau River (Giran) a distance of about 5 miles to Lake Kyukyute, on the bank of which a power station will be built. This involves the cutting of a tunnel over half a mile long, on which work will soon be commenced. The foundations of the power station are nearly completed. The site is said to be an ideal one, and there are other sites further down the river where supplementary power stations can be erected. Work was begun in June, 1920, and it is hoped to have the first power station in operation by the end of this year. A fall of 900 cub. ft. of water per second will be obtained and the installation will generate 7 500 kW. A large proportion of the power will be transmitted to the city of Taihoku (about 27 miles distant), to the Taiwan Electric Power Company, which will defray the expense of the transmission wires. The contract for the erection of the installation (other than the transmission lines) has been let to the Okura Gumi, and work is progressing satisfactorily. The cost of the installation is estimated at 471 yen per kW, compared with 600 to 700 or even 1 000 yen per kW in Japan. The Giran district is as yet undeveloped, but it is rich in coal, timber, sulphur and marble, and it is hoped to use the power produced for the development of the local resources. The marble will be used for the manufacture of carbide, and eventually it is intended to undertake cement manufacturing and lumbering. The promoters speak of starting work on a second power station in 1923 and of following that by a third. On the completion of the latter it is proposed to undertake the production of nitrogenous fertiliser from the air. Projects have also been put forward for the utilisation of the water of the Daiko river, in Taichu Province, and of the Dakko river, in Takao Province, and there is also another scheme by the Taito Sugar Company in Taito Prefecture, on the east coast.

Encouraging Technical Discoveries.

For electrical engineers one of the outstanding events of the autumn publishing season will be the appearance of a book by Prof. J. A. Fleming, F.R.S., entitled "Fifty Years of Electricity—Memories of an Electrical Engineer."

The biography, and, still more, the autobiography, of any worker in science and engineering of the eminence of Prof. Fleming must be so interconnected with progress of science and industry itself that they cannot be separated without harm to both. The book may therefore not inaptly be described as a history of electrical progress, a history in which not only is the matter interesting, but the style in which it is written is marked by a simplicity and clarity of expression which might well be a model for any writer of popular science.

In an opening chapter the state of electrical knowledge prior to 1870 is outlined, while subsequently progress in telegraphy and telephony, in dynamos, alternators, transformers and motors, in electric lighting, heating and cooking, in storage batteries, railways and power transmission are dealt with, while theory and measurements and, of course, wireless telegraphy and telephony receive their share of attention.

Prof. Fleming concludes with a strong appeal for the organisation of effective methods of encouraging technical discoveries and improvements. "Science," he remarks, "is said to be the coy mistress who will not be wooed for the sake of her dowry of useful applications."

... If we could have peeped into the laboratories of the Royal Institution in Albemarle-street in the autumn days of 1831 and seen Faraday busy with his magnets, copper wire and discs and iron bars we might perhaps have wondered that so much time and intelligence were not better bestowed, but, as we have seen, those epoch-making experiments have rendered imperishable service to humanity.

Dr. Fleming's book is to be published shortly by the Wireless Press, Ltd.

As the outcome of their experience with electric traction on the NORFOLK and WESTERN RAILWAY the American Railway Engineering Association's Committee on Electrification states that 44 000 V for transmission and 11 000 V on the trolley are practicable on the single phase system for lines having heavy gradients and heavy traffic, and that electrification would probably effect a saving of at least 12 per cent. of the total annual expenditure as compared with steam operation.

Simplex Colliery Lighting System.

Considerable attention has recently been devoted both to the improvement of lighting arrangements in collieries and to the provision of more efficient safety lamps for miners, so that the better conditions thereby obtained enable the work to be carried out with more ease and comfort. To this end, Messrs. SIMPLEX CONDUITS, LTD., of Birmingham, have placed upon the market a range of flameproof and watertight lighting boxes which comply with the latest regulations of the Mines Department of the Board of Trade. These boxes are fitted with "easy wiring" interiors, and with clamping and bonding glands for use in conjunction with single-wire armoured twin V.I.R. cables up to 7/0-036ins. They are equally suitable for use with Simplex screwed conduit, but in this case detachable screwed conduit glands are employed.



The Simplex colliery lantern and box illustrated herewith is intended for high voltage vacuum lamps up to 60 W, while a bracket lantern and box to take the place of a bulkhead fitting, and a lantern and box for high-voltage gas-filled lamps up to 100 W or for two 60 W vacuum lamps, are also made.

The general design and the interchangeability of the component parts render the system both efficient and inexpensive, with the not surprising result that it has proved popular with colliery managers.

New Cars for the Berlin Tramways.

A recent issue of the "Elektrotechnische Zeitschrift" gives a detailed description of a new type of car for the Berlin municipal tramways. These cars, which, as is usual in Continental practice, are of the single-deck type, have accommodation for 51 persons, there being 23 seats and nine places for strap hangers inside the car and for no less than 19 strap-hangers on the platforms.

The tare weight of the cars is 12.9 tons, the maximum width 2.13 m., and the overall length 10 m. In order to employ the room on the platforms to the greatest possible advantage, sliding doors are provided.

Great attention has been paid to the provision of proper illumination, which inside the car is obtained from five metal filament lamps of 16 Hefner candle-power. The usual head and side lights are fitted with similar lamps, and can be switched over as required, depending on the end from which the car is being driven.

These cars will normally be made up into a series of trains consisting of one motor-car and two trailers, and arrangements have been made whereby the switching on and off of the lights on the trailers is effected from the motor car. Supply from the motor car to the trailers is through a series of single-pole plugs, the return circuit being through earth, and the whole of the wiring on the trailers being dead once the connecting plug is removed. The motors have a capacity of 39 kW at 550 V and 550 revs. per min., and drive the road wheels through 1:5 tooth-gearing. Electrical braking is effected by short circuiting the motors, brakes being provided not only on the motor car, but on the trailers as well.

Wireless Control of Locomotives.

According to the "Revue Générale des Chemins de Fer," a series of tests on electrical intercommunication between two electric locomotives driving the same train is now in progress between Paris and Juvisy. The system, which was patented in 1917 by the Orleans Railway Company, consists of an arrangement whereby the locomotive at the head of the train produces a periodical secondary current of low voltage and relatively high frequency. This current is superimposed on the power current and is transmitted by the ordinary circuits which supply the two locomotives. In the locomotive at the end of the train selective receivers are installed which allow different effects to be obtained according to the form of the current transmitted. These secondary currents are used principally for operating the contactor and braking equipment and, of course, avoid the use of a driver at the tail of the train. It is considered probable that the experience gained with this method may make it possible to develop it into an arrangement whereby the necessary devices can be operated by wireless. The arrangement is, of course, more useful on mountain sections where locomotives are used at both ends of the train than for motor trains operated by an ordinary multiple-control system.

It would be interesting to know further details about the arrangements employed and the apparatus used before pronouncing an opinion on the possibility of using "wireless" in this way.

Hydro-Electric Power in Ceylon.

IN CONNECTION with proposals for the DEVELOPMENT of WATER POWER in CEYLON, the Government recently sent Mr. H. T. Creasy, assistant director of public works, to study hydro-electric progress in Sweden. Mr. Creasy has submitted a report, but it is mainly devoted to the conditions to be attached to concessions, &c. The system employed in Norway, under which the State controls directly the water-power rights and derives a direct revenue, is recommended for adoption. The Government is also considering the most appropriate means of and the most opportune time for embarking upon development work, and Mr. Chapman, Director of Public Works, has been sent to Canada to examine the working and administration of hydro-electric plants in Ontario. Mr. Wimalasurandra, engineer in charge of the Ceylon hydro-electric survey, is to report on the Tata hydro-electric works in Bombay. It is estimated that in Ceylon energy could be generated at ½c. per unit. The consulting engineers have advised the Government to carry out the hydro-electric scheme on its own account, but to entrust companies with the distribution of power to consumers.

We learn from "The Times" Commercial Supplement that the preliminary work of surveying, levelling, &c., in connection with the Laxapana-Aberdeen Falls water-power scheme is nearing completion. It is estimated that the electrification of the railway, the construction of electric tramways, and the lighting of the important towns of the island would provide a sound basis for a hydro-electric scheme. There are also a number of tea, rubber and other factories which would take electricity for power and lighting purposes if arrangements could be made to meet their power requirements on a fair basis. It might also be possible to establish electro-chemical industries in the island.

"The Electrician" at Olympia.

The proprietors of THE ELECTRICIAN have secured a prominent position in the gallery at Olympia (Stand 316) at the forthcoming Shipping, Engineering and Machinery Exhibition which opens on Sept. 7 and closes on Sept. 28. Copies of THE ELECTRICIAN, including the recent Marine, Engineering, and other special issues, which are a feature of the journal, will be shown. In addition to the other publications issued by Benn Brothers, Ltd., many electrical books will be exhibited, and copies of THE ELECTRICIAN Tables of Electricity Undertakings and the Electrical Trades Directory will be on sale.

Electric Traction in Chile.

THE conversion to electric traction of the VALPARAISO-SANTIAGO RAILWAY is among the first enterprises undertaken with the capital obtained by the new railway loans raised by Chile. The existing Valparaiso-Santiago line has never been satisfactory on account of the hilly, circuitous route followed, the total distance of 120 miles taking 3 to 3½ hours by the fastest express. The new line proposed will shorten the distance by nearly 40 miles and reduce the time to 2½ hours. In 1914, the "Railway Gazette" states, the Chilean Government decided on the construction of an electric line of the same gauge as the State line now connecting the capital with Valparaiso, via Casa Blanca, but there has always been considerable opposition to this route, which, to a certain extent, has prevented construction from being undertaken until now. In the absence of any better route, however, the Casa Blanca project will be adhered to.

We are not certain whether direct current is to be used or whether Chile is to be a devotee of the single-phase system.

Developments in Nitrogen Fixation.

A statistical supplement to the final report of the NITROGEN PRODUCTS COMMITTEE, which has been compiled by Dr. J. A. Harker, F.R.S., discloses a rather disquieting state of affairs with regard to the production of synthetic nitrogen in this country.

It is pointed out that while the synthetic ammonia factory at Billingham, which was designed to manufacture about 60 000 tons of ammonium nitrate annually for war purposes, was commenced by the Ministry of Munitions early in 1918, at the time of the armistice it was only a very little advanced. It has since been taken over by Messrs. Brunner, Mond & Company, and is being re-designed to manufacture peace products, chiefly fertilisers. A subsidiary company, which will have a capital of £5 000 000, is at present concentrating upon designs for an initial plant to produce 25 tons of ammonia per day, or about 6 000 to 7 000 tons of nitrogen annually. The works, however, are being laid out so that production may be increased to 100 tons per day, and afterwards to a maximum capacity of 300 tons per day, or about 80 000 tons of nitrogen annually. The original site is being extended to about 1 000 acres in all, and this increased accommodation will give ample room for the development of the whole scheme, including the manufacture of a number of by-products. There is also to be an oxidation plant of a capacity of 10 000 to 12 000 tons of nitric acid annually.

A British company, the Cumberland Coal, Power & Chemicals, Ltd., has been formed to erect works in England to operate the Claude process for the manufacture of synthetic ammonia; while the British Cyanides Company are continuing at Birmingham their large scale experiments on fixation of nitrogen by the process employing fuel-heated furnaces. Though these experiments have been partially successful, final conclusions as to the ultimate possibilities of the process have not been reached. The works erected at Dagenham by the Nitrogen Products Company to manufacture ammonium nitrate during the war period from cyanamide by the Ostwald process are now closed.

From the report it also appears that of the 50 nitrogen product plants in operation throughout the world not one is established in this country, and only two are to be found within the Empire. Thus, of the world's total estimated capacity for 1920 of 671 300 tons, the British Empire produced only 12 800 tons, all of which came from Canada. On the other hand, Germany has secured a predominant position in this field, for of the 325 000 tons credited to the cyanamide process, Germany produced 120 000 tons, while from the synthetic-ammonia process she produced 300 000 tons, the only rival being the United States, with the almost negligible figure of 8 000 tons. Even from by-product works this country only produced 100 000 tons, against Germany's 150 000 tons.

Parliamentary Intelligence

INCREASED TRANSPORT CHARGES.

Replying to Mr. Neville Chamberlain (C.U.—Ladywood), Mr. Neal (Parliamentary Secretary, Ministry of Transport) said almost all TRAMWAY UNDERTAKINGS, docks, and canals had permanent charging powers, which were to-day inadequate, and Parliament, in giving authority for temporary increases, delegated to the Ministry of Transport the responsibility (after consideration by an Advisory Committee) of seeing that the charges, though adequate, with efficient and economical management, should not be excessive in the interests of the public. The policy to be pursued in this matter was one which must be reviewed, having regard to the need for a reduction in administrative expenditure, and it should be possible early in the autumn to let these canal, tramway, and dock undertakings know the conclusion arrived at by the Government, in order to enable them to decide whether private legislation should be introduced or not.

STONEHAVEN WIRELESS STATION.

The ASSISTANT POSTMASTER-GENERAL (Mr. Pike Pease) stated in the House of Commons last week that the total cost of operating the Stonehaven wireless station (including engineering maintenance, interest and depreciation) for the year ended June 30 is estimated at between £13 000 and £14 000. It is expected that this cost will be reduced during the next 12 months, owing to the reduction of the hours and the introduction of new working arrangements. The reception of messages from communicating stations on the Continent is conducted partly at Stonehaven and partly by messages to a relay station at the London Central Telegraph Office. The wireless prices for the Continent are the same as the cable rates, except that the wireless rate for Press traffic for Denmark is 1d. a word, compared with the Press rate by cable of 1½d. a word.

NEATH EXTENSION BILL.

A Select Committee of the House of Lords has now passed the Bill for confirming the provisional order sanctioning the extension of the borough of Neath. The only opponents were Neath Rural Council and they withdrew their opposition when certain clauses had been adjusted.

For the promoters, Mr. Clode, K.C., stated that in 1908 the Rural Council purchased the electricity undertaking in their area from the South Wales Electrical Power Distribution Company. They bought for £7 000 what had cost £40 000, but nevertheless they had made a loss on it. Under the present Bill the Corporation agreed to take and the Rural Council to give a supply of electricity to the new area. He pointed out that the Rural area was a large one and the Rural Council's works were nearly obsolete. The new borough was likely to develop considerably and would require large supplies of energy, but the Corporation feared inability on the part of the Rural Council to supply them. They had, therefore, provisionally agreed to take a bulk supply from the Power Company in certain circumstances and on certain terms.

Mr. BEVERIDGE, for Neath Rural Council, contended that if this clause were confirmed it would be a breach of an undertaking by which the company bound themselves not to come into Neath rural area, and it would admit the company as competitors with the Rural Council. He maintained that they would be able to extend whenever necessary, and the Council's electrical engineer was called in support of this view.

Ultimately, agreement was reached between the parties. In regard to electricity, on failure of agreement between Neath Corporation and Neath Rural Council as to conditions of supply the Electricity Commissioners will decide, and the same body must be appealed to by the Corporation before they can take a supply from the Power Company.

FUTURE OF LIGHT RAILWAYS

The Report stage of the RAILWAYS BILL was taken in the House of Commons on Monday, and Mr. Roberts moved the omission of clause 72, which, he said enabled the amalgamated railway companies to purchase light railways compulsorily. The amendment put down by the Government did not meet the case, as it only covered existing light railways, and did not provide for the future. The clause would destroy the possibility of the development of light railways in future.

Mr. NEAL defended the clause, which was inserted in the interest of light railways. The history of those railways was that they had been starved almost out of existence by the larger companies until the time came when the larger companies had been approached with a request to take them over, and then they had been able to acquire them at their own price. It was to prevent that that the clause had been put in, and to secure that the large railway companies should no longer have an interest in hindering the development of the new railways. They had agreed to exclude anything in the nature of street tramways from the clause, and would also propose that it should not apply to existing undertakings.

Mr. MARSHALL STEVENS said there were 21 light railways not being taken over by the main line railways. Per ton per mile their tonnage was greater than the tonnage of the other railways of the country.

Sir E. GEDDES disclaimed a desire to retard the development of light railways. The clause would give fair recompense to the promoters of light railways, and make larger companies look upon such undertakings as potential friends rather than enemies. The motion to omit the clause was withdrawn, but an amendment was accepted, providing that the clause should not apply to a railway in the nature of a tramway. An amendment was also made providing that the clause should only apply to light railways authorised after the passing of the Act.

The Bill was read a third time on Tuesday.

TELEGRAPH (MONEY) BILL.

In moving the second reading of the Telegraph (Money) Bill in the House of Commons on Friday, August 5, Mr. KELLAWAY said that the £5 000 000 for which this Bill made provision would last, it was estimated, until the end of April next year. By that time he hoped the Committee would have before it the Report of the Select Committee on Telephones. Practically no new work would be provided for out of this sum. It was for the completion of contracts which had been made and work which was already in progress. As a result of the present inadequate equipment of the Post Office they had been obliged to refuse 23 000 applications for new telephones. During the two and a-half years ending March 31 this year, 280 000 miles of underground circuits for local systems had been authorised, and of these 200 000 miles had been completed; 200 000 miles of underground circuits for the trunk system had been authorised, and 76 000 miles had been completed. Of new exchanges 68 had been ordered, and 14 completed. Of extension of existing exchanges 44 had been ordered, and nine completed. The three main trunk routes of the great trunk cable system from London were rapidly approaching completion. With regard to the local system there had been an improvement in efficiency. The time taken in answering calls in London, which was 7.5 seconds in May, 1920, had been brought down to 5.3 seconds in May, 1921. He wished that the financial situation of the country made it possible to go into a very large extension of the automatic system, but this would mean a heavy capital expenditure. There were 13 automatic exchanges in this country, which were working satisfactorily.

In reply to LIEUT. COMMANDER WILLIAMS, Mr. Kellaway said he fully realised the importance and necessity of developing the telephone system in the rural areas, but the great difficulty in these districts was the prejudice against the rural party-line.

Mr. PIKE PEASE agreed with Major Entwistle on the necessity for laying more underground cables, as in one day in January last year 40 000 lines were lost in about two hours.

Legal Intelligence.

Marconi Patents in Spain.

A verdict in favour of Marconi's Wireless Telegraph Company and the Cia. Nacional de Telegrafía Sin Hilos has been given in the Spanish Courts in the joint action brought by them against the Cia Iberica de Telecomunicacion for infringement of patents relating to thermionic valves. The award nullifies certain "Telecomunicacion" patents known as the "De Forrest Audion," requires defendants to hand over to plaintiffs all materials manufactured under the patents concerned, and orders the payment by the Telecomunicacion Company of an indemnity to be fixed.

Poplar Councillors' Appeal.

The appeal of the POPLAR BOROUGH COUNCIL, and certain individual members of the Council, against a decision of the Court confirming two orders of attachment for failure to comply with writs of *mandamus* directing them to levy rates to meet the precepts of the L.C.C. and the Metropolitan Asylums Board, came before the Court of Appeal last week. In giving judgment the Master of the Rolls stated that with regard to the individuals the appeal failed; with regard to the Council as a body the appeal must be allowed. The writ against the Council would only go for the commitment of those individual members who had been parties to the joint affidavits, or who had addressed the Court. The writ would lie in the office until the end of the month. Lords Justices Warrington and Younger delivered judgments to the same effect.

A Magnet Steel Contract.

At the Leeds Assizes Mr. Justice Greer recently heard an action by Messrs. H. Backhouse & Company (Sheffield), Ltd., against Mr. Charles A. Gardner (trading as the Sheffield Magnet Company) for the recovery of a balance of £1 15s and damages for breach of contract. The action arose out of a contract for 100 tons of magnet steel at £154 a ton which was to be guaranteed mechanically and magnetically and delivered to defendant in quantities according to his specification. Between June, 1920, and February, 1921, plaintiffs delivered 5½ tons, for which defendant paid £8 00s 6s. 11d. Plaintiffs claimed a balance of £1 15s 13s. 1d. and as defendant refused to accept the remaining 4½ tons, they also claimed damages at £14 per ton for breach of contract, amounting in all to £567.

Defendant admitted the claim for the balance of account, but disputed that for breach of contract. He counter-claimed £3 55s 13s. 8d. for damages, caused by the delivery of defective material, loss incurred by plaintiffs not making up the material according to specification, &c.

After hearing the evidence, his Lordship said it was to be noted with regard to the contract that nothing was said about the composition of the material which was to be supplied. All plaintiff agreed to do was to satisfy the terms of the contract, and guarantee the material mechanically and magnetically sound and be suitable for making magneto-magnets. After reviewing the evidence, he found that defendant had failed to prove that the steel delivered did not comply with certain reservations and he gave judgment for plaintiffs for £1 37s on the claim and also on the counter-claim with costs.

Rights of Apprentices.

A test case of some interest to engineers and apprentices was recently decided by Mr. Justice Sargant. An apprentice fitter and turner of Messrs. Sir W. G. Armstrong, Whitworth & Company, Ltd., sought a declaration to establish his rights under an apprenticeship deed. The apprentice (W. W. Bell) was bound for five years and Clause 5 of the deed stated that "the working week, 53 hours, shall constitute a working week unless the hours are temporarily reduced by the employers, in which case, if the apprentice works the full shortened hours for the time being he shall be presumed to have worked a full week for the purpose of computation of the period of his apprenticeship." In April, 1920, Bell was in his fourth year of apprenticeship and was entitled to a weekly wage of 10s. 6d. for a week of 53 hours, but as the result of a general trade agreement the weekly hours of work had been reduced from 53 to 47 hours. After the armistice there was a cancellation of orders, and the firm decided upon a reduction of staff and upon a system of short time. The plaintiff was then employed for 47 hours in each successive fortnight only instead of in each successive week. He claimed that during the entire period of short time he should have been paid at the full rate to which he would have been entitled had he been employed on full time. Mr. Justice Sargant found in favour of the apprentice on the main points of his claim. He said that a power to reduce the apprentice's hours of work and his wage might go far towards rendering the hours of apprenticeship unenforceable against the apprentice, and the Court could not adopt a construction of the deed so antagonistic to the interests of the plaintiff. During the period of short time Bell was wrongfully deprived of approximately half the wages to which he was entitled under the indenture, and he gave judgment for that amount. Among the defences pleaded was custom, but his Lordship held that this had broken down. There was no universality shown, and, even if custom had been shown, he would have thought it was bad as being contrary to the terms of the indenture and also bad in law. With regard to the other payments to plaintiff, however, the 3s. 6d. addition made in 1918 was voluntary and could be withdrawn at any time; neither could the claim to the additions under the Ministry of Munitions Act of 26s. 6d. be sustained. As to the claim relating to the alleged failure of defendants to give Bell instruction, his lordship said defendants had fulfilled, and somewhat more than fulfilled, their obligation. There would be no declaration on the lines demanded, and there would be no order as to costs.

Electricity Supply.

It is proposed to light TIVIDALE by electricity.

It is proposed to light TULLICOLTRY by electricity.

It is stated that a company is to be formed for the supply of electricity in AMESBURY.

A proposal to increase the charges for electricity by 33½ per cent. has been adopted by the LEICESTER City Council.

CAMBRIDGE Electricity Supply Company, Ltd., has applied for an order to vary the maximum prices charged to consumers.

BARNSTABLE Town Council have decided to defer the question of the condensing plant for the electricity works until the spring of next year.

BLACKBURN Town Council have decided to borrow £221 500 in connection with the new generating station at Whitebirk.

A committee has been appointed to consider the establishment of electricity works at THERAPSTON.

The net profit on ST. ANNES Electricity Works for the past year was £2 52s 15s.

The SLEAFORD Urban Council has applied to the Ministry of Transport for permission to increase their maximum prices from 8d. to 11d. per unit.

For the three months ending June 30 the revenue of the REDDITCH electricity undertaking was £3 50s 2s less than for the corresponding period last year.

The net profit of the LOUGHBOROUGH electricity department for the past year amounted to £3 66s 8s. 6d., an increase of £2 53s 19s. 2d. on the previous year.

Application is to be made to the Electricity Commissioners by the TUNBRIDGE WELLS Lighting Committee for sanction to borrow £7 500 to erect a second cooling tower at the electricity works.

To meet the demand for current from the Corporation electricity works at SOUTHBEND-ON-SEA, £114 000 is to be expended on new plant at the generating station in London-road. The demand increases at the rate of 1 000 new consumers annually.

The advisability of electrically lighting WOODSTOCK Town Hall is under consideration. The electric-light committee have submitted an estimate for wiring the hall amounting to £35. This does not include fittings.

The Electric Lighting Committee of EDINBURGH Town Council have decided that it will not be necessary, as stated in our issue last week, to increase the charges for power, while it will only be necessary to increase the charges for lighting from 4½d. to 4¼d.

The terms of the United Steel Company to supply electricity to a certain part of Lowca being considered excessive, it was arranged at a meeting of the HARRINGTON District Council that a deputation meet the electrical manager and management on the question.

We understand that the Rushden Urban Council will approve an application by the NORTHAMPTON ELECTRIC LIGHT COMPANY to supply electricity in bulk to the district provided the company bear all expenses in connection with the laying of mains and the reinstatement of the roads.

A recommendation of the Electricity Committee that no objection be taken to the inclusion of STAFFORD in the area provisionally determined by the Electricity Commissioners for the supply of electricity in the North-West Midland area has been approved by the Stafford Town Council.

The Urban Electric Supply Company have applied for an order to increase the maximum price of electricity at CATERHAM from 10d. to 1s. 2d. per unit as from Sept. 30. The minimum quarterly payments will be increased in the winter quarters from 12s. 6d. to 17s. 6d., and in the summer quarters from 8s. 4d. to 11s. 8d.

SHREWSBURY electricity undertaking shows a deficit of £192 on the past year's working, the outstanding debt less sinking fund available being £14 55s. The North-West Midlands Electricity District scheme is viewed favourably by the committee. Shrewsbury will have two votes on the Joint Electricity Authority.

Dissatisfaction having been expressed with the supply of gas, the BROWNSHILLS Urban District Council have decided to approach the Walsall Corporation, the Walsall Wood, Messrs. W. Harrison (Brownhills) and Conduit (Norton Canes) Colliery companies, with regard to the supply of electricity to Sheffield, Walsall Wood and Brownhills.

The Electric Supply Company, Ltd., has applied for an order to supply electricity in the Rural District of Northwich and the Parishes of Ashton-by-Bredworth, Pickmere, Labley Superior, Labley Inferior, Plumley, Bexton, Toft, Lower Plover, Moberley and the Urban Districts of Northwich, Middlewich, Winsford and Knutsford.

The annual figures for PAISLEY Corporation electricity department show that 6 683 000 units were sold during the year, an increase of 14 per cent. over the previous year. The income for the year was £86 500, and the total working expenditure £51 775, leaving a gross profit of £34 725. After providing for interest and sinking fund, the net surplus was £7 796.

The Urban Electric Supply Company, Ltd., have applied for an order to increase the maximum price of electricity at WEYBRIDGE from 10d. to 1s. 2d. per unit, and the minimum charges from 12s. 6d. to 17s. 6d. up to 15 units for the winter quarters, and from 8s. 4d. to 11s. 8d. up to 15 units for the summer quarters.

A committee is to be appointed by CLITHEROE RURAL DISTRICT COUNCIL to confer with the electrical engineer and chairman of the Black-

harm Corporation Electricity Committee with respect to the extension of the electric cables to WHALLEY with a view to supplying that and other villages with electricity.

PORTRUSH Urban Council Lighting Committee recommend that application be made to the Electricity Commissioners to amend the Portrush Lighting Order, in order that the maximum price up to 20 units be 1s. 8d., and for each unit above 20 units 1s. 4d. The maximum price at present is 8d. per unit.

SHEFFIELD ELECTRIC SUPPLY COMMITTEE has rejected the German offer to supply a 10,000 kW generating plant for £200,000. The lowest British tender at current costs exceeds £300,000, and the buying of plant is to be deferred. It is hoped that prices will have fallen enough some months hence to enable the corporation to place the contract with a British firm.

COOKHAM Town Council has received notice of the intention of the Rt. Hon. the Lord Meston, K.C.S.I., Sir George Young, Bart., of Messrs. R. N. Caught, and H. E. Cooper to apply to the Commissioners for a special order to supply electricity to part of the parish of Cookham, which is in the area of the Maidenhead Corporation. The Council raise no objection to the application.

STEPNEY Council has recently taken up various loans for electricity supply purposes. Two sums of £25,000 and £15,000, repayable within 20 years, are to be borrowed from the L.C.C. at 7 per cent., a sum of £25,000 is to be obtained from the Royal London Mutual Insurance Society on the same conditions; £11,600 from the Union Savings Bank, and £4,800 from the Huddersfield and Upper Agbrigg Savings Bank, the two latter at 6½ per cent. per annum.

SEVENOAKS Electricity Company has asked the Urban Council for an increase in the charges under an agreement for the supply of electricity; in the case of public lighting from 2d. to 4½d. per unit, and for other purposes from 4d. to 8d. A recommendation that the company be offered 50 per cent. increase in the charge laid down in the agreement was referred back, the argument being that by adopting it the Council would be pledging themselves to stand by the higher rates.

The loss of £2,016 on the working of the WREXHAM ELECTRICITY WORKS during the year ending March last, and the further loss of £2,353 for April, May and June, was the subject of a special meeting of the Wrexham Town Council. It was pointed out that the expenditure in several cases had greatly increased the estimates, and that there was room for great economy at the works. After a long discussion consideration of the matter was adjourned.

THE WOLVERHAMPTON Town Council have decided to support the scheme for the West Midlands area, as their existing generating station will be fully loaded in a year or 18 months and "saturation" on the present site at the present rate of development would be reached in 1927. It is estimated that a saving of £250,000 in capital and of £50,000 a year in running costs will be obtained by this course. Extensions to the generating plant at the municipal power station, at an estimated cost of £137,000, have also been approved.

The cost of using the ELECTRIC CRANES was discussed at a recent meeting of the Dublin Port and Docks Board. Alderman Byrnes said he understood that the two shipyards found the charges for using the 100-ton crane prohibitive, and urged the necessity for looking into the question in order that these cranes should be used instead of private ones. The matter is under the consideration of the Finance Committee.

THE ELECTRIC LIGHTING COMPANY, of Newcastle, co. Down, have notified the Urban Council that they cannot accept the Council's offer of £300 for renewal of the street lighting contract for the ensuing year. The Council have decided not to increase their offer and to have the following conditions embodied in the agreement if, on further consideration of the matter, the company would accept the proposal already made: (1) That the cost of current should not exceed 1s. per unit; (2) that no meter rent be charged; (3) that charge to private consumers be made on current actually consumed; (4) that an improved service be provided; (5) that a charge not exceeding £2 2s. be authorised for testing and connecting houses in which the installation might be carried out other than by the company.

Owing to the deficiencies of the gas supply in the Strathaven district it is proposed to use electricity. LANARK County Council lighting committee are of opinion that application should be made to the Electricity Commissioners for an order to embrace the whole county area. Before coming to a final determination it has been agreed that the Clerk shall confer with the Clyde Valley Electrical Power Company, who are laying a cable along the Caledonian Railway line from Motherwell to Carstairs, as to the possibilities of supplying current for the Law district being obtained from them. As regards Strathaven, the Clyde Valley Company have a sub-station at Quarter, and it is suggested that it might be feasible to take a supply of current from Quarter to Strathaven without incurring prohibitive cost.

There was a heated discussion on the BELFAST electric undertaking at the meeting of the Council last week. The unsatisfactory state of affairs has long been known, and in June Messrs. Preece, Cardew & Rider, consultants, drew up a report. Instead of being distributed to the Council, as agreed, the report was apparently so unsatisfactory that it was handed over to the City Accountant for examination. A deputation was then sent to London to interview the consultants, to whom the report was later returned. A motion that the minute referring to the return of the report be deleted and that every member of the Corporation be furnished with a copy of the report was carried without a division.

Municipal Electricity Accounts.

ST. ANNE'S Urban Council have appointed a sub-committee to confer with the Lytham Urban Council regarding an immediate supply of electricity to Lytham. The amalgamation of the two districts is expected to take place next year.

The accounts of the MELBOURNE (Victoria) electric supply department for the year ended Dec. 31, 1920, show revenue £203,589 (compared with £240,081 in 1919), gross profit £116,250 (£105,227), and net profit £38,977 (£30,492), the whole of which has been transferred to the town funds. Units generated were 50,673,371 (increase of 10,698,723) and sold 41,954,531 (compared with 33,113,841).

The revenue of the LUTON electricity department for the year ended March 31 was £107,376 (compared with £103,084 in previous year), gross profit £29,895 (£31,687) and net profits £8,110 (£15,391). Units generated were 11,995,262 (12,856,588) and sold 10,607,708 (11,010,326). Motors connected increased from 9,962 kW to 11,146 kW, and heating appliances from 2,659 kW to 3,073 kW. Total maximum supply demanded was 6,315 kW (5,620 kW).

BRIGHTON electricity department's accounts for the year ended March 31 show revenue £109,019 (compared with £158,062 in previous year), and gross profit £60,360 (£52,307). Interest required £17,296 (£17,301), sinking fund £17,677 (£19,740), and income tax, &c., £13,468 (£1,892), leaving net profit £11,859 (£13,374). Total costs, including capital charges, were 3-56d. (3-11d.) per unit. Maximum load on feeders was 6,286 kW (5,349 kW) and load factor 20-4 (23-5) per cent. Units sold were 11,261,408 (11,002,835).

The accounts of the CROYDON Electricity Committee for the year ended March 31, 1921, show a loss of £25,161 15s. 7d. This is mainly due to the heavy interest on the new machinery, which has only just started work, to high wages and to coal costs, which were about 31 per cent. more than in the previous year. Councillor E. W. Gough, the chairman of the Electricity Committee, estimates that even if coal remains at the present price and the output does not increase £26,000 will be saved during the coming year owing to the new plant. The report was adopted.

The report of the NORWICH Electricity Committee shows that the gross revenue for the year amounted to £135,499 9s. 4d., and the working expenses to £94,692 9s. 7d., leaving a gross balance of £40,806 19s. 9d. After allowing for equipment of sub-stations, wages of permanent staff in connection with new plant purchased out of loan, a 3½ ton electric wagon, garage, charging equipment, new meters, &c., there remains a balance in the appropriation account of £32,642 2s. 2d., which is absorbed in the business as working capital. The report has been adopted by the City Council.

For the year ended March 31 the revenue of WEST HAM electricity department was £456,505 (against £380,013 in previous year), and gross profit £32,064 (£26,236). Repayment of capital required £29,871 (£26,834) and interest on loans and special charges £29,737 (£28,051), leaving net profit £22,456 (£14,350). Average revenue per unit was 2-25d. (1-97d.), and total cost, including capital and special charges, 2-14d. (1-9d.). Units generated were 53,459,147 (49,701,886), and sold 45,095,784 (41,628,476). Maximum loads were 17,995 kVA and 14,970 kW.

SUNDERLAND TRAMWAYS DEPARTMENT's accounts for the year ended March 31 show revenue £158,165 and working expenses £136,668. Interest required £5,277 and repayment of capital £8,660, leaving a balance of £7,560, but, after providing for income tax £8,149, bank interest £54, Wheat Sheaf improvement £140, and cost of Burdon-road pay office and shelter, £359, there was a net deficit of £1,142. Passengers carried were 32,574,618, compared with 31,634,178 and car-miles run 1,647,618 (1,597,525). Traffic revenue per car-mile was 22-9d. and working expenses, including power, were 19-9d.

The capital expenditure of the Borough of STEPNEY electricity undertaking at March 31 last was £744,719; the amount of loans redeemed was £248,102, leaving £497,190 outstanding; the year's income was £232,835; revenue expenditure (including interest and repayments of loans £46,982) £223,459, leaving a surplus of £9,376. In order to meet certain other expenditure amounting to £17,793 a sum of £8,417 was transferred from the reserve. The total reserve at the end of the year amounted to £30,804. The costs per unit for fuel and wages as compared with those in 1913 show an increase of 185 per cent. During the year 502 services were connected, which is the largest number in any year.

THE IPSWICH electric supply department accounts for the year ended March 31 show total revenue £90,854, compared with £75,310 in previous year, and working expenses were £61,682, against £51,804. Interest required £9,390, against £6,607, repayment of loan £11,133 (£8,415), and the net profit was £8,648 (£8,443), of which £7,981 has been placed to reserve or renewals fund. Maximum supply demanded was 3,438 kW (2,372 kW). Motors connected aggregate 6,082 (5,567). Horse-power units generated were 7,174,805 (5,812,921), and sold 5,464,955 (4,695,046). The engineer and manager, Mr. F. Aytoun, says in his report the profit on the work of the installation department was £667, or just over 5 per cent. on the turnover, after meeting cost of canvassing and advertising, while the profit on the electric vehicle garage was £83, or 10-94 per cent. In addition to this, the units sold through the garage department brought in a revenue of £582, and the current was taken off the peak. In spite of the fact that cost of coal per unit increased from 1-067d. to 1-105d., the coal used per unit was only 4-95 lb., against 6-15 lb. Mr. Aytoun is certain that the department will benefit from the showroom which is to be established when suitable premises can be found.

Electric Traction.

BIRKENHEAD tramways show a loss of £4,900 on the first quarter's running, and a decrease of 1,300,000 passengers. The fares and stages are, therefore, to be revised.

Traffic returns of the L.C.C. TRAMWAYS for the week ended Aug. 3, covering the main holiday period, show receipts amounting to £104,074 as compared with £89,661 in the corresponding week last year.

LEITH tramways were run at a loss of £4,610 during the past year, the balance in hand now being reduced to £1,914. It is proposed to merge the Edinburgh and Leith tramways for accounting purposes as soon as possible.

An L.C.C. tramcar left the tramlines and mounted the pavement in High-street, Lewisham, on Tuesday, knocking down and slightly injuring a cyclist. The tramcar dropped its plough and some of the castings of the undercarriage were smashed.

Acting on the advice of its Parliamentary Committee, the GATESHEAD Town Council have decided not to purchase the tramway undertaking on the terms provided in the Gateshead Tramways Act of 1899, the conditions of purchase laid down by the Act being considered impossible.

A 3s. reduction in the WAGES of TRAMWAY EMPLOYEES throughout the country comes into operation next week. This reduction is automatic under the wages scheme adopted by the N.J.L.C., and affects about 50,000 employees.

The application of the Newcastle City Council to construct a light railway through GOSFORTH PARK has been approved by the Light Railway Commissions, subject to the passing of a formal resolution by the Council as to the compliance of the Corporation with the requirements of the Light Railways Acts.

The receipts of NOTTINGHAM tramways during the past year amounted to £403,114, an increase of £24,167, or 0.14d. per mile over the previous year. For the same period, however, the total working expenses increased by £71,137, or 3.02d. per mile, leaving a balance of £37,752, against £84,723 in the preceding year.

The IPSWICH tramways accounts for the year ended March 31 show income £20,341, compared with £47,954 in previous year, and working expenses £51,942 (£46,387). After providing for interest and repayment of loan, there was a net deficit of £7,802 (£4,151). Total revenue per car-mile was 18.518d. (17.248d.), and working expenses, including power, were 19.107d. (16.684d.). Passengers carried were 6,170,242, compared 7,474,338, and car-miles run 652,420, against 667,260.

The accounts of BRIGHTON tramways department for the year ended March 31 show total revenue £131,478 (against £116,839), and gross profit was £20,803 (£18,680). After providing for capital charges, the net surplus was £2,387 (£1,981), and this has been transferred to reserve and renewals fund. Total revenue per car-mile was 24.77d. (23.29d.), and working expenses, including power, were 20.854d. (19.52d.). Passengers carried were 16,268,035 (20,441,351), and car-miles run 1,273,787 (1,203,961).

The works of the BELFAST tramways department for the past year, which were adopted by the Council last week, show revenue £601,184, compared with £545,348 in the previous year, and working expenses £503,555 (against £379,088). Interest required £51,393, sinking fund £43,215, income tax and sundry charges £23,021, and depreciation and renewals £25,000, a total of £142,629, against £134,325 in the previous year, the increase being mainly due to increased income tax. The net result was a deficit of £39,635; compared with a surplus of £3,515 of last year. Total revenue per car-mile was 22.85d. (against 20.85d.), and working expenses were 19.14d. (14.49d.). Passengers carried were 100,643,705 (95,761,171).

The total revenue of the EDINBURGH Corporation tramways for the year ended May was £611,703, and the working expenses were £514,118. The amount required for interest and sinking fund was £67,661, and the surplus was £29,924. After paying for special expenditure and taking into account the deficit of £21,690 from last year, there is a balance of £1,599 to be carried forward. Mr. Pilcher states that there is a brighter outlook for the undertaking. The increased receipts received since the fares were raised in September will be maintained throughout the summer, and on the other hand the cost of material is decreasing steadily and the wages in the industry are to be regulated according to the cost of living. The revenue of the Leith electric system showed an increase of £5,494 for the year, which is considered satisfactory, seeing that there was no increase of fares during the period.

Personal and Appointments.

Mr. A. J. HAILWOOD has been awarded the Moseley memorial prize in physics.

Mr. A. S. BLACK, chief engineer of Southport electricity department, has been selected by Ipswich Electricity Committee to succeed Mr. Frank Ayton as chief engineer and manager of the electricity supply and tramways departments.

Mr. A. L. TESTER, A.M.I.E.E., who joined the firm of Messrs. Williams & Williams, Ltd., engineers and metal casement manufacturers, of Chester, towards the end of last year, has just been appointed sales manager to Mr. B. A. Williams, managing director. Mr. Tester will control the sales organisation from the Sardinia House office in Kingsway, London, W.C.2., and will give personal attention to the requirements of clients.

Imperial and Foreign Notes.

The net profit of the HONGKONG ELECTRIC COMPANY, LTD., for 1920 was \$464,910 and a dividend of £1:50 per share has been paid.

A large wireless receiving station is to be erected in MONTREAL under the ownership and operation of the Marconi Wireless Company of Canada.

Apparently the course of electricity development runs no more smoothly in SOUTH AFRICA than in this country. The South African Institution of Engineers is objecting to the proposed constitution of the Board which is to deal with the Union's electricity scheme on the grounds that it will be impossible to get impartial views from them.

Provided the prices for material are not prohibitive it is hoped to proceed with the electrification of the main railway line between DURBAN and PIETERMARITZBURG as the estimated saving to the Government is 40 per cent. The electrification of the Capetown-Simonstown suburban line is to stand over for the present.

Since June 12 the inhabitants of DURBAN (NATAL) have been without a tramway service as the Corporation could not accede to the demands of the tramway employees who went out on strike. The recent municipal elections were fought exclusively on the strike and the ratepayers have now endorsed the Council's attitude in refusing to submit the points in dispute to arbitration.

In ordering INDIAN GOVERNMENT STORES in future attention is to be paid to certain rules laid down for the encouragement of Indian manufactures, but stores which have to be imported are to be procured by indent upon the London Stores Dept. Exceptions are to be made in the case of big works of construction and branches of British manufacturing firms established in India.

It is reported that 20 to 25 miles of electric tramway are to be constructed in PEKING, and it is probable that plant and materials will be required.

A new directorate has been formed, under the control of the leading commercial banks, to reorganise the several establishments of the Ilva Iron and Steel Works of ITALY, which have suffered severely from the general depression in that industry.

The HYDRO-ELECTRIC plants in ITALY at the end of 1920 numbered 387 with a total capacity of 1,152,131 H.P. These figures, it is stated, do not include plants of less than 200 H.P. The plants in course of construction number 54 with a potentiality of 339,213 H.P.

The problem of UTILISING THE TIDES for generation of electrical energy has recently been receiving a good deal of attention in France with so much success apparently that the Minister of Public Works has authorised the erection of an experimental station with a capacity of 5,000 H.P. at Aber-Vrach Bay in Brittany. A dam 150 metres in length will be built to enclose the necessary water.

A scheme involving the construction of a barrage 70 metres in height at Stechovice, near PRAGUE, has been submitted to the Minister of Public Works. This barrage, situated 30 kilometres south of Prague, would produce, it is stated, over 250,000,000 kWh a year, and would save Czechoslovakia 60,000 wagons of coal.

THE PRUSSIAN TRADE MINISTRY'S REPORT for July states that there is renewed activity in almost all branches of industry and higher prices have stimulated buying. The heavy iron industry was well occupied and prices were firm. Machinery orders for home and foreign markets were fairly good. The electrical branch is rapidly improving and building activity has caused a demand for installation material. There is also a demand for small and medium-sized motors. The cable industry improved and the telephone branch received many State orders. The fine mechanical and optical industries have not yet gained anything from the general increase in business.

Educational.

The Honours Lists of the B.Sc. (Engineering) Examination of the LONDON UNIVERSITY have been issued and 27 internal and five external students secured first class. Between 60 and 70 names figure in the second-class list.

THE ROLL OF WAR SERVICE of the University of London Officers' Training Corps has been published by the Military Education Committee of the University, from whom it may be obtained at 46, Russell-square, W.C., at the price of one guinea upwards, according to the binding. The work is divided into three sections. Section I. contains the names and other particulars of the 665 officers who fell in the war who were members or former members of the contingent; Section II. records 1,726 honours and distinctions awarded to 1,068 officers; Section III. gives particulars of 4,276 officers and former officers and cadets who served as officers during the war. The appendices contain statistical and historical information.

The proposed University of Jerusalem, the foundation stones of which were laid in 1918, will be the only real University for a considerable section of the East, and it is hoped that it will act as a link to encourage co-operation between the East and the West. It is proposed to begin with physical and chemical departments, a medical faculty, an arts faculty, departments of law and commerce, and a Jewish faculty. The equipment will be of the most up-to-date. As regards methods of teaching and research the University will be modelled entirely on European and American standards.

Institution Notes.

The Western Centre of the INSTITUTE OF ELECTRICAL ENGINEERS held their annual meeting at Hereford recently, and inspected the arrangements made for supplying electricity to rural districts.

We are asked to state that a special council meeting of the INSTITUTE OF METALS will be held in London on Sept. 7 for the purpose of considering applications for membership. All applicants for membership whose forms are in the secretary's hands by that date will be entitled to attend the Birmingham meeting, which is to be held from Sept. 21 to 23.

At the annual meeting of the NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS, at Newcastle, on Saturday, the chairman, Col. F. R. Simpson, said that, with few exceptions, English mines were well equipped in every way. England had led the way in coal cutting and conveying, while full advantage had been taken of electricity and compressed air for transmission of power. With regard to surface equipment, a modern British colliery could compare favourably with those of any other country, and the same applied to safety, to layout underground, and ventilation.

Business Items, &c.

Messrs. TWISS ELECTRIC TRANSMISSION, LTD., of 39, Victoria-street, S.W.1, have obtained an additional telephone line. Their number is now Victoria 3310 (2 lines).

The STANTON IRONWORKS COMPANY'S monthly stock list of cast-iron pipes is to hand. The Company claim that, with an output exceeding 200 000 tons per annum, they are the largest makers of cast-iron pipes in Europe.

The BRITISH THOMSON-HOUSTON COMPANY, of Rugby, have secured additional premises for their Manchester branch at National Buildings, St. Mary's Parsonage, for the display and storage of their Mazda lamps, fittings, reflectors, &c.

The JACKSON ELECTRIC STOVE COMPANY, LTD., have appointed Messrs. Witty and Wyatt (Cardiff), Ltd., 5, Burt-street, Clarence-road Docks, Cardiff, their agents for Wales and the West of England. The arrangement with the previous agent, Mr. W. Blogg, is now terminated.

We are notified that in the case of cable drums supplied by members of the CABLE MAKERS ASSOCIATION subsequent to Aug. 1, 1921, a reduction of 25 per cent. from the current prices will be allowed, and the same reduction will be allowed for all periods of hire (that is, beyond the free loan period of three months subsequent to Aug. 1, 1921).

The SUN ELECTRICAL COMPANY are in the fashion. They announce that owing to reduction in the cost of materials and other charges they are cutting the list prices of the Sunco fires. Pamphlet No. 317 gives full particulars of the revision. We congratulate them in advance of the result.

Mr. WILLIAM C. JEARY, late of the General Electric Company, Armorduct Manufacturing Company, and Magic Appliances, Ltd., and recently manager in Great Britain for N.V. Telga, Amsterdam, is now, we learn, managing director of the Jeary Electrical Company, Ltd., 8, Lambeth Hill, Queen Victoria-street, E.C. 4, a company which has been formed for the purpose of taking over the business of the late Mr. G. Braulik.

Messrs. HARWELL, LTD., announce that they have been appointed to control the sales for the Semaphore dry batteries and cells. They are also the sole selling agents for insulating material manufactured by the Improved Solidite Company, Ltd., and are specialising in all classes of insulating materials for electrical and other purposes. They further represent Messrs. Grothe & Sons, of Cologne, for electric bells, and lighting accessories, as well as medical coils, toy motors, &c., &c.

In order to reduce manufacturing costs and bring down retail prices the MAGNETA TIME COMPANY, LTD., has acquired the control of the Standard Time Company, Ltd., 19-21, Queen Victoria-street, E.C., and the directors have personally acquired the control of the Lowne Electric Clock & Appliances Company, Ltd., 108, Bromley-road, Catford, S.E., and the Silent Electric Clock Company, Ltd., 192, Goswell-road, E.C. 1. The Catford works are being enlarged and additional up-to-date plant is being installed.

The employees of the HART ACCUMULATOR COMPANY, LTD., electric accumulator manufacturers of Stratford, held their 24th annual outing on Saturday, July 23rd, the trip taking the form of a visit to Southend by motor char-a-bancs. Dinner was served at the Maisonnnette Café, after which the time was spent in various ways according to personal inclinations. The thanks of all concerned are due to the Committee, who organised the very successful outing, and to Messrs. W. McDonald and C. Cartwright, who acted as hon. secretary and treasurer respectively.

The CIE CONTINENTALE DES FOYERS TURBINE (Soc. Anon.) was recently formed in Brussels with a capital of 1 000 000 francs to exploit the well-known turbine furnace invented some four or five years ago by Mr. V. R. Chadwick, now technical director of the Turbine Furnace Company, of Gray's Inn-road, London. Mr. W. H. Badams, managing director of the English company, has a seat on the board of the Continental company, and represents the English interests. The managing director of the Continental company is Lieut.-Col. B. A. Thornton, and an influential board includes (amongst others) Compté Louis van der Burch, Compté de Pelland and M. D. Rom, who represent the interests of Compté Horace van der Burch, one of the principal shareholders. The company will work the whole of the Continent of Europe and such colonies as belong to Continental countries.

Miscellaneous.

The NATIONAL BOARD for the COAL INDUSTRY have agreed to accept Sir William Plender as the independent chairman.

While engaged in work in connection with a crane at the LLANELLY COPPER WORKS last week, G. Clements came in contact with a live electric wire, and falling from a height of 15 ft. sustained a fractured skull.

Plans for the BRITISH EMPIRE EXHIBITION to be held in London in 1923 are progressing. Committees are to be set up in order to secure adequate representation of local industries, and generally to promote interest in the Exhibition.

We are glad to be able to announce that the wages dispute at the STERLING TELEPHONE & ELECTRIC COMPANY'S works at Dagenham has ended, and the works have been re-opened. The dispute lasted two or three months, and resulted in 1 000 hands being out of work.

The threatened reduction of 2d. an hour on the wages of the SCOTTISH ELECTRICIANS as from September 1 is held over for the present. A further conference of the Electrical Contractors' Association and the Electrical Trades Union will be held before the end of the month.

For the six months ended June 30, 1 157 000 FEWER TELEGRAMS were sent than in the first six months of last year, a decrease of 20.85 per cent. The revenue, however, was 13.85 per cent. greater this year. In the case of Press telegrams, there was an increase of 1.75 per cent. in number as compared with last year, but a decrease of 4.89 per cent. as compared with 1919.

The rapid expansion of GREATER LONDON during the last few years and the increased number of independent local governing bodies has led to many difficulties in administration. The need for reform in the local government was urged by the L.C.C. soon after the Armistice, and the Government have now decided to recommend the appointment of a Royal Commission to go into the question.

In a recent issue of "La Nature," M. L. JOUCH, the chief mechanic of the French Government, compares the geared turbine and the electric drive for marine work. He calculates that the maximum efficiency of gearing will be 2 per cent. higher than the electric drive, but this is off-set by an equal gain in favour of the electric drive at mean speeds and by not less than a 20 per cent. gain at low speeds. As there is no fixed relation between the speed of the propeller and the speed of the steam turbine when using the electric drive, the latter can always be run at the speed at which the efficiency is its maximum.

For some time negotiations have been proceeding between various Councils in INVERNESS-SHIRE and the Postmaster-General in regard to the extension of the TRUNK TELEPHONE SYSTEM TO FORT WILLIAM. The Board of Agriculture for Scotland and the Scottish Board of Health have now intimated that they will be prepared to make grants, on certain conditions, towards providing the necessary guarantees. In the meantime the Clerk of the Fort William Council has been instructed to make inquiries as to the guarantee and service, and to report at next month's meeting of the Council when the subject will be further considered.

IMPORTS.—The following are official values of electrical machinery, apparatus and material imported into this country (a) during June, 1921, and (b) the aggregate figures from Jan. 1 to June 30, with increase or decrease compared with corresponding periods of 1920:—

Electrical machinery, (a) £51 463 (decrease £43 605), (b) £444 158 (decrease £54 872); telegraph and telephone cables, submarine, (a) nil, (b) nil (decrease £50); other than submarine, (a) £8 153 (increase £6 978), (b) £51 652 (increase £48 019); telegraph and telephone apparatus, (a) £41 509 (increase £26 976), (b) £195 316 (increase £125 306); other electrical wires and cables, rubber insulated, (a) £1 953 (increase £1 771), (b) £13 689 (increase £2 585); with other insulations, (a) £5 617 (decrease £5 655), (b) £60 544 (increase £14 762); carbons, (a) £13 416 (increase £6 183), (b) £62 944 (increase £2 639); glow lamps, (a) £40 142 (increase £37 729), (b) £166 863 (increase £147 510); arc lamps and electric searchlights, (a) £36 (decrease £285), (b) £5 680 (increase £2 840); parts of arc lamps and searchlights (other than carbons), (a) £164 (decrease £258), (b) £9 129 (increase £2 528); batteries, (a) £16 877 (increase £11 589), (b) £82 336 (increase £59 568); meters and measuring instruments, (a) £11 769 (decrease £993), (b) £111 705 (increase £74 833); switchboards, (a) £2 749 (increase £2 749), (b) £7 140 (increase £6 147); electrical goods and apparatus unenumerated, (a) £49 134 (decrease £19 707), (b) £471 772 (increase £167 615). Total of electrical machinery, apparatus and material, other than uninsulated wire, (a) £242 932 (increase £23 492), (b) £1 682 928 (increase £589 430).

EXPORTS.—The exports of electrical machinery, apparatus and material (a) during June, 1921, and (b) from Jan. 1 to June 30, with increase or decrease compared with corresponding periods of 1920, were:—

Electrical machinery, (a) £330 787 (increase £157 173), (b) £2 467 980 (increase £1 508 814); including railway and tramway motors, (a) £1 382 (decrease £1 821), (b) £117 653 (increase £98 342); other generators and motors, (a) £191 342 (increase £75 927), (b) £1 370 334 (increase £817 716); and electrical machinery unenumerated, (a) £138 063 (increase £83 067), (b) £979 993 (increase £282 756); telegraph and telephone cables, submarine, (a) £63 338 (decrease £353 515), (b) £1 545 309 (increase £508 108); other than submarine, (a) £115 342 (increase £25 727), (b) £851 271 (increase £358 952); telegraph and telephone apparatus, (a) £157 237 (increase £75 728), (b) £905 200 (increase £349 051); other electrical wires and cables, rubber insulated, (a) £77 631 (decrease £63 131), (b) £846 447 (increase £98 815); with other insulations, (a) £150 424 (decrease £55 062), (b) £1 182 032 (increase £174 219); carbons, (a) £1 672 (decrease £8 978), (b) £48 442 (decrease £3 194); glow lamps, (a) £35 905 (increase £8 385), (b) £274 345 (increase £171 259); arc lamps

and searchlights, (a) £1 882 (decrease £602), (b) £8 780 (decrease £193); parts of arc lamps and searchlights (other than carbons), (a) £690 (increase £349), (b) £3 984 (decrease £1 411); batteries, (a) £40 488 (increase £754), (b) £404 308 (increase £180 743); meters and measuring instruments, (a) £50 014 (increase £15 110), (b) £256 406 (increase £71 247); switchboards, (a) £19 999 (increase £10 304), (b) £105 392 (increase £61 337); electrical goods and apparatus unenumerated, (a) £162 568 (increase £9 761), (b) £1 239 379 (increase £456 323). Total of electrical machinery, material and apparatus, other than uninsulated wire, (a) £1 207 977 (decrease £177 997), (b) £10 139 275 (increase £3 933 979).

Catalogues, Price Lists, &c.

Two leaflets, which have been issued by Messrs. CROWTHER & OSBORN, LTD., 7, Blackfriars-street, Salford, give the revised prices and particular details of the "Secando" gasfilled and one watt spiral filament lamps manufactured by them.

A number of pamphlets which we have received from the ELECTRIC CONTROLLER & MANUFACTURING COMPANY, of Cleveland, Ohio, deal with d.c. and a.c. automatic pressure regulators and with automatic compensators for a.c. squirrel cage motors.

A revised catalogue recently issued by the CITY ELECTRICAL COMPANY contains details of their direct-current motor starters, speed regulators, and shunt resistances. An interesting equipment is a new form of low-priced inching starter which, we understand, is filling a popular demand in the printing and allied trades. The pamphlet is well illustrated and excellently got up.

MESSRS. W. ROBINSON & COMPANY, 53, Summer-row, Birmingham, are circulating their catalogue of "Robinson" lifting and conveying apparatus. The firm supply electric and hand runways, overhead travelling cranes, electric monorail hoists and transporters, electric pulley blocks, winches, &c., and a number of illustrations of typical gear are shown. The standard capacities range from $\frac{1}{2}$ to 3 tons, but apparatus for dealing with loads up to 5 tons can be supplied.

MESSRS. REAVELL & COMPANY, LTD., Ranelagh Works, Ipswich, send us a catalogue illustrating and describing a new design of quadruplex compressors. In this equipment a number of improvements have been introduced as a result of years of experience, and owing to a cheapening of production due to re-designing and mass production lines. A recent report made by Capt. Sankey shows that the volumetric efficiency of this compressor is remarkably high and compares favourably with results obtained from two stage compressors of the old double connecting types.

Some very artistic fittings are described and illustrated in the new catalogue of electric fittings of Messrs. DAVID SHANKS & COMPANY, LTD., Denmark-street, Birmingham. There is a variety of brackets, candle fittings, pendants, candelabra, semi-indirect lighting and ornamental alabaster bowl fittings, lanterns, desk and table standards, fixtures for offices and public buildings and cinemas, also ship lighting fittings. Though there is a wide choice of handsome designs in various styles and finishes to select from, the firm are prepared to manufacture to special designs of clients.

An artistic and profusely illustrated catalogue issued by Messrs. JOHNSON & PHILLIPS, LTD., gives details of their new mining cable boxes. These include a three-way disconnecting box, suitable for three-core cables up to 0.3 sq. in., a universal distribution box for colliery lighting, and non-disconnecting joint boxes of various types. A mining type gate end box, which is also dealt with, is a substantial piece of apparatus and both electrically and mechanically is a thorough engineering job. Accessories such as cable cleats, armouring clamps and whitening glands are also described.

One of Messrs. ALFRED HERBERT'S, LTD., latest publications deals with a new small ball hardness testing machine for delicate work and a power-operated Brinnell testing machine which employs a standard 10 mm. ball. The former of these machines is made under Craig, Moore and Mather's patents. It is especially designed for use with thin specimens to which the Brinnell test as usually applied is unsuitable. The second machine is power-operated, the pressure being automatically applied, and the period of application is uniform. A second pamphlet deals with Herbert's new 4 ft. radial drill which is motor-driven. The usual speed gear box is eliminated so that there is a large reduction in the number of rotating shafts and gears.

In the general descriptive catalogue of the BRITISH INSULATED & HELSBY CABLES, LTD., of Prescott, particulars are given of the Company's principal manufactures. Incorporated in 1897 under the title of the British Insulated Wire Company, it was for many years the only manufacturer in this country of paper-insulated lead-covered cables, but in 1902, on amalgamating with the Telegraph Mfg. Company, the present title was adopted and the scope of its activities was greatly extended, while to-day the output exceeds that of any other cable company in the Empire. Naturally progressive, the history of the company is to a certain extent the history of the development of the electrical industry, for it has always kept abreast of the times. From time to time it has added other lines of manufacture, such as copper wire, aluminium sheet, joint boxes, switches and fuses, power insulators, overhead equipment for electric railways and tramways, cotton-covered wires, commutator bars, static condensers, electric welders, meters, primary batteries, telegraph and telephone supplies, &c. The catalogue, which is well illustrated, commences with a sectional view of a 3-core Prescott paper-insulated cable for working at 35 000 V, and it then goes on to give a brief description of the telegraph and telephone cables, the Prescott wiring system, the Helsby vulcanised bitumen cables and the various other products of the Prescott and Helsby works of the company.

Tenders Invited and Accepted.

THE HIGH COMMISSIONER FOR INDIA invites tenders for telegraph cable. Particulars from the Director-General of Stores, India Office, Whitehall, S.W.1. Tenders by 2 p.m., Aug. 30, to above address.

Tenders are invited by DURBAN CORPORATION for supply of two 500-kW rotary converters, switchgear, &c. Tenders to Town Clerk's Office, Durban, by Sept. 8. Specifications at the Department of Overseas Trade.

LONDON COUNTY COUNCIL invite tenders for the supply and erection of h.t. and l.t. switchgear for sub-stations. Specifications from the Clerk of the Council, Spring-gardens, S.W.1, to whom tenders by Sept. 5.

WEST HAM GUARDIANS require tenders by Sept. 8 for three months' supply of electrical fittings, asbestos goods, engineers' oils and sundries, ironmongery, &c. Forms of tender, &c., from the Clerk, Union-road, Leytonstone, London, E.11.

SOUTHAMPTON CORPORATION invites tenders for the supply and laying of extra high pressure three phase cable, &c. Specification and form of tender from the Borough Electrical Engineer. Tenders to the town clerk, Mr. R. R. Linthorne, by Aug. 30.

Tenders are invited by Oct. 5 for the supply of bronze wire (schedule 536) to the Postmaster-General's Dept., State of QUEENSLAND. Specifications, &c., from the office of the High Commissioner for Australia, Room E 5, Australia House, Strand, W.C.2.

THE LESSEES OF MANCHESTER CITY HALL invite tenders for the carrying out of electrical work at all exhibitions to be held in the hall. Particulars from the Lessees, Provincial Exhibitions, Ltd., 60, Corn Exchange Buildings, Fennel-street, Manchester.

THE VICTORIAN GOVERNMENT RAILWAYS invite tenders (by Sept 28) for the supply and delivery of a lifting-magnet and generating set, with control apparatus and accessories (Contract No. 34241). Specifications at the Department of Overseas Trade, 35, Old Queen-street, S.W.1.

THE VICTORIAN GOVERNMENT RAILWAY COMMISSIONERS want tenders by Sept. 7 for 16 sets of air brake equipment for Melbourne suburban electric street railways (Contract No. 34 198). Specification can be seen at the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1.

BRISTOL ELECTRICAL COMMITTEE invite tenders for the supply of a 3 000. kW single-phase and a 6 000-kW 3-phase turbo-alternators with condensing plant and auxiliaries. Tenders to the chief engineer and general manager, Mr. H. Faraday Proctor, M.I.C.E., M.I.E.E., by noon, August 15.

THE COMMERCIAL SECRETARY TO H.M. LEGATION at MONTEVIDEO (Capt. E. C. Buxton) reports that the local authorities advertise for tenders (by Sept. 3) for the supply of 59 250 metallic filament lamps (from 10 to 300 c.p. for 225 V circuits) which are required by the State Power House. Local representation is essential.

THE SECRETARY OF THE NEW ZEALAND PUBLIC WORKS TENDER BOARD (Wellington) invites tenders (by Nov. 1) for the supply and erection of new or secondhand auxiliary plant for the Rotatoria electric supply as follows:—One oil engine (200 to 250 B.H.P.) and one three-phase 50 cycle alternator of 190-kW (power factor of 0.8) with exciter and switchgear. Specifications at Department of Overseas Trade.

PRETORIA (Transvaal) Municipality requires tenders by Oct 4 for coal handling plant (contract No. 6), 6 600 V cables (contract No. 7), induced draught and ash-handling plant (contract No. 8), and feed pumps, steam, air, and water piping, &c. (contract No. 9), for the electric light and power department. Specifications, &c., from the General Manager, or Mr. G. M. Clark, 40-42, Meische-buidings, Johannesburg.

DURBAN CORPORATION invite tenders for the supply and delivery, C.I.F., Durban, of one 3 000 kW 3-phase, 50 period, 6 600 V turbo-alternator with condensing plant, circulating water pump and piping. Specifications from the Agents, Messrs. Webster, Steel & Company, 5, East India-avenue, Leadenhall-street, E.C.3. Specifications two guineas per copy, to be refunded on receipt of bona-fide tender. Tenders to agents by Aug. 31.

THE URUGUAYAN BOARD OF STATE ELECTRICAL STATIONS require tenders for four electrical generating sets, including one 300 to 325 kW, 3-ph., 50 cycle (2 000 V between phases), one 175 kW, 3-ph., 50 cycle (6 600 V between phases), one 125 kW and one 100 kW., d.c., three-wire 2×230 V; and four 4-stroke Diesel engines, one for each set. Particulars from the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1. Tenders by Sept. 19.

BELFAST CORPORATION invites tenders for the manufacture and erection of one 12 500-kW turbo-alternator with condensing plant, accessories, four water-tube boilers, with super-heaters and forced-draught fans, four fuel-economisers, two steel chimneys, with four electrically-driven suction draught fans and one electrically-driven centrifugal pump. Specifications from Messrs. Preece, Cardew & Rider, 8, Queen Anne's-gate, Westminster, S.W. 1, or the city electrical engineer, Mr. T. W. Bloxam. Tenders to the Town Clerk, City Hall, Belfast, by Aug. 22.

COVENTRY CORPORATION invite tenders for the manufacture and erection at their new generating station of two 10 000 kW three-phase turbo-alternators, with condensing plant (Contract H 1), and four water-tube boilers, with chimneys, superheaters, mechanical stokers, economisers, &c. (Contract H 2). Specifications from Mr. Geo. Tough, engineer and manager, and tenders to the Chairman, Electricity Committee, Council House, Coventry, by Sept. 1.

The RAND WATER BOARD invites tenders (by September 28) for supply and erection at the intake pumping station, Vereeniging, of two centrifugal pumps, direct-coupled to electric motors, one 10-ton travelling crane, and the supply and erection at the main pumping station site of two centrifugal pumps coupled to electric motors. Specifications of the Department of Overseas Trade, 35, Old Queen-street, S.W.1.

The NEW ZEALAND Public Works Department are calling for fresh tenders for the supply and erection of steel pipe lines and fittings required in connection with the Mangahao power plant. While the quantities, &c., are substantially the same as those specified in the original call for tenders, some of the conditions appear to have undergone modification. The closing date for the receipt of tenders in Wellington is Nov. 1, 1921. Specifications can be inspected at the Department of Overseas Trade.

The GREAT WESTERN RAILWAY invite tenders for the supply for three months from Sept. 1 of (18) telegraph instruments; (19) electrical apparatus (insulators, &c.); (20) electrical wires and cables; (21) telegraph ironwork and tools; (22) telegraph drysalteries. Samples may be seen at Swindon from Aug. 15-19, between 10 a.m. and 5 p.m., on application at the office of the Stores Superintendent, Swindon, from whom forms of tender may also be obtained. Tenders by 10 a.m., Aug. 22, to A. E. Bolter, sec., Great Western Railway, Paddington Station, London.

THE VICTORIAN RAILWAY COMMISSIONERS invite tenders (by Aug. 31) for the supply and delivery of accumulator cells and accessories (Contract No. 34 171), including (a) 100 sets, 140 Ah capacity in sets of 12, and (b) 32 sets, 200 Ah in sets of 12 cells (electrolyte not included); also for electric lighting equipment (axle generator system), including (a) 45 sets, 30 A set for passenger car, (b) 10 sets 30 A set for van, (c) 16 sets, 40 A set for special car; (d) 72 main car switches (chopper or rotary type), and an extra battery, &c. Tenders to the Commissioners, Spencer-street, Melbourne, and must be accompanied by a preliminary deposit of 4 per cent. of the total offer. Local representation is essential. Specifications at Department of Overseas Trade.

WHITEHAVEN Rural Council has accepted the tender of T. S. Bell & Company for plant for the public electric lighting of Distington.

STAFFORD Council has accepted the tender of Siemens Bros. & Company for the supply and laying of 2 700 yds. of h.t. main.

NORTHWICH Urban Council has accepted the tender of The Electric Supply Company, Ltd., for public lighting in a portion of the town.

EDINBURGH Tramways Committee has recommended for acceptance the tender of Hurst, Nelson & Company for 16 electric car bodies, at £18 520.

Mr. G. Morrison, electrical engineer, Birley-street, Blackpool, has obtained the contract for the electric installation on the CROOK (DURHAM) housing scheme.

GRIMSBY Corporation has placed an order with the Metropolitan-Vickers Electrical Company for h.t. switchgear at £1 386, and with B. Thomas for l.t. switchgear at £1 224.

Out of eight tenders, varying from £1 800 to £2 800, received by ISLINGTON (London) Borough Council for h.t. switchgear, the lowest, by the Metropolitan-Vickers Electrical Company, has been accepted.

The Joint Isolation Hospital Committee at Salisbury has accepted the tender of the SALISBURY Electric Light & Supply Company, Ltd., for renewing the battery at the hospital, at a price of £197 14s.

BIRKENHEAD Corporation has accepted the tender of W. T. Henley's Telegraph Works Company, for high-pressure mains between Marshall-street sub-station and Wallasey generating station.

ST. PANCRAS (London) Electricity Committee recommend the acceptance of the tender of Brown, Boveri & Company for two sets of power rectifying plant, each of 900 kW capacity, with regulating and switch gear, at £13 010, plus additional charges amounting to £1 082.

DONCASTER Corporation has accepted the tender of the Enfield Edison Cable Works, Ltd., for l.t. cable to the Carr House-road building site, at £1 384, and that of Callender's Cable & Construction Company, for e.h.t. cables from the generating station to Carr House-road, at £1 146.

MELTON MOWBRAY Council has accepted the tender of the local electric light company for public lighting at 6d. per unit, plus £200 per year for rental of standards, the Council undertaking renewals and labour. The gas company tendered at 6s. 8d. per 1,000 cubic ft., plus 90 per year rental.

The following contracts have been let by STENEY Borough Council: Albion Clay Company, half mile 3 in. conduits, £134 15s.; T. W. Ward, Ltd., fuel oil tank, £65; Geo. Ellison, 18 circuit breakers, £16 2s. each; Aron Electricity Meter Ltd., combined meters and demand indicators, Ferranti Ltd., 50 and 100 A meters; and Reason Mfg. Company, 21 to 25 A meters; Marrvat & Scott, 5-ton lift, £1 595; British Thomson-Houston Co., nine line reactance coils, £1 464.

HASTINGS Town Council have accepted the following tenders: Brush Electrical Engineering Company, Ltd., 1 125 kW "Brush-Ljungstrom" turbo-generator plant, £17 705; Burnsted & Chandler, centrifugal pump engine and achometer, £864, 24 b.h.p. fan engine, £402; Stirling Boiler Company, water-tube boilers, "A" type, underfeed stokers, Crosby water regulators, foundations, flues, coal chutes and Lea coal meters, £10 085; Aiton & Company, steam and water pipes and valves, Lea recorders, and Holden & Brooke feed water heater, £3 198 13s. 6d.; Holden & Brooke No. 10 high-velocity heater, £149; Ferguson, Palin switchgear, £866 15s.; Premier Cooler & Engineering Company, forced draught cooling tower, £1 880.

Patent Record.

SPECIFICATIONS PUBLISHED

The following abstract from some of the specifications recently published have been specially compiled by MESSRS. MEWBURN, ELLIS & CO., Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.

COMPLETE SPECIFICATIONS

- 135 861 STEPHENSON. Dynamo-electric machines. (10/10/18.)
 136 175 SCHROTER. Electric gas-filled lamps with glow discharge. (3/5/15.)
 139 192 SIEMENS & HALSK AKT.-GES. Apparatus for heating X-ray tubes. (28/12/17.)
 139 496 PUPIN. Receivers for high-frequency sound waves. (4/2/18.)
 Relates to a receiving arrangement for a signalling system employing high-frequency sound waves in which the signalling sound waves produce electrical variations differing in phase, comprising a local electric repeater, and circuit connections for applying the electrical forces to the repeater, the connections being so related to the phase distribution of the generated electrical forces that the points of the receiving arrangement connected to the repeater differ in phase by an odd multiple of one-half wave length of the waves which are to be received.
 139 783 HANSEMAN. Escapement devices for telegraphs or other instruments. (19/9/18.)
 140 065 BURGESS BATTERY CO. Dry batteries. (13/3/19.)
 140 127 SIEMENS & HALSK AKT.-GES. Gas-filled electric incandescent lamp. (20/9/13.)
 140 791 BURLAT & RENAUDIN. Magneto-electric apparatus. (25/3/19.)
 143 928 SCHUSTER. Induction electricity supply meters. (15/8/18.)
 144 610 LANDERS, FRARY & CLARK. Electrically heated device. (11/6/19.)
 145 705 EDDY. Electric stoves. (4/12/06.)
 146 968 WESTERN ELECTRIC CO., LTD. High frequency signalling. (3/3/16.)
 Relates to a multiplex signalling system in which the energy of a high-frequency carrier wave is utilised to transmit signal stations, in which means are provided for producing a wave of an intermediate frequency, low in comparison with the carrier wave frequency, but high in comparison with the frequency of the signals, and that a characteristic of the intermediate-frequency wave is variably controlled in accordance with the signals to be transmitted and the carrier wave is controlled in accordance with the signal-controlled wave of intermediate frequency.
 149 645 ANDERSON, FRARY & CLARK. Electrically heated device. (11/6/19.)
 149 933 LANDERS, FRARY & CLARK. Electrically heated utensil. (18/8/19.)
 155 296 SORELLI. Process for feeding electric traction lines supplied with direct current. (15/12/19.)
 157 081 BISHOP. Means for communication between the vehicles of electrically-driven trains. (3/1/20.)
 157 376 DREYER. Protective device for electrical circuits. (12/1/18.)
 157 774 MASCHINENFABRIK OHLIKEN & KRISTEN. Induction regulator for mono and polyphase systems. (23/3/20.)
 160 815 AKT.-GES. BROWN, BOVERI ET CIE. Process for suppressing upper-harmonic anode currents in metal vapour rectifiers fed through polyphase transformers. (1/4/20.)
 The currents of all the polygon sides of the primary of the main transformer are utilised for exciting auxiliary coils that are mounted upon the iron core of an auxiliary transformer in such a manner that they will have an inductive action upon one another.
 161 190 SPERRY. Relay systems and apparatus. (13/11/14. Divided application on 135 871.)
 161 551 GAILLEMIN. Means for tapping uncut electric wires. (10/4/20.)
 163 131 RUSSELL. Renewal of incandescent electric lamps. (2/3/20.)
 163 135 AUTOMATIC TELEPHONE MFG. CO., LTD., & SATIN. Telephone systems. (4/3/20.)
 163 462 ECCLES & VONCEY. Wireless communication. (17/2/20.)
 163 467 TWISS. Connectors for electric insulators. (17/2/20.)
 163 478 BRIGHTHOUSE. Electric incandescent lamps. (19/2/20.)
 163 486 PYRRE. Electric switches. (20/2/20.)
 163 487 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.) Detection of high-frequency electric signalling currents. (20/2/20.)
 Relates to an apparatus for detecting high-frequency signals having a receiving circuit in which is included a device having substantially ohmic resistance characteristics upon which the signalling currents are impressed, and the value of which is periodically varied independently of the current in the receiving circuit.
 163 488 HOWLETT. Switch and means for locking same for use in connection with the ignition circuit of an internal combustion engine and the like. (20/2/20.)
 163 525 BERNARD. Electric heater. (8/3/20.)
 163 537 RAILING & ANGLID. Means for supporting arc lamps. (17/3/20.)
 163 538 RAMSAY & WOOD. Condensing steam electric locomotive. (17/3/20.)
 163 548 RESIDUE. Divided application on 154 822.
 163 562 SHERGOLD & MAXWELL. Electrical fuse holders. (31/3/20.)
 163 590 SATIN. Electric switches and the like. (11/5/20.)
 163 594 HEINLEY'S TELEGRAPH WORKS CO. Machines for laying up or twinning conductors for dry core or other electric cables. (25/5/20.)
 163 609 HOLM. Rotary current distributors. (28/6/20.)
 163 632 LACUESSE. Means for operating the magneto of an internal combustion engine. (17/2/20.)
 163 652 PENMAN. Electric fuse fittings. (9/12/20.)
 163 727 TRAVIS & WATSON & CO. (OF SHEFFIELD), LTD. Electrical resistance elements. (13/8/19.)
 163 728 MARCS. (Macfarlane Communications Corporation.) Telephone transmission systems. (2/10/19.)
 163 729 GREFFSALL. Contact for their alarms or other electrically operated devices. (8/10/19.)
 163 730 LYON & WRENCH, LTD., ENGELKE & TODMAN. Electrical resistances. (8/10/19.)
 163 737 CLEARY & PHILLIPS. Electric current limiting devices. (27/5/20.)
 163 741 LOTH. System and apparatus for enabling a movable object to pursue an electrical signal about route in a more precise way than by means of visual points of reference. (19/12/19.)
 163 744 BOCKER & EICHOFF. Galvanic devices. (30/12/19.)
 163 745 B. T.-H. CO. (E. C. Co.) Electron discharge devices. (12/1/20.)
 The device comprises only two electrodes, a portion at least of one of which may be heated to incandescence, and in which a current flows between the electrodes varying inversely as the potential applied between the electrodes.
 163 759 INGERSOLL. Booster motors for locomotives. (11/2/20.)
 163 773 WILSON. (Buckley.) Transmitters for electric recording and signalling systems. (20/2/20.)
 163 792 SMITH, DINE & STOCKS. Method and means for operating tipping gear electrically. (24/2/20.)
 163 794 LUCAS & IRELAND. Ignition magnetos for internal-combustion engine. (24/2/20.)
 163 796 SCHROEDER. Construction of the field magnets of dynamo-electric machines. (21/2/20.)
 163 800 ISORANIC MANUFACTURING CO., LTD. (Cutler-Hammer Manufacturing Co.) Electrical control apparatus for lighting systems and the like. (25/2/20.)
 163 807 AUTOMATIC TELEPHONE MANUFACTURING CO., LTD. (Automatic Electric Co.) Telephone systems using call indicators. (26/2/20.) Cognate Applications, 12261/20, 2913/20 and 3125/20.
 163 810 HOUGHTON & PORTHOLME AIRCRAFT CO., LTD. Receivers for wireless telegraphy and telephony. (26/2/20.)
 163 812 STONE & CO., LTD. (Walton.) Fuse and junction or terminal boxes for electric lighting installations. (26/2/20.)
 163 823 NIECK & LEGGIST. Apparatus for subjecting substances of molecular matter to the electrostatic stress of a high tension electric discharge. (28/2/20.)
 163 838 B. T.-H. CO., LTD. (General Electric Co.) Systems of electric ship propulsion. (9/3/20.)
 163 845 B. T.-H. CO., LTD. (General Electric Co.) Systems of electric motor control (3/3/20.)

APPLICATIONS FOR PATENTS.

March 2, 1921.

- 6815 THOMAS. Transformer voltage regulators.
 6828 MECHAN. Electrical apparatus for indication of movements of rotatable shafting, &c.
 6840 WILSON, GARRARD & RAILING. Electric starters and cut-outs.
 6876 HOCKLEY. Telephone transmitters, microphones, &c.
 6891 DUNCAN. Lanterns, &c., for electric lamps.
 6896 PRESTON. Electric device for heating liquids, &c.
 6912 MORGAN CRUCIBLE CO. & SPEIRS. Electric melting furnaces.
 6917 METROPOLITAN-VICKERS ELECTRICAL CO. & COATES. (Westinghouse Electric & Mfg. Co.) Switches.

March 3, 1921.

- 6928 CHARNOCK. Electrically controlling ignition of engines.
 6940 GEORGE & MORLEY. Combined electric fan and radiator.
 6942 ROBERTS. Electric lamps for road vehicles.
 6976 EVERETT & GOODWIN. Electric lamp locking ring.
 6996 TAYLOR. Electrical transmission systems.
 7006 WHITE & WINSTANLEY. Shade for semi-indirect electric light fittings.
 7013 CARNEY & LACEY. Cooling electric machines.
 7019 KEMP. Electric vehicles.
 7021 COMPRESSION STARTER & SWITCHGEAR CO. & LOMAX. Electric lamp holders.
 7022 WRIGHT. Wireless telegraphy.
 7032 RANA. Motors.
 7033 RANA. Electrophonic signalling and advertising apparatus.
 7035 REDDIE. (Soc. Pirelli & Co.) Electric cables.
 7036 & 7037 REDDIE. (Soc. Pirelli & Co.) Electric cables.

March 4, 1921.

- 7052 FULLER. Electric fuses.
 7072 DEMAINE. Adjustable electrical temperature alarm.
 7109 B. T.-H. Co. High resistance conductors.
 7110 B. T.-H. Co. & HASTINGS. Motor-control systems.
 7143 SZARVASY. Electrizers. (15/218, Hungary.)

March 5, 1921.

- 7174 AUTOMATIC TELEPHONE MFG. CO. Railway signalling apparatus.
 7200 COLLINS. Electrolysis of brine.
 7201 SIEMENS-SCHUCKERTWERKE. Protective arrangement for high voltage insulators. (9/5/20, Germany.)
 7216 AUTOMATIC TELEPHONE MFG. CO. Telephone systems.
 7226 BULLINGER. Electric generators for bicycles, &c.

March 7, 1921.

- 7241 TORRANCE. Electric generators.
 7276 OLIVER. Electric blasting caps.
 7285 BUNET. High-tension electric condensers. (18/5/20, France.)
 7293 METROPOLITAN-VICKERS ELECTRICAL CO. Electric relays. (4/5/20, U.S.)
 7294 BECKER. Burglar alarms.
 7297 MADSEN. Electro-deposition of metals.
 7303 STEVENS. Earthing and bonding clip.
 7307 MARKS. (Dufaux.) Magneto-electric machines.
 7325 RELAY AUTOMATIC TELEPHONE CO. & DAVIS. Telephone systems.
 7326 RELAY AUTOMATIC TELEPHONE CO., JOHNSON & BRYANT. Telephone exchanges.
 7327 RELAY AUTOMATIC TELEPHONE CO. & WARD. Telephone systems.
 7328 & 7329 RELAY AUTOMATIC TELEPHONE CO. & JOHNSON. Telephone systems.
 7330 RELAY AUTOMATIC TELEPHONE CO. & JOHNSON. Telephone systems.
 7333 DONISTHORPE. Wireless telegraphy and telephony.

March 8, 1921.

- 7340 TRIPPE. Safety apparatus for electric trams, &c.
 7343 VILLIERS ENGINEERING CO. & PARKER. Electric lighting from dynamos, magnets, &c.
 7347 EVANS & HAYDEN. Miners' electric gas-testing lamp.
 7351 BROULT, LTD., & HOLT. Self-regulating electric machines.
 7410 HOLDEN. Electric measuring instruments.
 7423 GILL. (Deutsche Telephonwerke Ges.) Counter-speaking and telegraph systems with amplifiers.
 7428 LIEBREICH. Electrolytic separation of chromium. (8/3/20, Germany.)
 7449 JOHNSON & PHILLIPS & BAILEY. Truck-type switchboards.

March 9, 1921.

- 7551 WESTERN ELECTRIC CO. Telephone exchange system.
 7558 B. T.-H. Co. Ignition for engines.
 7559 B. T.-H. Co. & E. E. Co. Electric power transmission and braking systems.
 7560 & 7561 SIGNAL GES. Electrical navigation of ships.
 7571 SIEMENS & HALSKE AKT. GES. Loud-speaking telephone. (9/3/20, Germany.)
 7584 THAMES PAPER CO. & PETERS. Automatic variation of resistance of circuits.
 7591 INDUSTRIAL TRAMWAYS, LTD. & HAMILTON. Electrically-propelled vehicles.
 7593 KOUNETZOFF & STEINHEIL. Electrically-driven ploughs.
 7596 SULLIVAN. Electrical condensers.

March 10, 1921.

- 7606 WEEKES & CLARKE. Electric lamps.
 7677 KARMEAN. Electric heating devices. (13/3/20, U.S.)
 7678 METROPOLITAN-VICKERS ELECTRICAL CO. Measuring devices for polyphase circuits. (31/3/20, U.S.)
 7684 WESTERN ELECTRIC CO. Telephone transmission systems.
 7692 EASTERN TELEGRAPH CO. & DAVIES. Electric signalling along conductors.
 7698 SIEMENS & HALSKE AKT. GES. Loud-speaking telephones. (10/3/20, Germany.)
 7699 SIEMENS & HALSKE AKT. GES. Connection of twin cored leads in telephone installations. (15/4/20, Germany.)
 7703 SAYERS. Commutators for electric machines.
 7712 GELHOFF & C. P. GOERZ AKT. GES. Arc lamps.

March 11, 1921.

- 7728 YOUNG. Electrical polarity indicator.
 7743 MILLAR. Fastening cables and wires to insulators.
 7749 MYERS. Supports for trolley wires.
 7753 CONNOLLY. Insulating tape.
 7778 LANGDON DAVIES & SOMERS. Electric current regulators.
 7781 COULSON. Accumulators.
 7787 LANDIS & GYR AKT. GES. Rectangular casing for electrical apparatus (13/3/20, Switzerland.)
 7795 DALE. Electromagnetic apparatus for detecting electric currents.
 7814 GES. FUR DRÄHTLOSE TELEGRAPHIE. Wireless receiving systems. (13/3/20, Germany.)
 7817 MASCHINENFABRIK OERLIKON & KRISTEN. Induction regulator for alternating current circuits. (23/3/20, Switzerland.)
 7819 SEFTON-JONES. (Deutsche Kabelindustrie Ges.) Providing cables with distinguishable wrappings.
 7848 MARSHALL. Apparatus for detection of Herztian waves.
 7882 ARNTUNOFF. Cooling arrangements for electric machines.
 7884 BARON. (Aidendorf.) Electro-mechanically controlled telephone system.
 7885 HOLDEN. Electric measuring instruments.
 7887 MATHEU. Oscillating valve relays.
 7889 TAYLOR. Supporting thermionic valves.
 7900 STEINER J. GES. & MAGERLE. Electric bells, &c. (12/3/20, Austria.)

March 14, 1921.

- 7933 AUTOMATIC TELEPHONE MFG. CO. & HULL. Electric motors.
 7947 TUCKER. Fuse-boards.
 7954 AITKEN. Automatic, &c., telephone systems.
 7965 DOHERTY. Motor Components, LTD. & PENTON. Portable electric lamps.
 7973 ELEKTRIKZATIS A.G. VOM SCHUCKERT & CO. Electrolytic cell. (14/6/20, Germany.)
 7982 ORLING. Magnifying effects of small efforts for telegraphy, &c.

Companies' Reports, &c.

MARCONI INTERNATIONAL MEETING.

Mr. Godfrey C. Isaacs, who presided over the ordinary general meeting of the MARCONI INTERNATIONAL MARINE COMMUNICATIONS LTD., last week, was able to give a good account of the expansion of the company's business. At the outset he explained that Senator Marconi was away from London on important research work. In the course of his analysis of the accounts Mr. Isaacs said that the general reserve account and the reserve for obsolescence of plant together represented the same figure as at the end of 1919. Investments and loans against securities stood at £123 000 less. Additional stations on ships showed an increase of £100 000, after writing off £62 535 for depreciation. They hoped to continue holding their securities and to abstain from bringing home their money from foreign countries until there was a further appreciation. The year's revenue was £933 567, compared with £772 018 in 1919, the increase being due to the continued expansion of the business. There was, however, an increase in expenses. They had already paid an interim dividend of 5 per cent. and they were making a final distribution of 10 per cent.

EXPANSION OF BUSINESS.

Though it was disappointing to see a set-back in the profits, it must be borne in mind that they were going through a bad period. That which had effected most was the state of foreign currencies and the depreciation of Government securities, but they could confidently look to their losses as being far less extensive finally than the figure at which they had been calculated at the end of December last. What was most material and upon which they could congratulate themselves was that their business during the period showed further expansion. The number of ship's installations increased during 1920 by approximately 12 per cent. and the revenue from ships' telegrams showed an even greater appreciation. These circumstances, together with the fact that their business this year continued to expand, had been mainly responsible for recommending that part of the balance of profits of previous years should be used to maintain the dividend for the last year. Until foreign currencies became more normal the profit in sterling of their foreign business must continue to suffer, but he hoped they had seen the worst in that direction.

COMPETITION.

Mr. Isaacs referred to attempts made by a new wireless company to compete with them by offering to ship-owners terms and conditions which were represented to be more advantageous than those furnished by the Marconi company. Whilst ship-owners have been satisfied with the service of the company, they had not been altogether loth to give some support to a competing company, believing that competition was a healthy thing. He was, however, very strongly of opinion that a business such as theirs was likely to give infinitely better results if under one control. They believed that their experience, world-wide organisation and the care given to the conduct of their business, would ensure their holding their own at all times. They claimed that the competing company was infringing a number of their patents, and a request had been made to them for a licence.

DEVELOPMENTS AND IMPROVEMENTS.

Considerable improvement had been made in wireless installations on ships at sea since the war. The new designs, carrying the latest improvements, were now being installed; the range of a ship's station had been increased under normal conditions to between two and three thousand miles. Improvements had also been effected in the direction finder. Wireless telephony for use by ships had also made considerable strides during the year. A demonstration of the progress made was given on the Canadian Pacific steamship "Victorian," and those on board were able to carry on telephone conversations throughout the greater part of the journey with either England or Newfoundland. There could be no doubt that wireless telephony was destined to play an important part on ships at sea.

NORTHAMPTON ELECTRIC LIGHT & POWER COMPANY has declared an interim dividend of 3½ per cent. on the "B" ordinary shares.

THE CITY OF BUENOS AYRES TRAMWAYS COMPANY, LTD., has declared a dividend of 1s. 3d. per share (being at rate of 5 per cent. per annum), less tax, for the quarter ended June 30.

The directors of the RANGOOON ELECTRIC TRAMWAYS & SUPPLY COMPANY, LTD., have issued the balance of the ordinary capital, amounting to 72 900 shares of £1 each.

A meeting of the holders of the five per cent. first mortgage debenture stock of the MONTEREY RAILWAY, LIGHT & POWER COMPANY, was held last week when a plan of re-organisation was approved.

The net profit of VERA CRUZ ELECTRIC LIGHT, POWER & TRACTION for 1920 was £48 582. A dividend of 10 per cent. absorbs £35 000, and £15 000 is placed to depreciation and reserve, carrying forward £21 981, against £23 398 brought in.

BRITISH COLUMBIA ELECTRIC RAILWAY CO. have declared a dividend of 3½ per cent. (free of tax) for the year on the preferred and deferred ordinary stocks. Last year a dividend of £4 13s. per cent. was paid on the preferred ordinary and £6 4s. per cent. on the deferred ordinary.

The directors of W. T. HENLEY'S TELEGRAPH WORKS COMPANY have declared a dividend on the preference shares at the rate of 4½ per cent. per annum, less income tax, for the half-year ended June 30, and an

interim dividend on the ordinary shares of 1s. per share, less income tax, to be paid on Sept. 1.

TOTTENHAM DISTRICT LIGHT, HEAT & POWER COMPANY have declared a dividend for the half-year ended June 30 at the rate of 6 per cent. per annum on the A stock and 4½ per cent. per annum on the B stock (less tax). A year ago the dividends were at the rate of 3½ per cent. and 2½ per cent. respectively.

The net profit for 1920 of the SHROPSHIRE, WORCESTERSHIRE & STAFFORDSHIRE ELECTRIC POWER COMPANY were £2,515 and £740 was brought forward. It is proposed to pay the dividends on the 7 per cent. and 6 per cent. preference shares, to add £4,572 to the sinking fund and to carry forward the remaining £16 183.

The net profit of the KALGOORLIE ELECTRIC TRAMWAYS, LTD., for 1920, before charging depreciation, was £8,742. In January last a demand was made for a further increase in wages, which the company was unable to agree to. Negotiations followed, but on February 1, without waiting for the decision of the Arbitration Court, the men went on strike, and service was entirely suspended until February 25. It was then agreed to refer the dispute to the local tribunal, whose award gave the men a considerable increase in wages, subject to confirmation or variation by the Federal Arbitration Court.

New Companies.

The following list is compiled from information supplied by Messrs. Jordan & Sons, Ltd., company registration agents, 116 and 117, Chancery-lane, London, W.C.2:—

ACME ENGINEERING COMPANY (LONDON), LTD. (175 960).—Reg. July 27, 9, Great Sutton-street, E.C.1. General, electrical, hydraulic and mechanical engineers. Nominal capital £15 000 in 15 000 shares of £1 each. Directors: H. N. Kaye, Park Lodge, Kenley, Surrey (gov. dir.), Helene A. Kaye, Park Lodge, Kenley, Surrey, H. R. Hall, 18, Ospringe-road, N.W.5.

ALLENWEST-BROOKHIRST (or) LTD. (175 995).—Reg. July 28, to enter into four agreements (some of them) to be made between Allen West & Company, Ltd., Brook Hirst & Company, Ltd., Electric Control Ltd., Watford Electric & Manufacturing Company, Ltd., and the company, and to carry on the business of electrical and mechanical engineers. Nominal capital £550 000 in 550 000 shares of £1 each. Directors to be appointed by subscribers. Subscribers: W. J. Hill, 2, Bond-court, Walbrook, E. C. J. Bennett, 5, Kildoran-road, Brixton, S.W.2.

ELECTRIC LOCOMOTION AND FOUNDRY COMPANY, LTD. (175 895).—Reg. July 23, capital £6 000 in £1 shares, to acquire and carry on business of iron and brass founders and electrical and mechanical engineers. Directors: G. L. Collins, R. A. Bowron, R. L. Stanbrook, W. S. Mundle, G. D. Gillender and T. Gillender. Reg. office: Globe-chambers, The Side, Newcastle-upon-Tyne. Private company.

MANCHESTER AND DISTRICT RADIUM INSTITUTE. (175 725).—Reg. July 14, to acquire radio-active materials whether containing radium or mesothorium or other radio-active substances. Every member to contribute a sum not exceeding £1 if necessary. Directors: Sir E. Holt, Sir W. Cobbett, F. P. Nathan, G. N. Midwood, L. Pilkington, Sir W. Milligan, S. H. Renshaw and W. Armistead. Reg. Office: Nelson House, Nelson-street, Manchester. Company limited by guarantee.

HAY MARYON WORKS (STROUD), LTD. (175 943).—Reg. July 26. Electrical and general engineers. Nominal capital £1 000 in 1 000 shares of £1 each. Directors: M. Hay, Pyrford Green House, Pyrford Green, nr. Woking, J. T. Maryon, 75, Park Road, Ilford.

REGENT ELECTRICAL INSTALLATION COMPANY, LTD. (175 727).—Reg. July 14, capital £1 500 in £1 shares, to carry on business of electrical engineers and contractors. Directors: B. Barnett, R. Lerdeman and M. Heller. Reg. Office: 104, Whitechapel-road, E. Private company.

ROSE BROS. ELECTRICAL COMPANY, LTD. (175 936).—Reg. July 27, 25/27, Milton-street, E.C.2. Manufacturers and dealers in electrical batteries, electrical instruments, &c. Nominal capital £20 000 in 20 000 shares of £1 each. Directors: A. H. Rose, T. A. Rose (per. directors).

STANDARD ELECTRIC SIGN COMPANY, LTD. (175 987).—Reg. July 27. Advertising contractors by means of electric and other illuminated signs. Nominal capital £500 in 500 shares of £1 each. Directors to be appointed by subscribers. Subscribers: E. A. F. Boys, 478, Archway-road, Highgate, N., Doris Wain, 65, Clyde-road, Alexandra Park, N.

W. J. TOUGH & PARTNERS, LTD. (175 871).—Reg. July 21, capital £2 000 in 1 500 £1 preference and 2 000 5s. founders' shares, to carry on business of electrical, mechanical and motor engineers. Directors: J. Wright and W. J. Tough. Reg. office: 32, Shaftesbury-avenue, W.1. Private company.

Company Incorporated Outside U.K.

A'S DET NORSKE RADIOSKAP, CHRISTIANIA. (1981r)—Incorporated in Christiania, Norway. Capital kr.1 000 000 in 1 000 shares of kr.1 000 each, to manufacture and sell radio-stations and apparatus. A. E. Salvesen, 50, Grainger-street, Newcastle-on-Tyne, authorised to accept service.

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"Cabinet Maker": "Practical Window Dressing," by H. E. Coombes, B.A.D.M.; "Films and the Furniture Trade: A Suggestion"; and "Industry and Society," by E. J. P. Benn.
"Chemical Age": "Heat Required in Acid Concentration," by F. Colin Sutton; "Industrial Uses of Electro-Deposited Iron," by W. E. Hughes; and "Standardisation of Petroleum Specifications."
"Farm and Home": "Cornish Cheese Making"; "The Dairy Cow (Successful Farming)"; and "Labour and the Land."
"The Fruit-Grower": "Standards in National Apple Marketing Scheme"; "Road-Transport Problems"; and "Potatoes after the Drought."
"Gardening Illustrated": "Tulip Clara Butt," illustrated; "Black Currant Boskoop Fruit," illustrated; and "The Apple Crop."
"Hardware Trade Journal": "Examinations for Hardware Assistants"; "Notes on Pumps, VI," by Joseph Horner; and "Hardware in the New U.S. Tariff."
"Gas World": "Practical Estimate of the Value of Gas"; and "The Lighting of Factories and Workshops."

Forty Years Ago.

(THE ELECTRICIAN, AUGUST 13, 1881.)

THE TELEPHONE IN THE NORTH OF ENGLAND.—The telephone seems to be gaining favour in the north every day, applications to local authorities for leave to erect telephone lines being very numerous.

ELECTRIC LIGHT AT KING'S CROSS STATION.—Mr. Crompton has successfully installed his system of lighting by electricity at this station of the Great Northern Railway. We hope to give some details in a future number.

ELECTRIC LIGHT v. GAS.—At a recent meeting of the Dundee Gas Commission, it was stated that several large consumers in the town were fitting up their premises for the electric light, and that if it were found to be satisfactory its adoption would affect the gas revenue.

SS. "GREAT EASTERN."—This vessel, which has been so intimately connected with Atlantic cable work, is to be sold by Messrs. C. W. Kellogg & Company, Admiralty brokers, on the 19th of October next. She is still lying at Milford Haven, where she has lain idle for a long time.

THE STORAGE OF ELECTRICITY.—The Cleveland (U.S.A.) Trade Review says that Mr. C. Brush, of electric light notoriety, has invented a system of electric storage for lighting purposes. All that is yet known of the system is that metal is used as the recipient of the electricity to be stored. Mr. Brush has stated that he is able to store double as much electricity as M. Faure in a given space.

Prices of Metals, Chemicals, &c.

		Price.	TUESDAY, Aug. 9.	
			Inc.	Dec.
Copper—	Best selected..... per ton	£70 0 0	—	£0 10 0
	Electro Wirebars	£75 10 0	—	£1 10 0
	H.C. wire, basis per lb.	0s. 11½d.	—	½d.
	Sheet	0s. 11½d.	½d.	—
Phosphor Bronze Wire (Telephone)—				
Phosphor-bronze				
wire, basis "				
1s. 3½d. — ½d.				
Brass 60/40—				
Rod, basis "				
0s. 8d. — —				
Sheet, basis "				
0s. 10½d. — —				
Wire, basis "				
0s. 11½d. — —				
Pig Iron—				
Cleveland Warrants .. per ton				
£6 15 0 — —				
Galvanised steel				
wire, basis 8 SWG .. "				
£25 0 0 — —				
Lead Pig—				
English "				
£25 0 0 £0 5 0 —				
Foreign or Colonial ... "				
£23 15 0 £0 7 6 —				
Tin—				
Ingot "				
£162 0 0 £2 0 0 —				
Wire, basis per lb.				
2s. 3d. ½d. —				
Sal ammoniac. —Per cwt. 65s.-60s.				
Sulphur (Flowers). —Ton £13.				
" (Roll-Brimstone).—Per ton				
£13.				
Sulphuric Acid (Pyrites, 168°). —				
Per ton, 92 lbs. 6d.				
Rubber. —Para fine, 1/-; plantation 1st latex, 9½d. lb.				
The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber figures by W. T. Henley's Telegraph Works Co.				

Copper Sulphate.—Per ton £30.
Boric Acid (Crystals).—Per ton £69.
Sodium Bichromate.—Per lb. 7½d.
Sodium Chlorate.—Per lb. 4d.

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Notes.

The Decontrol of the Railways.

WE are not exaggerating when we say the most important event of the week for the electrical industry has been the removal of the dead hand of State control from the railways of the country. It is trite to say that a cheap and efficient system of transport for both goods and passengers is a matter of vital importance to a commercial and industrial country like our own, and equally trite that some of the present stagnation in trade may be attributed to high railway rates and to the lack of enterprise in railway management which has recently been so evident. Having got rid of a chequered past we must now wait and hope that the railways will be able to make for themselves and for us a brighter future, and that, now the lines are again under business management, the public will gradually recover some of the transport facilities both for themselves and for their goods which they enjoyed in pre-war days. But in order to effect this very necessary improvement there must be efficient administration and reduced working expenses. Revenue must be increased by reducing the charges and costs must be decreased by a careful attention to detail. The grouping of the railways into four main groups, which will practically abolish competition between the different lines, should help to this end, though at the same time it will get rid of a strong incentive to progress and efficiency. Fortunately road transport is now a formidable competitor, and it is to be presumed that the railway companies in their own interest will act with both caution and enterprise in stabilising their position. Electrification of many of the suburban lines would be an efficient means to this end.

The Future of the Light Railways.

WE fear, however, that light railway development will be seriously affected by the Bill. For the proposed changes will not improve the prospects of this means of transport, unless the railway companies make a radical change in their methods. Under the new Bill the Light Railways Commissioners are to be abolished and the administration of the

Light Railways Acts placed in the hands of the Ministry of Transport. In the past railway companies have been very jealous of any sort of competition by either canals or light railways, and several projects of the latter kind have been killed by formidable opposition. As a matter of fact, this is a short-sighted policy, for in rural and agricultural areas, where transport facilities are poor and inefficient, light railways could have been developed as feeders of the standard lines, and the traffic and receipts of both increased. We hope that this will be the policy of the future, for it is only by employing cheaply constructed light railways or perhaps railless trolley vehicles in the more crowded areas that the present motor competition can be effectively met.

Joint Authority Progress.

THE formation of Joint Electricity Authorities is for several reasons taking an unconscionable time. These reasons include: Difficulties in adjusting local interests, the delay which arises from a natural desire to wait and see what some one else is going to do, and then try and do it better, and the discouragement to development which has been caused by the demise of the Electricity Supply (No. 2) Bill. Statistics indicate how slow the progress has been. For of the thirteen electricity districts provisionally defined, schemes have so far been submitted for only eight. Five local inquiries have been held, but in two instances only, namely, North Wales and West Lancashire, have the Electricity Commissioners given their decision. But even this is not the end, for the necessary draft orders are still being prepared for the creation of the Joint Electricity Authorities, and some further time must obviously elapse before we can see one of these bodies in full working order. This is a very little flour for a great deal of grist.

Stagnation in the West.

IN the case of districts where enquiries have been held so far without result, the position may be roughly summed up as follows: The proceedings in the Severn area, the first to be delimited, unfortunately, proved abortive, and the proposals to form a Joint Authority in that part of the country have

for the time being been abandoned. While inquiries have recently taken place in the Aire and Calder and the London and Home Counties Districts the Commissioners have not yet promulgated their decisions. Nor is progress more definite in the districts that have been defined, but where inquiries have not yet been held. In three cases the periods for submitting reorganisation schemes have had to be extended several times, partly to give further time for local consideration and partly to assist the Commissioners. In two or three other districts nothing has been done, and owing to conflicting municipal and company interests we imagine little will be done until the Commissioners have time to tackle the subject themselves. This is not a very satisfactory record for a year's work. And the blame for this lack of progress lies not at the Commissioners' door, who have wrestled long and well with an almost impossible task, but with those who do not see that the best future for their own undertaking lies in combination rather than in individualism.

Electric Traction in Austria.

THERE are certain countries where the employment of electric traction appears more advantageous than steam working, even to those who are inherently opposed to it. This may be due either to the shortage and consequent high price of coal or to the configuration of the country through which the railways run. In this country we are not much affected by either of these considerations and in discussing the advantages of electric traction in its application to British railways we are, therefore, sometimes liable to forget them and to consider the problem from the economic and traffic standpoints alone. The two articles on electric traction in Austria which we publish on another page of this issue give another view of the picture. For Austria is a country where coal has always been scarce and is now very expensive, where much of the railway communication lies through mountainous regions, but where, fortunately, quite a satisfactory amount of water power is available for use. It is, therefore, not surprising to find that the suggestion to electrify the railway system of the country in a more or less wholesale way has been under consideration for over 30 years, while for the past 15 years the various phases of the problem have been studied by a special department. But it is interesting to note, however, that while the earlier plans for electrification were based on comparisons between working costs of electric and steam haulage, the coal scarcity now compels electrification in order to make the railways independent of foreign supplies. For of the 14 million tons of coal now consumed in Austria each year only 16 per cent. can be obtained in the country itself, and even these deposits would be exhausted in 20 years at the present rate of consumption. Electrification of all the railways would reduce the total coal consumption by 25 per cent., or about $3\frac{1}{2}$ million tons, so that the scheme, which, of course, includes the use of the large amount of water power available, is both economically and financially sound.

Factory Lighting.

IN these days of calls for increased output from those employed in factories it is realised as essential that everything must be done to render that output as easy as possible of achievement. In other words, it is essential to ensure that the human part of the industrial machine is operating as efficiently as possible under the best possible conditions. One of the most important factors in this matter is adequate lighting, and it will be remembered that as long ago as 1913 a Committee, of which Sir RICHARD GLAZEBOOK was the Chairman, was appointed by the Home Office to consider the

whole question of factory and workshop lighting. This Committee issued a report in 1915 recommending that an adequate and suitable standard of lighting should be provided in every part of a factory and workshop and giving power to the Secretary of State to make orders defining adequate and suitable illumination for these places. But, as we pointed out at the time, it is easier to call for adequacy in lighting than to achieve it. Partly because it is not a fixed value but depends not only on the character of the work, but on its colour, size and shape, so that a man operating a large planing machine requires different illumination from a man repairing a watch. Adequacy is, therefore, a question which must be mainly left to experience, provided that a minimum is fixed below which the illumination must on no account fall.

Glare, Shadow and Constancy.

ON the other hand, there are a number of lighting regulations which require definite formulation, and no less needful are appropriate sanctions for their non-fulfilment. We are glad to see that these matters are dealt with in the second report of the Departmental Committee, of which an abstract will be found on another page of this issue. The three important questions dealt with are glare, shadow and constancy. To overcome the first, which is becoming more and more harmful owing to the increasing use of gasfilled lamps and units of high candle-power, proper shading is recommended. Shading is defined by prescribing a maximum brightness not exceeding a given number of candles per square inch, or, more simply, by ensuring that the source of light is non-distinguishable when viewed through the shade at a distance of 100 ft., unless it be so placed that the angle between lines from the eye to an unshaded part of the source and the horizontal plane is less than 20 deg., or, in the case of a person employed at a distance of 6 ft. or less from the source, not less than 30 deg. At the same time, adequate means are to be taken to place or screen the light source so as to prevent direct reflection of the light from a smooth surface into the eyes of the worker. It is also recommended that adequate means should be taken to prevent the formation of shadows and that light sources which flicker or undergo abrupt changes in candle-power should not be used in any factory. This, of course, is not the end of the story, nevertheless it will represent a great step forward, especially when the standards laid down in this report become universal not only in the archives of the Home Office but in actual practice.

Electricity Supply in Glasgow.

THE citizens of Glasgow do well to take a pride in their municipal undertakings, particularly in those concerned with electricity supply and tramways. For quite sufficient cause for self congratulation can be obtained from a perusal of the accounts for the year ended May 31, which, issued in an elaborate form, show that considerable progress has been made, notwithstanding the unfavourable working conditions. It appears that the gross revenue for the year ended May 31 was £1311 951, compared with £977 486 in 1920, and that the working expenditure was £902 425, against £713 451. After meeting interest and sinking-fund obligations and writing off £67 161 for depreciation, there was a net profit of £2 730, compared with a deficit of £54 614 in the previous year. The result would have been much more favourable but for the breakdown of the new generators at Dalmanock in mid-winter, when the demand was at its highest, while the coal strike also adversely affected the revenue.

Satisfactory Progress.

UNDER the circumstances the increase in the electricity sold to private consumers to 151 688 636 units from 146 223 311 units in 1919-20 must be considered satisfactory. The total costs amounted to 2-0380d. per unit sold and the receipts to 2-0422d., or a balance of only 0-0042d. per unit. (Meticulous accuracy, this!) The number of motors supplied from the Corporation mains on May 31 was 15 391, representing a total of 130 207 H.P., and showing increases of 720 in number and 6 786 in the H.P. connected, although there was a slight drop compared with the previous year in the total units consumed. The total maximum demand was 165 523 kW, compared with 155 219 kW, an increase of 6-64 per cent., but the number of consumers was 46 922 against 42 892, an advance of 9-4 per cent. The first two 18 750 kW turbo-alternator sets for the Dalmarnock station were installed during the year, and the third and fourth sets will be put into commission during the coming winter. At the end of the year the amount borrowed for electricity supply amounted to £5 063 554, but the amount outstanding was only £3 874 030. Since the accounts were made up the Electricity Commissioners have authorised the borrowing of a further sum of £1 800 000, which is to be repaid by means of a sinking fund provided out of revenue at a rate of not less than 4 per cent. per annum. From these few facts and figures it will be seen how important the Glasgow municipal electricity undertaking has become, and the engineer and manager is to be heartily congratulated on being able to present such a good result at the end of a difficult year. Those who argue that a municipal electricity supply undertaking cannot be a commercial concern are requested to note.

The U.S. Battleship "Maryland."

THOSE who are interested in the important subject of the electrical propulsion of ships will seize the opportunity of studying closely the details given about the latest recruit to the ranks of battleships operated by this means. This recruit is the United States battleship "Maryland," which is expected to undergo her official trials in November next. The ship has a displacement of 32 600 tons, is 624 ft. long, and has a beam of 97½ ft. She has a full speed of 21 knots, with a radius of 10 000 miles at cruising speed. Her main propelling machinery consists of two Curtis turbines, each developing 11 000 kW at 2 030 revs. per min. These turbines supply four 7 000 H.P. induction motors, which run at 170 revs. per min., and are directly connected to four propellers. The motors are 12 ft. in diameter and weigh 62 tons. Any of the generating sets is capable of driving the ship at a speed of 17 knots. Electrical appliances are also extensively used throughout the ship and the auxiliary generating plant, from which these are supplied, consists of six 300 kW turbo-generator sets. The preliminary trials of the vessel have already taken place, and were very successful though no official results have been given. The design and construction of the electrical machinery was carried out under the supervision of Mr. W. L. EMMETT, of the General Electric Company, whose successful work in this direction is well known to readers of THE ELECTRICIAN.

Education and After Life.

THE future occupation and the success achieved in it by those who have endured a certain course of education with distinction might well form the subject of a fascinating essay which, however, we do not propose to write. Apparently, however, though Senior Wranglers may become Field Marshals and Porson prize men Prime Ministers, there is something about electricity supply which attracts Fellows of Trinity.

Our authority for this statement is Dr. WALTER LEAF, who recently pointed out that three out of four of the board of a London electricity company of which he was a member were able so to describe themselves. Without wishing to be irreverent upon a serious subject, we do not know whether the company in question are to be congratulated or not upon their acquisition. The connection between the roads to success in the two fields is not immediately evident. But it may be that, in both, initiative, energy, tact and enterprise are required and that success depends on the possession of these qualities rather than on a knowledge of those details which, though valuable to schoolmen, cannot easily be translated into bread and butter and are even a little out of place in electricity supply.

More Electricity Schemes.

ALTHOUGH little actual progress has been made in the formation of Joint Electricity Authorities there is no lack of schemes for reorganising electricity supply in the various areas. Among the latest of these the South West Midlands Area is distinguished by providing a scheme but no Joint Authority. For as we pointed out in a recent issue the Corporation of Birmingham and the Shropshire, Worcestershire & Staffordshire Electric Power Company already supply about 98 per cent. of the electricity generated in this district. They therefore simply propose to divide the spoils between them, to set up an advisory committee of four and to pool their resources, although no actual fusion of financial interests is considered practicable or desirable. As the only other independent undertakers of importance in the district are the Worcester and Sutton Coldfield Corporations and the Redditch Urban Council, it is probable that the suggested advisory committee would work well, at all events for some years, and that the development of supply would be as rapid as under any other arrangement. On the other hand, because an undertaking is small that is no reason why it should be frozen out, when it may be quite willing to co-operate, and for that reason the absence of any attempt to create a committee representative of all the undertakers, of the large consumers and of other interests is hardly the right policy.

TECHNICAL PROPOSALS.

Technically there are no complications. It is proposed to adopt a 25 period three-phase system throughout the district. The Corporation and the power company have identical systems of supply which are at present linked together, and a further link of substantial capacity would be provided. The main underground transmission pressures in Birmingham and Warwickshire would be 33 000 V and 11 000 V, though certain overhead lines would be worked at 66 000 V. A pressure of 5 500 V would be used for secondary transmission.

For general purposes the most economical portions of the plant at the Nechells and Summer-lane generating stations of the Birmingham Corporation and the Power Company's station at Smethwick would be utilised in conjunction with the new capital stations. Eight of the existing supply stations in the district, including those at Sutton Coldfield, Kidderminster, Dudley, Redditch, Malvern and Ludlow, would be closed down when opportunity serves. But the Worcester stations would continue to operate as would the Shropshire company's station at Stourport. Eventually three capital stations are projected, viz., at Nechells (110 000 kW), at Hams Hall (300 000 kW) and at Stourport (105 000 kW). Negotiations for a traction supply have been opened with the

Midland Railway Company, and as the District at present contains about 390 route miles of railways, with a very heavy goods and suburban traffic extending to 2 000 route-miles within a 50 mile radius of Birmingham, a wholesale conversion to electric traction might well be contemplated.

ELECTRICITY SUPPLY IN NORTH LANCASHIRE.

A second scheme emanates from the North Lancashire and South Cumberland Electricity District, where it is proposed to form a Joint Authority of 30 members, 24 of whom would be representatives of local authorities, the remainder being appointed by large consumers and railway companies. In addition to the ordinary powers sanction is sought to manufacture, sell or hire, connect and maintain all sorts of electrical apparatus, while the price of electricity is to be so regulated as to provide a surplus of receipts over expenditure for the creation of reserve and renewals funds. There is, however, a complicated and, in our opinion, an unworkable clause for dealing with deficits, if there should be any, while the details to which we have referred above seem unnecessarily to widen the true work of a Joint Electricity Authority, though it must be remembered that the area is mainly an agricultural one.

TECHNICAL SCHEME.

The standard three-phase system of generation at 6 600 V 50 periods will be adopted, and the distribution in all areas will be on the four-wire system at 380 V for power and 220 V for lighting and heating. The transmission will be at 33 000 V and 6 600 V, and it is suggested that the "Board of Trade" (!) should construct the lines scheduled in the scheme and hand them over to the Joint Authority within two years of its formation. Is this ignorance or bad sub-editing? The development scheme will be carried out in two stages. In the first period, ending in 1925, it is hoped to acquire the Cavenish Park power station of the Vickers Company, and to erect a hydro-electric station at Backbarrow, about a mile below the foot of Lake Windermere, which will contain three 730 H.P. turbines, so no time will have to be lost. The estimated cost of this station is £60 000, and it is calculated that, if 50 per cent. of the water power available is utilised for generating electricity 4 450 000 units per annum can be supplied. Of the total of £287 250 proposed to be expended in this period, £157 250 will be devoted to the transmission lines and £70 000 to the distribution network, but of the £736 850 spent in the second stage £400 000 will be required for a 20 000 kW steam capital station at Barrow, £171,850 for transmission lines, switchgear, transformers, &c., and £105 000 upon the distribution system. It will be gathered that the area is somewhat scattered as regards power supply, and we fear that to obtain an adequate return on the capital expended will be a slow job.

EXCLUSIVENESS IN THE NORTH-WEST MIDLANDS.

The scheme for the North-West Midlands District differs from either of the two preceding, in that the Joint Electricity Authority will consist of representatives appointed by the eleven electricity undertakers in the area and by no one else. Representation will be given according to the gross revenue of the undertaking, and each undertaker will have one vote for each £20 000 of gross revenue. The maximum number of the Authority is not given, but 12 will form a *quorum*. The voting basis is to be adjusted each year, and though the ordinary term of office of a member is three years, provision is made by which one-third of the members shall retire each year. This is a useful means of preserving continuity of policy and of avoiding radical changes in the constitution of the Authority at the end of the triennial period. It is suggested that the Authority may exercise, by itself or through com-

mittees, or by any of the undertakers, any of its powers of generation and supply.

The usual borrowing powers are sought, with authority to suspend the operation of the sinking fund for the first five years and to apply temporarily sinking fund moneys for capital purposes. After meeting all expenses, the Authority may create funds to provide for depreciation, renewals and reserve. The charges for electric supply are to be so fixed as to secure that over a term of years the receipts shall meet all expenses on revenue account.

ELECTRICAL PARTICULARS.

The standard three-phase system of generation at 6 000 V to 6 600 V 50 cycles is proposed. The main transmission pressure is to be from 30 000 V to 33 000 V, and the secondary pressure from 6 600 V to 11 000 V. Six generating stations are to be taken over, viz., those at Ocker Hill (Tipton), Stafford, Hanley, Walsall (Birchills), West Bromwich and Wolverhampton; and later on the stations at Shrewsbury, Newcastle-under-Lyme, Leek and Market Drayton will also be transferred. It is not considered desirable to shut down any of the existing generating stations at present, but after interlinking cables have been laid all the direct-current stations and plant, and later the more uneconomical of the alternating-current plant, will be discarded. Three new capital stations are scheduled, viz., one near Rugeley on the Trent, to have an ultimate capacity of 80 000 kW; the second near Ironbridge on the Severn, with a capacity of 150 000 kW; and the third near Stoke-on-Trent, with a capacity of 30 000 kW. Provision is to be made for the supply of energy for traction, and though the water-power resources in the district are limited, it is contemplated to develop them as opportunity serves.

This brief outline of the three latest schemes will show that opinions differ widely as to the methods to be adopted for developing electricity supply. But this diversity of opinion is not in itself a bad thing provided it leads us eventually to discover the best method of obtaining an economical supply in any particular area. It will at least necessitate discussion of many administrative and technical details, and in the absence of full legislative powers no serious harm can be caused to the industry by a little delay over the preliminary stages of these Joint Authorities.

Chinese Electrical Development.

THE interest of its past history and the vastness of its territory combine to give a glamour to China which it perhaps would not otherwise possess. Unfortunately these qualities seem also to have obscured a great amount of more mundane development and have hidden from the eyes of present day British traders opportunities which would have otherwise been seized. This is the more unfortunate in that we were among the pioneers in introducing western ideas to this eastern civilisation and have only lost that pre-eminence by a forgetfulness of our own interests which it is hard to excuse.

Nevertheless we are glad to be able to record that electrical development is proceeding satisfactorily. For the purpose of considering what is being done it will be convenient first to deal with Shanghai, an outpost of Westernism which is under English management and then with electrical prospects in China in general.

ELECTRICITY SUPPLY IN SHANGHAI.

As regards Shanghai much information can be obtained, from the annual report of the municipal electrical engineer which usually makes interesting reading, and Mr. ALDRIDGE's account of his stewardship in 1920, which was given in a recent issue, is no exception to the rule. Notwithstanding the very adverse working conditions caused by a shortage of plant and the final breakdown of the two A.E.G. alternators, which have now been discarded, the net sales (blessed term!) of electricity for all purposes increased in 1920 to 144 540 000 units from 102 338 000 in 1919, while the units consumed for power increased to nearly 117 million units, or about 47 per cent. more than in the previous year. All former records were thus surpassed. This was in some part due to the large number of mills and industrial establishments that were connected, including six cotton mills with an aggregate of 140 000 spindles. At the end of the year there were 2 673 motors, of an aggregate of 45 305 H.P. connected, and of these 918 motors of 16 271 H.P. were let on hire by the electricity department. These hiring facilities have proved very advantageous, though there is now, as might be expected when there is no doubt about the advantage of the electric drive, a growing tendency to purchase motors outright. The prospects for the current year are stated to be very good, as several other mills are awaiting connection.

EXPANSION OF THE INDUSTRIAL POWER LOAD.

There are, we are glad to learn, great possibilities for the expansion of the industrial power load in Shanghai, though as it is the output under this heading in 1920 was only exceeded by those of the Manchester and Glasgow Corporations, so that within a few years it should compare favourably with even the most electrified of electrical zones in this country. But the load factor is enough to make English supply engineers' mouths water, being 46.7 per cent., compared with 25.28 and 25.54 in Manchester and Glasgow respectively. Perhaps the eight hour day is unknown in that happy clime? With all this development, it is, therefore, not surprising to learn that two new 18 000 kW and one 10 000 kW turbo-generators have had to be obtained, and will be available during the current year, while two further 20 000 kW turbo-alternators, with the necessary steam raising and auxiliary plant, are on order. The gross profit for the past year was 1 290 121 taels, or 10.34 per cent. on the capital outlay, the net profit being 781 910 taels, of which 630 000 taels were contributed to the municipal general funds, the remainder having been placed to reserve and equalisation accounts. Altogether, Mr. ALDRIDGE must be congratulated upon his success under conditions which, however adverse, do not prevent real development taking place, and we wish him still greater fortune in future.

HEATING AND COOKING PROSPECTS.

Another interesting feature of the year's working is the increase in the sales of energy for cooking and heating. These amounted in aggregate to 1 240 136 units, or an advance of 30 per cent. over the previous year. Though the tariff for this supply is relatively high, it has had little effect in checking the demand for radiators, cookers and other heating apparatus. New showrooms were opened during the year, with the result that many additional consumers were attracted. We are glad to notice that the wiring contractors and supply houses are co-operating with the department in developing this branch of the business, and the results should be satisfactory to both. We should like to see more of this co-operation adopted in this country, not only for popularising the domestic load, but also for increasing the demand for power and lighting.

MARKED DEVELOPMENTS.

It is not, however, only in Shanghai that the advantages of the electric drive are being recognised. According to

an interesting report in the British Chamber of Commerce "Journal" published in Shanghai there has been generally a marked development in the use of electrical machinery during the year 1920. One result of this was rather curious in its effects and leads us to thank our stars that we live in a country where the doings of our supply companies are to some extent controlled by a grandmotherly government. Owing to the demands for electric lighting the plants became heavily overloaded, to counteract which the voltage was constantly being reduced until the consumers had to retaliate by using lower voltage lamps. Voltage reduction and lamp changing then followed one another with increasing rapidity until on one system where the declared pressure was 220 V the actual pressure at the lamps was found to be about 23 V. Although in most cases the management, and we might add the consumers, were mainly responsible for this state of affairs, it was peculiarly due to the difficulty in obtaining delivery of plant which had been ordered. This is a good story and we publish it with the reservations usual on such occasions.

INCREASING USE OF PRIVATE PLANT.

Another result of this deficiency, a result which can only be looked upon as retrograde, is the tendency of many of the large merchants and shopkeepers in the various Chinese cities to instal their own electric lighting plant, though under the conditions we have outlined they can hardly be blamed for taking that course. Whatever we may think of this policy, however, it has at least had the effect of stimulating the demand for semi-automatic lighting sets with an output of about 1 kW. These sets, which are, of course, used in conjunction with batteries, are, however, unfortunately mainly supplied from America partly no doubt as a result of the easier deliveries obtained, but partly because one American firm at least has established a very large and efficient selling organisation in Shanghai. As regards public supply there is a tendency towards working under more modern conditions by installing larger sets, but here again there is not much satisfaction to be obtained by British electrical engineers as most of this plant seems to have been supplied either from the United States, from Switzerland or from Germany.

COTTON MILL DRIVES.

As in Shanghai so in other districts there is a constant change over of the cotton mills from steam to the electric drive. This change over has resulted in orders being placed for an amount of plant of satisfactory aggregate capacity, and this demand has been stimulated by the disinclination of the Chinese to use a common power station even where two or more mills are located close together. So far is this individuality carried indeed, that it is not uncommon to find two power stations, one of 500 to 1 000 kW and the other of, say, 2 000 kW, almost side by side when greater reliability and lower capital cost could have resulted from building only one power station, which would have been common to a group of mills.

The increase in the amount of machinery installed has, of course, increased the demand for electrical accessories of all kinds. In this market Japan seems to have captured most of the business, though America has a good footing, especially in the better class fittings and glassware, while for the supply of lamps the various Dutch firms have also built up a good business.

It is, therefore, evident that before British electrical industry can establish itself in China on a firm footing a good deal of competition will have to be encountered and overcome. This is a matter to which close attention might well be given, as with the general development of the industries in China there seems no reason why there should not be a very good chance for the British electrical manufacturer to operate on a large scale.

The Thermionic Tube—A Return to Simplicity.

By L. C. POCOCK, B.Sc., A.M.I.E.E.

The extraordinarily wide field of usefulness occupied by the thermionic tube has rendered it necessary for many engineers and others who did not study the early development of this device to make themselves familiar with at least the elementary theory of its behaviour.

COMPLICATIONS VERSUS SIMPLICITY.

Every writer has his own way of thinking of the action of a thermionic tube, and the majority of articles on the subject commence with an explanation of the author's theory; differential equations are introduced and shown to be too complicated to be of practical utility, and then when the unaccustomed reader has withdrawn from the unequal combat—all the complications are thrown overboard and simplifying assumptions are introduced which lead quickly to a result, the simplicity of which might well be more emphasised than it generally is.

It is, of course, important to remember that the practical formulæ are only approximately true under finite conditions, and it is important to understand the differential equations associated with the action of the tube, but, since the final formulæ in many cases depend on the simplifying assumptions rather than on the differential equations it may be of use to show how a simple explanation can be given.

SIMPLIFYING THE THEORY.

The usual simplifying assumptions that appear in the theory of amplifying and oscillating tubes are as follows:—

- The grid current is zero.
- The capacity currents are negligible.
- The grid-voltage plate-current characteristic is linear, or, what amounts to the same thing, the plate current varies over so small a part of the characteristic that the latter can be considered linear.

To these might perhaps be added an assumed constant resistance in the tube between the plate and filament; on the other hand the linearity assumed in (c) is equivalent to

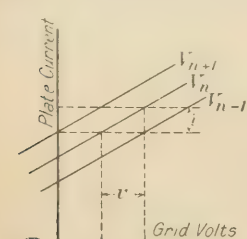


FIG. 1.

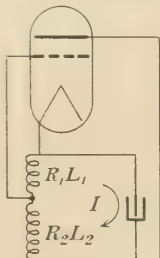


FIG. 2.

a constant mutual conductance in the tube so that it is not difficult to conclude that the plate-filament resistance will also be constant and the current between the plate and filament will then be a linear function of the plate voltage.

We have, therefore, a series of parallel equidistant straight lines representing the characteristics for a number of equidistant plate voltages.

THE AMPLIFICATION FACTOR.

The amplifying properties of the tube depend on the fact that a small voltage change v in the input (grid) circuit will vary the current between the plate and filament by an amount that would require a much greater change V in the plate voltage, had the same change of current been effected by a change of plate voltage instead of grid voltage. The ratio V/v is the amplification factor (μ) of the tube.

From Fig. 1 it is apparent that a given change i in the plate current can be produced by a change of plate voltage $V_{p1} - V_{p2}$ or a change of grid voltage v so that these two E.M.F.s correspond and are by definition related through μ in the formula

$$\mu = \frac{V}{v} \quad (1)$$

It is apparent from the figure that μ is constant and independent of the magnitude of current change i in all circumstances under which the assumptions made are valid.

THE EFFECTIVE AMPLIFICATION.

A change v in grid voltage can evidently be considered as the introduction of an actual E.M.F., $V = \mu v$ into the plate circuit within the tube. Now, in practical circuits, there is almost always some impedance Z in the plate circuit external to the tube so that a change v in the grid voltage will, in the given circuit, cause a change of plate current,

$$i = \frac{\mu v}{R_0 + Z} \quad (2)$$

where R_0 is the internal resistance of the tube.

The amplified voltage (potential difference) at the output terminals is therefore,

$$iZ = \mu v \frac{Z}{R_0 + Z} \quad (3)$$

for a grid voltage change v .

The effective amplification is therefore

$$\frac{iZ}{v} = \mu \frac{Z}{R_0 + Z} \quad (4)$$

and is a maximum equal to μ only when Z is infinite. This is equivalent to considering the tube as a step-up transformer having primary voltage v , primary current zero, secondary E.M.F. V and internal secondary impedance R_0 .

THE PROPORTIONS OF THE CIRCUIT.

The applications of thermionic tubes are very numerous, but, broadly speaking, it is generally necessary to secure either maximum voltage amplification or maximum power output. By what has been said it is evident that maximum voltage amplification is secured when the plate circuit impedance is as high as possible, but this will evidently not give a maximum power output on account of the very small plate current.

The alternating-current power vector in the plate circuit for an assumed impressed alternating-current grid voltage v will be $(\mu v)^2 / (R_0 + Z)$, of which only the energy absorbed by Z will be available. It is well known that when energy is expressible in this form the maximum energy is available if Z is equal to R_0 . The energy dissipated is a maximum if Z is a pure resistance equal to R_0 , and if Z is a complex impedance it must have its modulus equal to R_0 for maximum power in Z . For maximum dissipation in Z , the effective resistance of Z must equal the modulus of the impedance of the rest of the circuit.

DYNAMIC CHARACTERISTICS.

Before passing to the consideration of oscillating circuits it may be as well to point out that there is no real difference (within the limits of this article) between the static and so-called "dynamic" characteristic in so far as the tube action is concerned.

The static characteristic is experimentally determined without any external plate circuit resistance merely as a matter of convenience, and this characteristic can be directly applied to a tube in a working circuit if proper attention is given to the necessary transformations. The dynamic characteristic may be considered as the characteristic of the whole assembly of apparatus forming a tube circuit.

If the characteristic shows that a change of grid voltage of 1 V changes the plate current by 1 mA, this must not be understood to mean that a change of 1 mA in plate current will result when the grid voltage changes by 1 V, whatever the plate circuit resistance external to the tube may be; but it does mean that whenever the grid voltage changes by 1 V the plate current will change as if the plate circuit battery had changed by μ volts (equation 2), or as if the actual P.D. between plate and filament had been changed by an amount equal to the effective amplification factor (equation 4). This

is equivalent to changing the scale of the plate current ordinates, so that the inclination of the characteristic is the mutual admittance of the plate circuit instead of the mutual admittance of the tube only; but the original characteristics still give the correct relation between grid volts, plate current and plate voltage if for the last is used the actual P.D. across the tube.

With the above interpretation and a proper treatment of reactive impedances the ordinary characteristics can be applied to circuit problems.

THE OSCILLATING TUBE.

The limiting conditions under which a tube will just oscillate at frequencies such as do not contravene the initial simplifications are readily found from the linear characteristics, and are, moreover, given accurately since the investigation is directed towards determining limiting conditions in which the plate circuit alternating current is vanishingly small, so that the assumption of a linear characteristic is justified in the limit.

In a given oscillating circuit let V' be the alternating-current voltage as measured between the plate and filament, when an alternating-current voltage v acts on the grid. From equation (4)

$$\mu = \frac{V'}{v} \cdot \frac{R_0 + Z}{Z}, \quad \dots \dots \dots (5)$$

which, as has been seen, is a general statement of the relation between the circuit and tube constants, but it can be made to

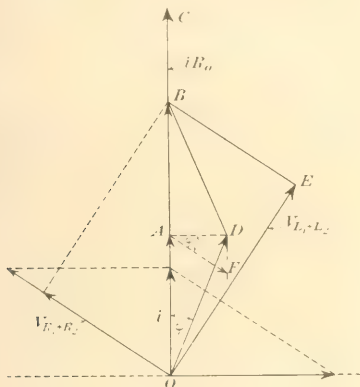


FIG. 3.

give the critical conditions with which oscillations will just cease to be possible. This is done by giving V'/v its value under the conditions that the plate current (alternating current) is indefinitely small, while the oscillation current still exists and is of appreciable magnitude. The value of V'/v depends on the circuit considered, and is the more easily determined by reason of the assumed zero plate current.

THE SIMPLE CIRCUIT.

As an example take the simple circuit shown in Fig. 2. If I is the oscillating current and is the only appreciable current flowing, the voltage applied to the grid will be simply

$$v = (R_1 + j2\pi n L_1) I, \quad \dots \dots \dots (6)$$

and the voltage at the plate terminals will be

$$V' = \{ (R_1 + R_2) + j2\pi n (L_1 + L_2) \} I, \quad \dots \dots \dots (7)$$

where n is the natural frequency of the oscillating circuit.

Thus, the conditions for extinction of oscillation are given by the vector equation

$$\mu = \frac{(R_1 - R_2) + j2\pi n (L_1 + L_2)}{R_1 + j2\pi n L_1} \cdot \frac{R_0 + Z}{Z}, \quad \dots \dots \dots (8)$$

where Z has to be expressed in terms of the circuit constants and the resonant frequency.

Expressions of the above type have been developed by R. A. Heising for a number of circuits, from the circuit equations ("Phys. Rev.," Sept., 1920) and the general expression (5) has been given by R. D. Duncan, who obtained it from a consideration of the energy conditions in the circuit ("Phys. Rev.," March, 1921).

VECTOR DIAGRAMS AS AN AID.

Without departing from simple and familiar processes a more complete picture of the mechanism of oscillation can be obtained from a study of the vector diagram. Let OB be the voltage across the resonant circuit, then OE and EB represent the reactance and resistance components of voltage across the resonant circuit in the inductance branch. Now, if the resistance and inductance are variably distributed in the inductive arm so that both the total resistance and the total inductance remain constant, each distribution will give rise to voltages such as OD , DB representing the voltages across coils one and two respectively.

The resonant network and the whole plate circuit act like a pure resistance so that OB must be in phase with the grid voltage producing it. It follows, therefore, that the component OA of OD is the only voltage effective in producing the plate circuit voltage OC , where BC is the voltage dropped in the tube resistance.

THE RESIDUAL COMPONENT.

The residual component of grid voltage AD will give rise to a second vector diagram in which all the previous vectors are turned through 90 deg. and reduced in the proportion AD to AO and there will be a corresponding grid voltage AF having components AD , DF of which the former has been taken into account and the latter is in opposition to OA . The plate circuit voltages due to OA and AD will now have a resultant in phase with OD and the residual voltage DF will react on the system to produce a new set of similarly related voltages of reduced magnitude. The process can be continued until the plate circuit voltage is left in phase with OD without any residual grid voltage.

The value of the resultant plate circuit voltage will evidently be the vector sum,

$$V = \frac{OC}{OA} \{ OA + AD + DF + \dots \} \\ = \{ OC \{ 1 - j \tan \varphi - j^2 \tan^2 \varphi - j^3 \tan^3 \varphi + \dots \} \}, \quad \dots (9)$$

where $j = \sqrt{-1}$ and φ is small.

Summing the geometric vector series and rationalising,

$$V = \frac{OC(1 + \tan^2 \varphi)}{1 - \tan^2 \varphi} \\ - \frac{OC}{OA} \cdot OD \cos^2 \varphi, \quad \dots \dots \dots (10)$$

This result shows that V , the amplified voltage, is in phase with OD whatever distribution of resistance and inductance has been selected in the resonant circuit; since V must be equal to μv , it follows that

$$\frac{OC}{OA} \cos^2 \varphi = \mu \quad \dots \dots \dots (11)$$

for any stable condition at the limit of oscillation. μ may be least when $\varphi = 0$, which is secured when $R_1/L_1 = R_2/L_2$, a condition coincident with the vanishing of the imaginary part of (8).

The ratio OC/OA depends on the tube resistance and the constants of the circuit, but it is independent of μ ; φ depends on the distribution of resistance and inductance in the inductive branch of the resonant circuit and is independent of μ . It is the equating of $\frac{OC}{OA} \cos^2 \varphi$ to μ that introduces the tube action and gives the essential relation between the various constants which must be satisfied to make oscillation just possible.

From the trigonometry of the figure we can write

$$\mu = \frac{OC}{OD} \cos^2 \varphi = \frac{OC'}{OD} \cos^2 \varphi, \quad \text{. . . (12)}$$

but OC/OD is the ratio (fixed by the circuit solely when i is small) of voltage in the plate circuit to voltage across coil L ; when multiplied by $\cos \varphi$ the ratio is reduced to the real part

of the quotient. Thus oscillation is possible when the tube constants and circuit constants are such that the real part of the ratio of simultaneously existing voltages in the plate and grid circuits—regarding the tube as an inert resistance element—is equal to (or less than) the essentially real ratio (μ) of the voltages that may co-exist in the plate and grid circuits of the tube when in action. This is the verbal interpretation of vector equation (5).

A Quiescent Aerial Wireless Telephone.

By JOHN SCOTT-TAGGART.

The present writer has recently described in *THE ELECTRICIAN** the use of a two-electrode valve in wireless receiving circuits, and it was thought that a further application of this class of valve to wireless telephony might be of interest. The arrangement about to be described employs a thermionic valve having a filament, two grids and an anode, the two grids being in the form of concentric spirals surrounded by a cylindrical anode.

The novelty consists chiefly in the operation of the circuit in such a manner as to obtain a quiescent aerial effect; that is to say, there is no radiation from the aerial when not speaking into the microphone. The thermionic valve has an anode, A , a grid, G_2 , a grid, G_1 , and a filament, F (Fig. 1). In the anode circuit is an inductance coil, L , and a source of high voltage, H , shunted by a condenser, C , to by-pass the high-frequency component of the anode current. The foot of L is connected to earth, and the aerial is connected to a tapping on L . To obtain maximum output an anode tap is also provided. The output circuits may, of course, be varied in many ways, but the one shown is a convenient one. Across the grid, G_2 , and the filament, F , is connected a source, S , of steady continuous oscillations. This source will be some form of oscillating valve. The circuit so far would act as a power amplifier. The power developed in the output circuit is, however, con-

vary the amount of power developed in the anode circuit by varying the effective high-frequency positive voltage applied to the other grid. Under normal conditions when not speaking

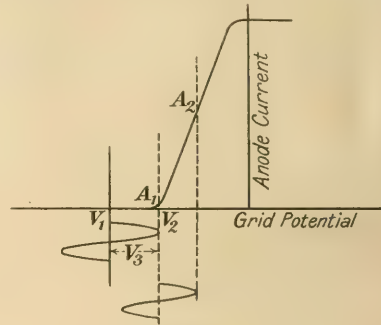


FIG. 2.

there is a sufficient negative potential on the grid, G_1 , just to neutralise the highest positive potential applied to G_2 by the source of high-frequency potential. If now we make the negative potential on the grid G_1 less, the positive half-cycles delivered by S will, beyond a certain point near the peaks, overcome the controlling effect of the negative potential on G_1 , and produce an electron flow from filament to anode, and an oscillatory output in the aerial circuit. By varying the potential of the grid G_1 we can vary the portions of the positive half-cycles measured from the peaks which are effective in producing a high-frequency current in the anode circuit of the valve. The potential of the grid G_1 is varied microphonically in order to obtain a modulated output from the valve. Usually a microphone, M , and step-up transformer, T , is used. The negative half-cycles of the microphone potentials are not used, but only the positive half-cycles. Similarly only the positive half-cycles of the high-frequency potentials applied by S are used.

GRAPHICAL EXPLANATION.

The method of operation may be explained roughly by examination of Fig. 2 which shows the characteristic curve of the valve. The anode current curve lies completely to the left of the grid zero ordinate, which is usually the case in practice. Sufficient negative potential is given to the grid, G_1 , to operate the valve at a point, V_1 , on its characteristic curve. This point is well to the left of the point where the anode current is zero (A_1). The source of high-frequency oscillations, S , does what is equivalent to varying the operating point on the curve between two points both of which are on the portion of the curve to the left of zero anode current. The negative potential, V_1 on G_1 , is such that positive half-cycles of high-frequency current, having an amplitude, V_3 , are just sufficient to bring the operating point to the point, A_1 , where current begins to flow through the valve.

Under these conditions the high-frequency source produces no high-frequency output in the anode circuit of the valve. If, however, we lessen the negative potential of the grid, G_1 ,

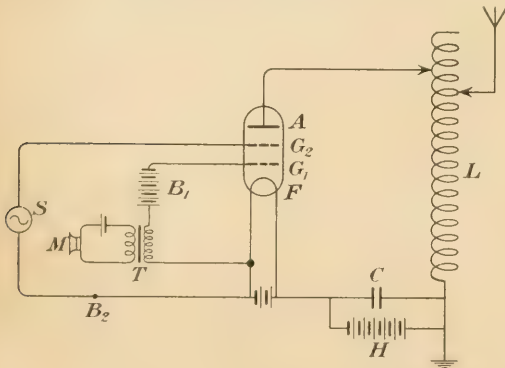


FIG. 1.

trolled by varying at low frequency the potential of a second grid, G_1 , which controls the electron flow from filament to anode.

METHOD OF CONTROL.

The method of controlling the electron current in this manner is done in a special way which will be more readily understood by reference to Fig. 2. The grid, G_1 , of the valve is normally given a high negative potential which not only cuts the anode current of the valve to zero, but even keeps it at zero when high positive voltages are given to the other grid by means of the source, S . The arrangement, therefore, does not work merely on the principle of varying microphonically the electron current to the anode. Rather does it

*Vol. LXXXVI, p. 97.

we will be doing what is equivalent to moving the zero line of the alternations to the right. The positive half-cycle will now peep round the corner of the characteristic curve. In other words, the representative point will now move from A_1 up a portion of the curve and down again. The extent of this excursion will depend upon the extent to which we lessen the negative potential on G_1 . A slight lessening of the negative potential on G_1 will only produce a small high-frequency output in the anode circuit of the valve, but larger decreases will produce correspondingly larger effects in the aerial. If the negative potential on G_1 is made such that we are operating at the point A_1 on the curve the positive half-cycle of high frequency current will cause the representative point to sweep over a large portion of the characteristic curve. Naturally, we should have the amplitude of the positive half-cycles such that when the potential of G_1 brings us to the lower bend the whole of the characteristic curve is in use. The movement of what may be called the base-line point of operation is accomplished by the positive half-cycles of microphonic potential which lessen the E.M.F. of the battery, B_1 . It will be clear that the high-frequency potentials should be greater than the microphone potentials. It will also be clear that the output of the valve will be proportional to the microphonic potentials, which is what is desired for good modulation.

The circuitual arrangements may be altered by including the battery, B_1 , in the grid, G_2 , circuit at the point B_2 , instead of in the G_1 circuit, shown in Fig. 1. The operation of such a varied circuit is analogous to that already explained.

A PRACTICAL FORM.

Fig. 3 is an illustration of a practical form of the circuit given in Fig. 1. A three-electrode valve, V_1 , produces oscillations in

any known manner, such as that shown where a mid-way tapping is taken from L_1 through the high-tension source, H , to the filament. A grid condenser and a grid leak, R , is provided. The oscillations in the circuit, L_1 , C_1 , are induced into a coil, L_2 , across G_2 and F . When the valve, V_1 , is oscillating there will be a steady potential drop across the resistance, R ,

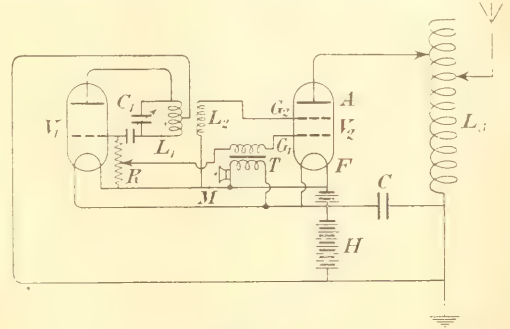


FIG. 3.

and the necessary negative potential for the grid, G_1 , is obtained by taking a tapping off the resistance, R . The microphone-transformer has its secondary in the G_1 grid circuit, while the microphone, M , derives its current from the filament heating source. The other details of the circuit will be readily understood from the figure.

Electric Traction in Austria.

I.—Introduction of Electrification on the Austrian Federal Railways.

On July 23, 1920, a proposal by the Austrian Government for the electrification of certain of the Federal Railways was adopted by the National Convention. The works begun under previous Acts are to be continued so that by June 30, 1925, the following lines shall be worked electrically:—(See Fig. 2.)

- The Arlberg Railway (Innsbruck-Landeck-Bludenz) and the Voralberg Railway (Bludenz-Bregenz-Lindau and branch lines).
- The Salzkammergut Railway (Steinach-Ischning-Attnang Puchheim).
- The Western Railway (Salzburg-Schwarzach St. Veit and Schwarzach St. Veit-Wörgl).
- The Jaurn Railway (Schwarzach St. Veit-Spittal-Millstättersee).

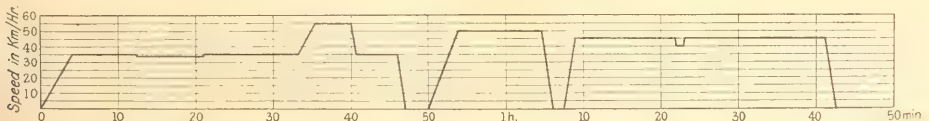


FIG. 2.—SPEED-TIME CURVE FOR EXPRESS TRAIN OF 320 TONS HAULED BY STEAM LOCOMOTIVE.

The proposals for the supply of energy were also agreed to. These include bulk supply from private stations and the erection of railway water-power stations at Spullersee, near Donöfen, in Stubachtal, and on the Mallnitz, near Oberrnallach, as well as the extension of the existing railway generating station on the Rutzbach.

To carry out this plan the sum of 5 096 million kronen, based on present-day prices, has been voted. The chief items in this total are 1 560 million kronen for overhead lines and sub-stations and 2 260 million kronen for electric locomotives, &c.

THE ELECTRIC RAILWAYS OF THE WORLD.

Accompanying these proposals is a report on the electrified railways of the world, which reaches back to 1891, when the Austrian

ways and factories, and converting the generating stations to water power, seven million tons per annum can be saved.

SAVING IN COAL CONSUMPTION.

The annual consumption of coal on the Austrian Railways, based on the services for 1913 and on the present day unfavourable conditions, amounts to 4 410 000 tons, of which 73 per cent. is required by the Federal lines and 21 per cent. by the Southern Railway (Südbahn). By electrifying all the railways the total coal consumption would be reduced by 25 per cent. (about 3½ million tons), representing a cost of 2½ milliard kronen.

TECHNICAL ADVANTAGES OF ELECTRIFICATION.

Among the chief technical advantages of electrification must be mentioned the possibility of obtaining higher speeds economically;

* Abstract from the "Elektrotechnische Zeitschrift," Vol. XLII, p. 505.

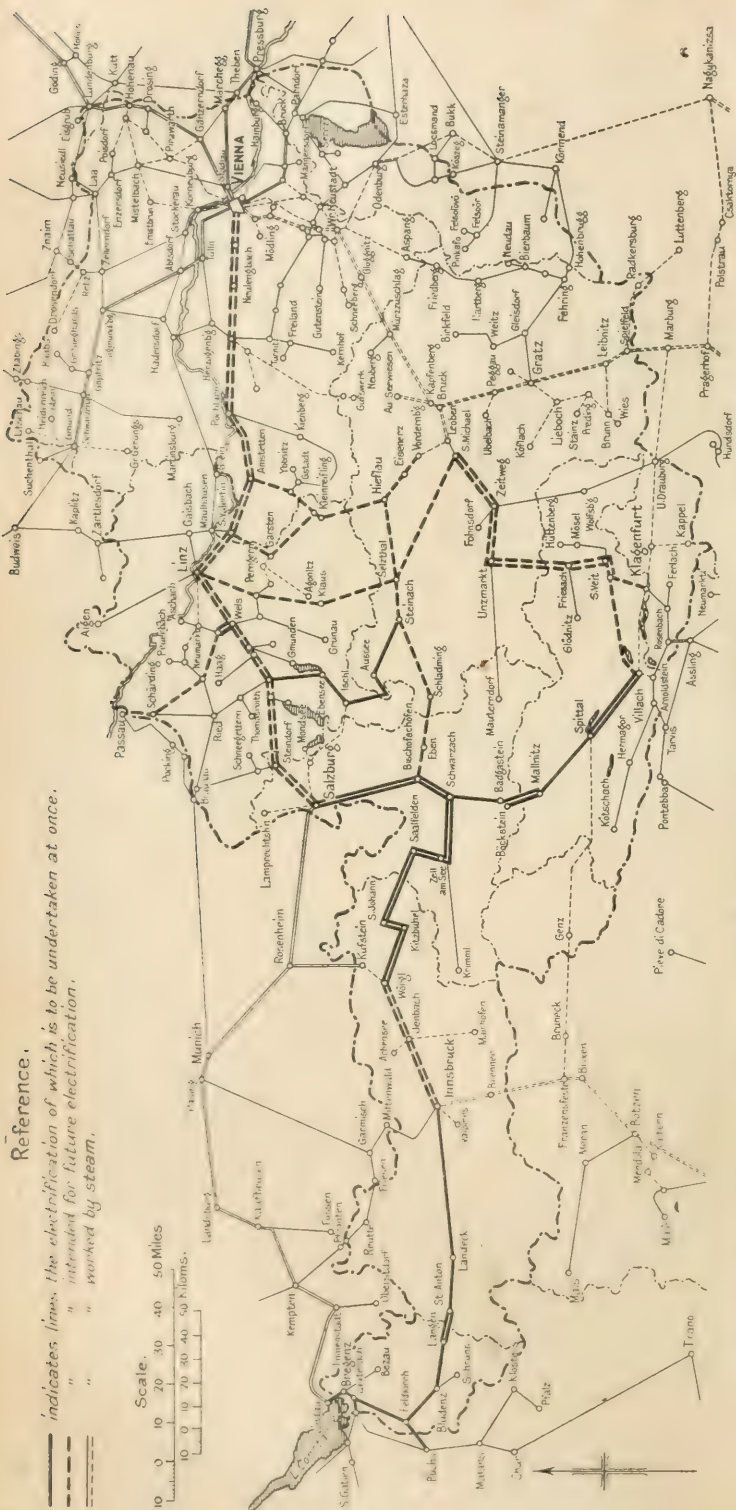


FIG. 2.—MAP OF THE AUSTRIAN RAILWAY SYSTEM.
 The heavy lines denote the sections to be electrified immediately; the broken lines the sections to be electrified later. The number of lines denotes the number of tracks.

in the first place by restoring pre-war speeds and later by increasing these by 15 to 20 per cent. without exceeding pre-war costs. The higher speeds will be obtained chiefly by increasing the average speeds and partly by increasing the acceleration during starting. Much will be gained through not having to stop for coal and water supplies, especially on long journeys; while the removal of the tender permits an increase of useful load. Increased loads are particularly important at present because of the need of using fewer and heavier trains, in consequence of coal scarcity, labour costs, repair delays, &c.

The higher speeds and heavier trains will permit an increase in the total traffic (in ton-km.) and thus relieve the congested single lines or postpone doubling the track. Electric locomotives and motor coaches can be better utilised because less time is needed for overhauling, and steam has not to be raised, &c. Also small repairs can be done more quickly because interchangeability is simpler.

Further, electric vehicles do not require to have always the same personnel and are more generally ready for service. The removal of smoke, rust and gas troubles is a great advantage, particularly in the west where there are so many tunnels. A certain increase in safety arises from the possibility of making any particular section dead in case of emergency. Useful traffic can also replace the mineral traffic no longer required for the railway service. Few electric locomotives need to be turned round, thereby leading to a saving in time and trouble. The lines to be immediately electrified are those which will show a great saving in coal and increased economy—conditions which can only be fulfilled on lines with dense traffic. All other lines, including all lines north of the Danube, cannot be considered now.

Tables 1 and 2 show the first and second constructional programmes—no plans have yet been drawn up for the remainder.

Assuming the work to extend over 12 to 15 years, it would be necessary to electrify 145 to 115 km. yearly. Work will be commenced on the sections Innsbruck-Landeck-Bludenz and Steinach-Attnang, because preparations have been in hand here for some years and because the energy can be obtained here under the best conditions. Also the coal saved on these western lines will be considerable.

SYSTEM EMPLOYED.

The choice of single-phase current at 15,000 V and 50 cycles was exhaustively discussed. With this system the over-all efficiency of transmission from the power-station busbars to the wheel circumference is 60 to 63 per cent., compared with 47 to 61 per cent.

Table I.—Details of the Lines to be Immediately Electrified.

Line.	Main details of Lines.					Energy required.		Energy supply.		
	Length, km.	No. of tracks.	Greatest incline in 1 000.	Gross traffic in 1913: ton-km. × million.	Gross daily traffic in 1913: tons.	Annual units, kWh × million.	Maximum turbine H.P.	Station.	Output, kWh × million.	H.P. of machines.
Innsbruck-Lindau ...	204	1	31.4	558.5	7 500	40.0	32 000	Spullersee Rutzbach	25.2	3 × 8 000
Feldkirch-Buchs ...	18.5	1	10.5	29.9	4 400	1.6			39.0	2 × 4 000
Bregenz-St. Margrethen ...	12.7	1	6.7	18.7	4 000	0.9				+1 × 8 000
Total for Western Group	235.2			607.1		42.5	32 000		64.2	40 000
Salzburg-Schwarzbach							48 000	Stubaietal		
St. Veit ...	66.7	2	10.0	378	15 500	19.5			34	5 × 8 000
Schwarzbach St. Veit-Wörgl ...	125.5	2	22.8	423	9 300	27.7				
Schwarzbach-Spittal-Millstättersee ...	80.9	1	28.1	169	5 700	17.4		Mallnitz	34	4 × 4 000
Spittal Millstättersee-Villach ...	36.3	2	12.5	76	5 700	3.4				
Total for Eastern Group	309.4			1 046		68.0	48 000		68	56 000
Steinach Irdning-Attnang Puckheim ...	107.3	1	25.2	111	2 800	9.0	6 000	Bulk supply from industrial undertaking.		

Table II.—Details of Lines to be Electrified Later.

Wörgl-Innsbruck...	59	2	4.8	129	5 900	5.7				
Vienna-Linz-Salzburg ...	313	2	10.9	2 213	19 300	120.0				
Amstetten-St. Michael ...	182	1	18.2	696	10 400	36.7				
St. Valentin-Klein Reifling	67	1	6.7	41	1 700	1.8				
Flieflau-Eisenerz ...	14	1	25.0	17	3 300	1.5				
Eisenerz-Vordernberg ...	20	1	71.0	33	4 500	8.4				
Linz-Selzthal ...	104	1	22.0	162	4 300	4.1				
Wels-Passau ...	81	1	6.0	187	6 300	9.1				
Selzthal-Bischofshofen ...	99	1	22.3	152	4 200	8.3				
St. Michael-St. Veit a.d. Glan ...	124	2	14.3	635	14 000	32.6				
St. Veit a.d. Glan-Villach	52	1	10.0	134	7 000	6.7				
St. Veit a.d. Klagenfurt...	18	1	5.0	65	10 000	2.8				
Total ...	1 131			4 464		237.7				

with the continuous-current system and 45 per cent. with the three-phase system.

The total costs are not decisive in selecting the system used, because the differences are in general small and vary according to the ratio of the cost of transmission lines to the cost of locomotives, &c. With continuous current and three phase the lines are the more expensive. Mostly 60 000 to 80 000 V will be sufficient for the transmission voltages, though occasionally 100 kV will be necessary.

The introduction of electric traction leads to larger loads and quicker journeys. The increased load is due to the removal of the tender and because with electric locomotives more driving axles can be used than with steam. The limit here is fixed by the maximum permissible stresses on the draw gear and buffers. If these stresses are fixed at 21 tons for the future, it will be only possible to reckon on a continuous draw-bar pull of 12 tons; consequently the only increase in trainload will be that due to the removal of the tender—which is very appreciable on gradients.

For the present, therefore, the number and weight of electrically hauled trains will follow the same

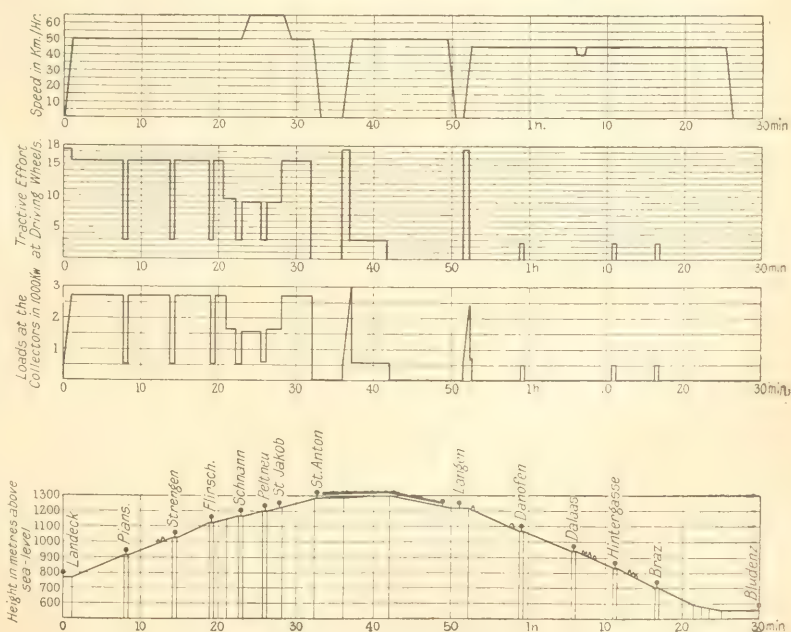


FIG. 3.—SPEED-TIME, DRAW-BAR PULL AND CONSUMPTION CURVES OF 360-TON TRAIN HAULED BY I-C-C-1 ELECTRIC LOCOMOTIVE.

development as steam-hauled trains, and the locomotives for the former will be equal to the most powerful for the latter. As far as possible, express and passenger trains will be hauled by single locomotives; the goods trains, as at present, will be loaded up to the limits, and on gradients the locomotive at the front of the train

TIME TABLE SPEEDS AND LOST TIME.

A special advantage of electric traction is the great certainty and economy with which time-table speeds can be worked to and lost time can be made up. With steam locomotives, scheduled working is largely dependent on the quality of the coal, especially

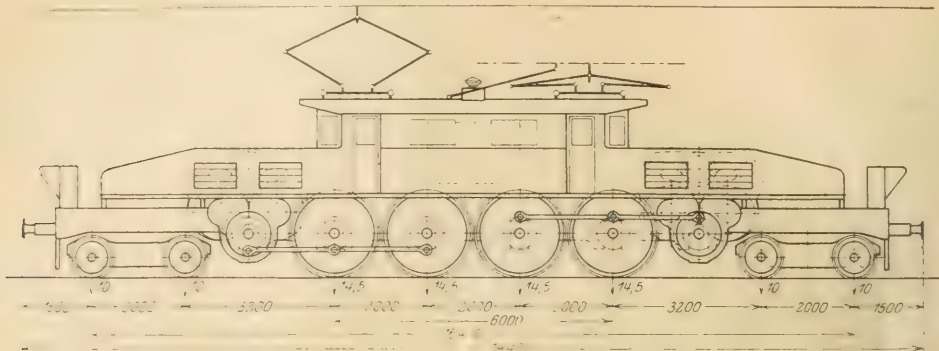


FIG. 4.—2-B-B-2 EXPRESS LOCOMOTIVE FOR FLAT COUNTRY.

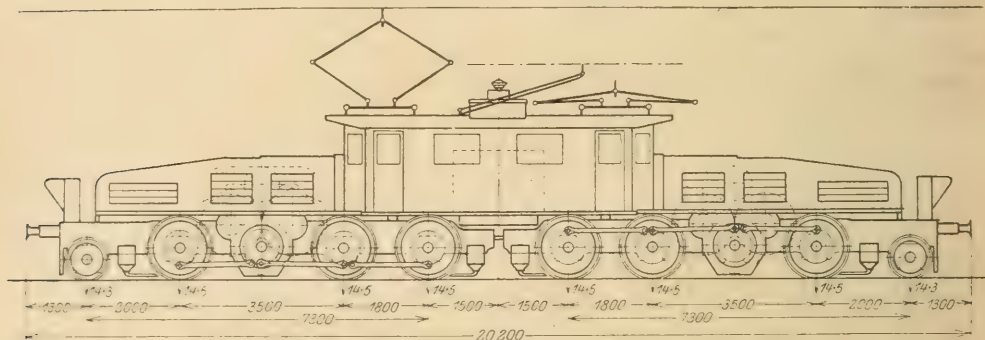


FIG. 5.—1-C+C-1 EXPRESS LOCOMOTIVE FOR HILLY DISTRICTS. 1 850 H.P. CONTINUOUS RATING AT 50 KM. PER HR. 3 000 H.P. MAXIMUM.

will be assisted by another at the rear. For shunting in large marshalling yards, light goods locomotives will be built.

The maximum speeds will be limited by the unfavourable gradients. There are only a few sections in valleys where express trains can run at 80 to 90 km. per hour. Even after the permanent way and curves have been improved there will not be many lines where 100 km. per hour can be attained. On the mountain lines, the present maximum speeds of 45 to 50 km. per hour will scarcely

in hilly districts; while it is both difficult and costly to make up lost time. Owing to the great energy demand by heavy trains, new regulations, particularly for mountain services, will be necessary with electric traction in order to obtain a rational ratio of peak load to average load, and care must be taken to prevent too many trains ascending gradients simultaneously.

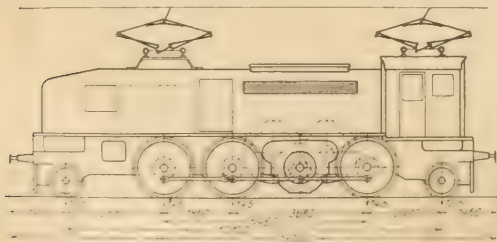


FIG. 6.—1-C-1 PASSENGER LOCOMOTIVE. 870 H.P. CONTINUOUS RATING AT 50 KM. HR. 1 500 H.P. MAXIMUM.

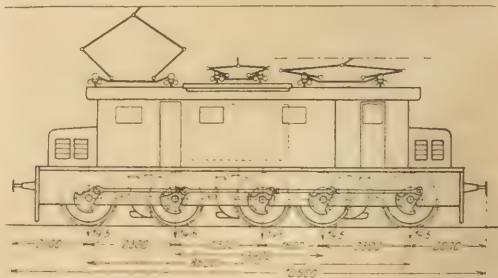


FIG. 7.—E GOODS LOCOMOTIVE FOR HILLY DISTRICTS. 1 000 H.P. CONTINUOUS RATING AT 30 KM. PER HR. 2 000 H.P. MAXIMUM.

be exceeded. Nevertheless, with electric traction it will be possible to shorten the time taken for the actual journey and for the stops. Particularly with certain goods trains, the speeds can be increased because electric locomotives can be manned by different crews.

Speed-time curves for steam and for electric haulage are given in Figs. 2 and 3.

The number of locomotives required for the work already sanctioned is shown in Table 3.

Table III.—Number of Electric Locomotives needed for the Services in Table I.

Section.	Type.				
	2-B-B-2 Fig. 4	1-C-1 Fig. 5	1-C-1 Fig. 6	E Fig. 7	D
Innsbruck to Bludenz					
Bludenz to Lindau	15	8	10	34	13
Feldkirch to Buchs					
Bregenz to St. Margrethen					
Salzburg-Schwarzach St. Veit- Wörgl	8	9	5	54	7
Schwarzach St. Veit to Villach	—	8	—	21	3
Steinach-Irdning to Attnang- Puchheim	—	—	15	10	—
Total	23	25	30	119	23

Of these 220 locomotives, three of the 1-C-1 type have been ordered from the Austrian Brown, Boveri Works, 12 of type 1-C-1 from the A.E.G. Union, Vienna, and 12 of type E from the Austrian S.S.W. (see Figs. 4 to 7).

To alleviate the condition near large towns as soon as possible, battery motor coach-trains will be used, as in Germany. Three such trains were ordered in 1919, and these will be made by converting existing rolling stock. A train consists of a battery coach between four passenger coaches, the two end coaches being motor coaches. Open freight trucks are used as accumulator coaches, and double-axle coaches from the Vienna tramways for passenger coaches. The four motors in a train together yield 192 h.p.; the normal speed is 35 km. per hr., the maximum 50 km. per hr. A train has seating room for 176 and standing room for 130 passengers. The first of these trains has already been delivered and put into service on the section Salzburg-Hallein.

II.—Progress in the Electrification of the Austrian Railways.*

Difficulty has been experienced in finding the money granted for the railway electrification scheme.

Most of the lines which it was decided to electrify were mountain lines with heavy gradients and numerous tunnels; while the traffic is comparatively dense. Another factor in deciding the lines to be electrified was the energy supply. For many years negotiations had been carried on and the rights over a number of water-power schemes suitable for railway purposes had been obtained. Thus work could be commenced at once and considerable saving in outlay resulted.

55 000 V TRANSMISSION.

For the network west of Innsbruck, there are to be the two stations at Spullersee near Danöfen and on the Rutzbach near Innsbruck.

built; while a haulage track has been laid from the station to the water tower on Grafenspitze. In many places, protection against avalanches is necessary. To carry out the work on the dam, &c., the lake had to be drained.

The 55 kV transmission line between the Spullersee and Rutzbach stations runs along the line as far as the Arlberg tunnel (10.3 km. long). Here it is carried on special iron poles over the Arlberg, reaching a height of 2 040 m. above sea level. The snow here is often 3 to 4 m. deep, while snow storms make the lines inaccessible at times. Hence the greatest care in the construction is needed here, the conductors consisting of two bronze cables each 95 mm². On each pole there is an earthing and lightning protective cable of 50 mm.² The average distance between poles is 115 m., the maximum 170 m.

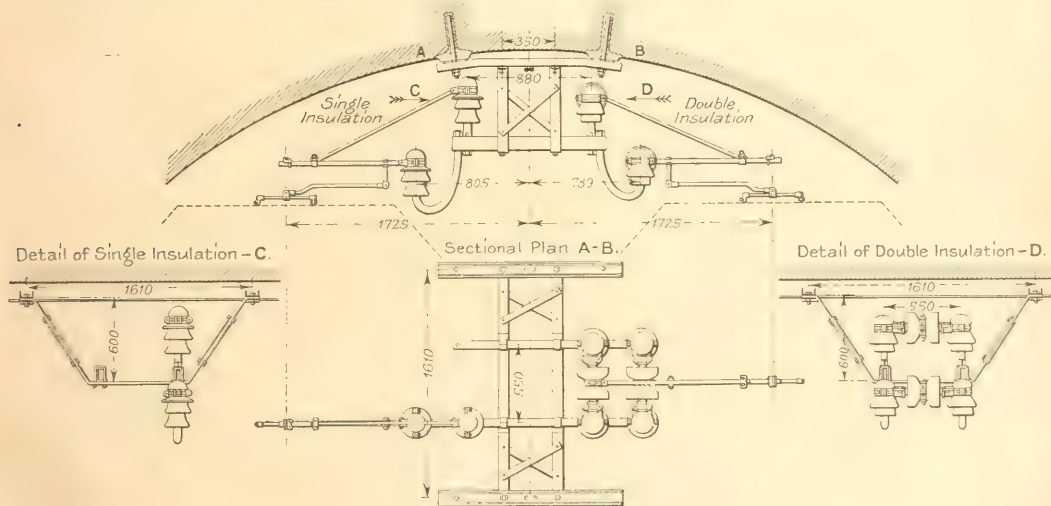


FIG. 8.—OVERHEAD CONSTRUCTION IN THE ARLBERG TUNNEL.

These will be joined by a 55 000 V line and feed six sub-stations. The station on the Rutz will supply 39 million, and the station at Spullersee 25 million units yearly. The extensions in the Rutz Station include increasing the capacity of the water tower from 3 000 to 7 000 m³, a new pipe line and a third generating set of 8 000 h.p. The work is sufficiently advanced to permit operation early in 1922.

THE SPULLERSEE STATION.

Work on the Spullersee Station with 800 m. head was begun in September, 1919. Eventually there will be six 8 000-h.p. sets. Three such turbines to run at 333 revs. per min. were delivered in 1920. For transporting building materials from Danöfen station to Spullersee, an electrically-driven suspended cable railway has been

It is intended to operate the Arlberg Tunnel section as soon as possible, the power being supplied from Rutzbach at the outset.

TUNNEL EQUIPMENT.

The overhead equipment in the tunnel was very difficult to erect owing to the small clearances (see Fig. 8), steam traffic and poor ventilation. There are altogether 390 points of support at an average distance of 26 m. apart. All iron parts are protected from rust by zinc and a lead covering (Schoop's metal-spraying process).

Just as the two generating stations west of Innsbruck are to be interconnected, so the two stations at Stubach and at Mallnitz east of Innsbruck will be interlinked by a 55 kV line.

In order to prevent interference to communication circuits, financial considerations rendered underground cables impossible; consequently the more important lines were kept away from the railway, the cost being reduced thereby to about one half.

* From a Lecture by Mr. P. DITTES, Director of the Electrification Department of the Austrian State Railways. "Elektrotechnik und Maschinenbau," 1921, Vol. XXXIX., p. 185.

Range of Wireless Stations.*

BY CAPT. R. CHENEVIX TRENCH.

A Paper by the author under the above heading appeared in THE ELECTRICIAN of April 20 and 27 and May 4, 1917. The effect on transmission of the height of the sending aerial, however, requires further treatment, and it is necessary to add some instances of continuous-wave valve transmission, in which such great advances have been recently made.

The principal factors determining range are:—(1) Wave-length employed; (2) natural wave-length of sending aerial; (3) power of sending plant; (4) height of receiving aerial, and these alone will be here considered. There are, however, other factors, such as:—(1) Nature of intervening surface; (2) nature of aerial; (3) nature of earth connections; (4) type of sending apparatus; (5) type of receiving apparatus; (6) time of day; (7) atmospheric conditions; and (8) degree of reliability required.

The treatment adopted by the author involves eight main assumptions. Thus he assumes transmission over sea with an aerial of the flat top non-directive type of capacity sufficient to take the power employed without brush discharge. The earth connection is good and daylight sending is used with modern musical spark sending apparatus, with only one wave-length. The receiving apparatus is good for telephone reception without amplifiers or relays, and though there is considerable atmospheric interference, a range enabling regular traffic of several thousands words a day is possible and the reception of power 64 times is that just required to give an audible signal.

The subject proper of the Paper is divided into four further sections, additional to the above introductory matter (section I.).

Section II. is devoted to the development of range formulae for normal conditions. The author gives in succession the Austen-Cohen formula connecting sending and receiving currents, wave length, height of aerials, &c. Formulae are next given for the power radiated by a Hertzian oscillator and radiation and effective height of radial. In discussing the proportion of power radiated the statement is recalled that the efficiency of an aerial with a good earth may reach 50 per cent., presumably at about 1.5 times the natural wave-length. Approximately the proportion of power radiated varies inversely as the square of the wave-length; but in practice resistance increases at the longer waves, so that the radiation efficiency is somewhat diminished. An equation applying to wave-lengths of 1.5λ and upwards is given. The efficiency at wave-lengths below 1.5λ is not considered as this depends so greatly on the type of condenser used. A number of practical examples are quoted.

The next expressions dealt with relate to the actual power delivered at the receiving aerial and range. For every given set of conditions there are certain best wave-lengths, but it is pointed out that for very short ranges wave-lengths too short to be of practical service may be indicated.

Section III. is devoted to a comparison between empirical range formulae and theoretical formulae for radiation from a Hertzian oscillator, which are illustrated by families of curves showing conditions over earth, sea, and flat land. The conception that an increased radial spread affects a larger wave field and therefore collects more power appears theoretically incorrect, though this is contrary to general experience. The author makes the tentative suggestion that the aerial collects a certain amount of power from passing waves depending on its height, capacity and properties of re-radiation, and the voltage and current developed from this power then depend on the total resistance of the aerial.

Having considered the relations between height, wave-length, power and range for assumed normal conditions the author in Section IV. considers the effect of radiations therefrom. Among the factors discussed are, nature of intervening surface, type of aerial, nature of earth-connections, type of sending and receiving apparatus, time of day, atmospheric conditions and degree of reliability required. With very long waves the intervening surface (except in mountainous areas) does not affect matters much; but for short waves equations applying to transmission over sea require modification when applied to land work. Correction exponential co-efficients of 0.02, 0.1 and 0.24 are suggested for flat land, hilly land and mountainous land respectively. Allowances for the use of direction aerials, effective heights of the receiving aerial, aerial capacity, &c., are suggested. If continuous wave transmission is used instead of the spark system there is also a gain in power delivered. The efficiency of crystal or valve-detector receiving sets is somewhat variable. Received signals can be multiplied to almost any extent by the use of valves in cascade. Finally, the effect of time of day, atmospheric conditions and degree of reliability receive consideration.

Experts on Factory Lighting.

The Second Report of the Departmental Committee on LIGHTING IN FACTORIES AND WORKSHOPS has been issued by the Stationery Office. It deals with the conditions necessary to secure suitable artificial lighting in, and certain requirements are detailed which must be fulfilled by all factories and workshops.

The Committee was appointed in January, 1913, with Sir RICHARD GLAZEBROOK as chairman, and the first report was issued in 1915.* The work of the Committee was then suspended owing to the war and was not resumed until November, 1920. A little later Sir R. Glazebrook resigned the chairmanship owing to pressure of other work, and Mr. W. C. DAMPIER WRETHAM, F.R.S., was appointed in his place. Prof. C. S. Sherrington has also resigned in consequence of pressure of work.

SCOPE OF COMMITTEE'S WORK.

On the resumption of its work it was suggested that the Committee should confine its attention to defining the conditions necessary for securing suitable lighting and to an inquiry into the effects of working in mixed natural and artificial light. In addition, the Committee was asked to classify processes according to the minimum illumination required, provided this could be done without incurring the heavy expense which detailed observations of the numerous processes of industry would involve. The Joint Industrial Council for the Furniture Trades also sought advice as to the best method of lighting glass-bevelling shops and H.M. Chief Inspector of Factories referred to the Committee the advisability of using translucent instead of transparent glass in factory windows.

The present Report is, however, confined to a consideration of suitable artificial lighting, the other matters being reported upon in due course. In the First Report the Committee recommended that there should be a statutory provision (a) requiring adequate and suitable lighting in general terms in every part of a factory or workshop, and (b) giving power to the Secretary of State to make orders defining adequate and suitable illumination for factories and workshops. Certain recommendations were also made as to standards of adequacy of illumination, but the question of the minimum amount of lighting for special processes was reserved. In arriving at its present recommendations the Committee has given consideration to the statutory codes of lighting in many of the American States and to the recommendations for industrial lighting formulated by the Illuminating Engineering Societies of America and Germany.

Abstracts of these codes and recommendations are given in an appendix to the Report.

REQUIREMENTS OF SUITABLE LIGHTING.

The Committee's Report states that some misconception and ignorance exist on the problems of suitable artificial lighting, and that unsuitable systems of lighting are still common in factories and workshops. This condition has been accentuated recently by the introduction and extending use of high-intensity gasfilled electric lamps, which in many instances are used to replace tungsten lamps in shades and reflectors intended for the latter. It is pointed out that, generally speaking, one type of shade is adapted to one type of lamp only, and that, to maintain suitable lighting, change of type of lamp often necessitates change of type or readjustment of the shade. The requirements of suitable lighting are quite definite. They are: absence of glare and of troublesome shadows, a steadiness and constancy of the light source, together with a moderate degree of uniformity of illumination and of surface brightness over the plane of work. Certain other factors bearing on suitable lighting are also considered, viz.: (i.) Diversity, i.e., the ratio of maximum to minimum illumination; (ii.) contrast, due to difference of surface brightness; and (iii.) colour and composition of the light.

RECOMMENDATIONS.

Glare.—Dealing with the phenomena of glare, which was defined in the First Report, the Committee states that the first essential of suitability is proper shading of the light sources. The effect of a shade is to reduce the intrinsic brilliance of the source when seen through the shade, and proper shading could accordingly be defined by prescribing a maximum brightness for the shades not exceeding a given number of candles per square inch. This method, however, involves complicated measurement, and it is suggested as a practical alternative, the simple criterion whether the incandescent filament, mantle or flame is distinguishable as such when viewed through the shade should be adopted. So far as glare is concerned, the source need only be screened when in or near the direct line of vision, and then only in the direction towards the eye. In formulating such a requirement two factors have been taken into consideration: (i.) The distance of the source from the eye, and (ii.) the angle at which the light from an

* Abstract of a Paper read before the Institution of Electrical Engineers.

* See THE ELECTRICIAN, Vol. LXXV., p. 850.

unscreened, or improperly screened source may enter the eye without producing objectionable glare.

The Committee think that in practice a suitable requirement might be expressed in terms of the distance of the source and of a limiting value of the angle between the line from the source to the eye and a horizontal plane, without which angle no such source should be directly visible. In the case of sources used for general lighting the limiting value of this angle should be 20 deg., but in the case of very near sources, such as are employed for local lighting, an angle of 30 deg. should be substituted. It is, therefore, recommended that there should be a provision as follows:—

"Every light source (except one of low brightness)* within a distance of 100 ft. from any person employed shall be so shaded from such person that no part of the filament, mantle or flame is distinguishable through the shade, unless it be so placed that the angle between the line from the eye to an unshaded part of a source and a horizontal plane is not less than 20 deg., or in the case of any person employed at a distance of 6 ft. or less from the source, not less than 30 deg."

The form of glare produced when the work is done on a polished material is generally caused by unsuitable placing of the source, and it may be remedied either by changing the position of the source relatively to the eye, or by increasing the diffusion of the light by enclosing the source in some diffusing material. The following simple requirement is suggested:—

"Adequate means shall be taken, either by suitable placing or screening of the light sources, or by some other effective method, to prevent direct reflection of the light from a smooth or polished surface into the eyes of the worker."

Shadow.—Troublesome shadows are frequently found even with systems of lighting which are good in themselves, and are generally due to unsuitable placing of the light sources. For this the provision recommended is:—

"Adequate means shall be taken to prevent the formation of shadows which interfere with the safety or efficiency of any person employed."

Constancy.—Constancy in artificial illumination is a matter of great importance. Unsteadiness and flicker have an injurious effect on vision, and if pronounced, increase the risk of accidents. Flicker which can be remedied should be prohibited, and it is accordingly recommended that:—

"No light sources which flicker or undergo abrupt changes in candle-power in such manner as to interfere with the safety or efficiency of any person employed shall be used for the illumination of a factory or workshop."

Finally, it is recommended that, as extensive alterations may be necessary in many factories to comply with the suggested requirements, a reasonable time limit should be given before the requirements become operative.

Economic Conditions in Roumania.

In a report on the economic conditions of ROUMANIA, dated April 1921, Mr. Adams, Commercial Secretary at Bucharest, states that one of the greatest difficulties under which the country is labouring is the depopled state of her railways. In common with the rest of Europe, the Roumanian railways suffered greatly in the war, and the disorganisation is increased by the fact that during their retreat from Wallachia the Germans destroyed 59 railway bridges. Nearly all the railways in the country before the war were single lines, which made the task of bringing some millions of tons of cereals down to the shipping ports each year during the few months following the harvest extremely difficult. The necessity for doubling the existing lines was recognised in 1914, and a radical programme of extensions was drawn up, but on account of the war these could not be carried out. Several projects for electrifying portions of the railway system, and also for building new portions, were mooted during the past year, but on account of lack of money no serious work was undertaken. One of the interesting experiments tried was that of running short trains of three or four trucks hauled by a converted motor lorry. A service of this kind was started in January, 1921, to run between Filaret, near Bucharest, and Giurgiu, on the Danube. The schedule and charges are similar to those of fast goods train services. But though the experiment may be fairly successful in the present time of stress and need of transportation, it is, of course, not suggested that it will be a permanent factor in Roumanian railway operation. In considering the question of trade with Roumania, Mr. Adams repeatedly lays emphasis on the fact that the stability of Roumania as an international economic unit, and as a market for British goods, depends entirely on the cereal harvests. The source of supply for much the greater part of the sterling and Western European bills sold in Bucharest is the payment made for Roumanian cereal exports, therefore it is undesirable for British merchants to commit themselves too heavily in the giving of credit to Roumanian dealers unless a good harvest is in sight.

* By "low brightness" is meant an intrinsic brilliance of not more than 5 c.p. per sq. inch.

High Temperature Phenomena of Tungsten Filaments.

A Paper on "High Temperature Phenomena of Tungsten Filaments," which summarises the work conducted by Mr. C. J. SMITH-ELLS at the Research Laboratory of the General Electric Company, Ltd., was recently presented before the Faraday Society. It is remarked that by the use of an atmosphere of nitrogen or argon in the gasfilled lamp the volatilisation of the filament is largely suppressed, but that the manufacture of such lamps has introduced new problems. Amongst these are (1) failures due to alteration in the crystalline structure of the filament giving rise to brittleness, deformation, &c., and (2) failures due to reactions which may occur between the filament and gases existing in the lamp, causing blackening, &c. In the gasfilled lamp the filament is in a spiral form, and at a higher temperature than in the case of vacuum lamps. Accordingly filaments which prove satisfactory in the former case may be unable to withstand the more severe strain in the latter. In gas filled lamps the pressures are of the order of one atmosphere, and there is no tendency to discharge such as may occur in a vacuum lamp. The reactions are of a purely chemical nature and are fully examined in the Paper.

Two distinct forms of drawn-wire tungsten have been in use for some years, one type is pure tungsten (more than 99.9 per cent.) The other type contains up to 1 per cent. of refractory oxide, usually thoria, and is described as "thoriated." These types behave differently.

At incandescent temperature the long fibres of filament tend to break up into equiaxial crystals, and the wire to lose its ductility. In the original Paper the author presents microphotographs illustrating the rapidity of grain-growth for various periods. Grain growth may continue until the diameter of crystals is about equal to that of the wire; no further change then takes place in the average size of crystals, but the crystal boundaries appear to be in constant motion. The final size of crystals is reached after the filaments have burned for 15 minutes.

Thoriated filaments are less liable to the above changes as the addition of thoria checks crystal growth. This is also illustrated by microphotographs in the original Paper. The filament is composed of relatively small grains, even after 600 hours, burning, and there is accordingly little deformation. Deformation of the spiral only takes place when there is crystal growth. Although thoriated filaments are thus in general stronger than those of pure tungsten, in certain circumstances they may behave abnormally and develop a coarse structure, leading to brittleness, thus reducing the average life of the lamp.

This occurs when excess of certain active reducing agents such as red phosphorus and sodium vapour are present. Experiments showed that the insertion of 0.01 mg. of phosphorus produces no effect on the filament, but a further addition, up to 0.04 mg., leads to increase in grain size after which no increase in size occurs. The grain size obtained with a thoriated filament and excess of phosphorus has the same value as that obtained with pure tungsten. Phosphorus has no effect on pure tungsten filaments. Other metallic oxides have been introduced into the wire instead of thoria, but they are reduced by both phosphorus and sodium in a similar manner.

Part II. of the Paper is concerned with the chemical reactions that occur when traces of common gases are present. One common form of failure of gasfilled lamps is accompanied by blackening of the bulb and ultimate failure of the filament, due apparently to effects of such residual gases. The author discusses in turn the effect of presence of oxygen, hydrogen, water vapour, carbon dioxide and monoxide and hydrocarbons. Hydrogen has little if any effect, and does not react with hot tungsten, but oxygen readily attacks the filament.

Water-vapour may also be prejudicial, and is difficult to eliminate. A curious cyclic action develops. Even very small traces of water vapour may destroy a filament in a few hundred hours. Carbon monoxide is slowly broken up by the incandescent filament. Failure of the latter usually takes place at the thinnest point on the filament and the result is thus distinguishable from that of water vapour, which tends to cause failure near the supports. Hydrocarbons have a vigorous and highly prejudicial effect converting the surface of the filament into tungsten carbide and rendering it very brittle.

In certain circumstances cyanogen may be formed, and sodium cyanide may be developed and deposited within the lamp. The filament, however, takes no part in the reaction, its function apart from giving light being merely necessary to raise the temperature of the combining gases.

Reviews.

Die Berechnung Elektrischer Leitungsnetze in Theorie und Praxis. By J. Herzog and G. Feldmann. (Berlin: Julius Springer.) Pp. XX. + 731. Third Edition. M. 136.

This book is an exhaustive and advanced text-book on the calculation of electric networks. The scantiness of the index, the absence of tables and the care with which each argument is developed so that each page is a preparation for those that follow it, all stamp it as a text-book for serious—for very serious—students rather than as a book of reference for the practical engineer.

The first chapter contains in an admirably concise historical survey of electrical engineering the author's one and only lapse from strict relevance to the subject-matter of the book. It is none the less worth reading for that. The next two chapters give the general theory of conducting circuits for continuous and alternating currents in a profound and individual manner, including the use of vectors, complex quantities, hyperbolic and exponential functions and continued fractions. The following ten chapters are devoted to the calculation of voltage drops and cross sections for any and every kind of distribution system with inductive and non-inductive loading, with examples taken from the distribution networks of various Dutch and German towns.

This part of the book contains a departure into the realm of pure mathematics in Chapter VIII. which is in itself a brief but thorough treatise on analytical and graphical methods for solving the numerous simultaneous equations which occur in the authors' methods for calculating the conditions in very complicated networks. Chapter IX. deals with the heating of cables and gives the usual exponential expression for a heating curve. According to this expression the time constant is the same for any loading of a given cable. But a table of empirical results is quoted on p. 388, which gives different time constants for different loadings of one and the same cable. This table has not a very convincing appearance, and it is surprising in view of the mathematical soundness of the rest of the book that the authors have overlooked the fact that this table and the theory on the heating of cables do not agree. The chapter on the calculation of supply mains to electric railways, which also explains the use of graphical time tables, is likely to appeal more to the practical engineer than some of the others, as it is more possible to predict conditions for a railway where at least the layout, if not the load distribution, is known beforehand than for a town network where both the feeder layout and the load distribution are generally too uncertain to make elaborate calculations worth while. The last two chapters deal with self-induction and capacity effects, and include a disquisition on half and quarter wave transmission for long distance overhead lines.

Footnotes and a bibliography at the end of chapters give references to other publications on the subject and cover the technical literature of all countries. A commendable remark in the preface states which sections of the book may be skipped, though the average student may think that the concession might have been extended to other sections without unduly pandering to the deadly sin of slothfulness. A trying feature of the method of presenting mathematical expressions is that all the constant coefficients which go to make up a formula are repeated line for line. If they were simplified into the smallest possible number of constants the mathematical reasoning would be easier to follow.

The book under review treats its subject with remarkable completeness; it must represent a life time of profound and original thought. It assumes on the part of the reader a familiarity with mathematical refinements rarely to be expected on the part of most engineers. It has reached a fourth edition, and so it must be assumed that it has entered into the training of a good number of German mains engineers in their student days, or afterwards, who must find it worth the expenditure of 136 marks, whatever that sum may represent among the topsy-turvy values of post-war Germany.

What then will the engineering outlook of the conscientious student be who has digested these 731 pages, skipping no more than the meagre ration which the authors let him off? It may be presumed that he will have absorbed equally complete books on the purely practical side of his job, such as methods of making joints and qualities of bitumen. The authors of the book under review have indeed themselves written a most exhaustive book on the purely practical side of installation work. It may further be presumed that he will have at his elbow equally thorough sets of tables for the constants which in the book under review occur only as algebraic symbols. He will then go out to face the battle of an engineer's life confident that he is fully equipped to determine by calculation any fact one may wish to enquire into concerning the most intricate distribution network, provided every householder goes to bed and switches off the light at the time allowed for in his calculations, and no new blocks of flats are erected to upset the load distribution. He will have learned *how* to carry out any and every conceivable calculation, but he may in the process have lost the sense of proportion that will tell him *when* and *why* he should carry out the calculation. One feels on reading the book that too much learning may be as dangerous a thing as a little learning, if unaccompanied by a sense of the proper use of that learning. Sometimes a very careful study of a subject is worth while, sometimes it is not, and one could wish the authors had devoted more attention to investigating what practical results, if any, can be based on the calculations. The criticism one is inclined to apply to this book is not so much that it is too theoretical (only silly people despise theory), as that it does not sufficiently discuss the relationship between theory and the practical problems an engineer has to deal with. The work would have been immensely more valuable if the authors had devoted their mathematical ingenuity to devising broad, simple methods of solving the usual type of problem with which the average mains engineer is faced, and which he has to leave unsolved as a rule for want of a handy method of treatment.

REGINALD O. KAPP.

The Theory of Direct Current Dynamos and Motors. By JOHN CASE, M.A. (Cambridge: W. Heffer & Sons, Ltd.) Pp. xiii+196. 15s. net.

The apology for this book appears to us to be unfounded. The author complains of a remarkable scarcity of English text books on this subject in such a form as to meet the needs of University students, and hopes that the present work will prove useful to students reading for an honours degree at English universities. Though reviewers may be rather biased, owing to the number of books brought forcibly to their notice, we must say that there is no justification for speaking of a "remarkable scarcity." With reference to the suitability of the present book for honours degrees, we should have considered the bulk of it to be of the standard for candidates reading for Grades I. and II. of the City and Guilds of London Institute's Examinations in electrical technology.

The author does not always maintain a fair balance in his treatment of the subject-matter. For example, armature windings are dealt with very cursorily—indeed the subject is said to be one of great complexity—yet theories of commutation and of pole leakage are given, though scarcely in a usable form. In the calculation of the ampere-turns needed for a magnetic circuit, after the column for H (not "ampere-turns per cm.") there follows a column for $\mu = B/H$ and then comes the m.m.f. $= (\text{flux} \times \text{length})/(\mu \times \text{area})$. We shall not repeat what we said when we read this new variant on "think of a number, double it, &c."

Our surprise, however, reached its culmination when we came to the part dealing with the area of the air-gap. We thought that here at last was a chance for theory and a good question for the Mechanical Science Tripos candidate. Not at all. The area of the gap, we are told, may be, in the first place, estimated as the mean between the area of the pole face and the area of the tops of all the teeth under the pole—to this 10 per cent. is added for fringing. Shades of Carter!

And in the example worked out, the gap alone is responsible for 6 584 out of a total m.m.f. of 8 319.

The most misleading passage that we noticed is the following: "The field due to the cross ampere-turns is at right angles to the main field; if, then, we provide another field at right angles to the main field, but in a direction opposite to the field due to the cross ampere-turns, the effects of armature reaction would be neutralised. *The most common way of doing this is by providing small auxiliary poles, called interpoles or reversing poles, between the main poles.*" After the sentence in italics, who could blame a reader for concluding that interpoles neutralised armature reaction generally and not merely locally?

The chapters on efficiency, losses, traction and multiple-wire systems seem to be better than the chapters on motors and generators. Since the static balancer has largely ousted running balancers, the former ought probably to be mentioned in the section on balancers. The author is to be commended for giving and working out so many examples; but it will be a bad day for England when the standard of this book becomes the standard demanded from honours candidates in electrical engineering.

S. PARKER SMITH.

Shorter Notices.

An Introduction to Technical Electricity. By S. G. STARLING. B.Sc., A.R.C.Sc. (London: Macmillan & Company.) Pp. xii.+181. 3s. 6d.

This little book was written in the expectation that the Education Act, 1918, would now be providing continuative education for young people between the ages of 14 and 16 years, and that the new type of student would require a new type of book. Mr. Starling recognises that he is providing for pupils whose fundamental knowledge is slight and he states that his aim is to arouse their intelligent interest (surely always the first aim of every teacher) and to make his appeal to them essentially practical in character. He opens his introduction with the dry cell and deals at once with the magnetising effect of a current. Then he proceeds to tell them something about magnetism—following this up with the electromagnet, the electric bell, the telegraph and the sander. Then some more magnetism, some rules about current and force directions, and so to the galvanometer, the ammeter and the shunt. Here, we think, that Mr. Starling begins to run away from his pupils. He introduces them to Ohm's law; grouping of resistances and cells; calibration of a galvanometer involving the use of a resistance box; and later gives details of an automatic arc lamp, chemical reactions (in chemical equation form), field distortion, characteristic curves of dynamos, and even gives a graph showing the pull on a telephone diaphragm. We admit that it must be difficult to gauge the capabilities and powers of reception of these more or less unknown pupils; and it is to be presumed that the author has had some personal experience which has enabled him to place a higher estimate upon them than we are able to do.

We think too that there is a danger that little books like this, which give lots of information, may tend to create a generation of youngsters who, having become more or less familiar with phrases and externals generally, consider themselves as fully equipped as is necessary. They may in fact look upon their continuative school work as the "finishing" process in their education. In such a case the Education Act, 1918, would defeat its own object.

Elementary Principles of Continuous-Current Armature Winding. By F. M. DENTON, A.C.G.I., A.Amer.I.E.E. (London: Sir Isaac Pitman & Sons, Ltd.) Pp. x.+102. 2s. 6d. net.

The object of this little book is to explain the theory of continuous current armature winding in non-mathematical terms. The author's treatment is a development of the device for deriving the simple lap winding from the gramme ring and the chief feature is the evolution of the wave winding from a ring winding having high multiplicity.

With the exception of the final chapter, which contains data concerning windings used in a number of modern armatures, the book appeared serially in the columns of THE ELECTRICIAN in 1918. This will suffice to indicate that the author assumes his readers to be familiar with the general principles of the continuous-current dynamo and that he is writing for the intelligent reader. We think that the book will be appreciated and enjoyed by all those who have found the principles of armature winding to be troublesome; and particularly by those who have been worried by wave winding.

The Electric Lamp Industry. By G. A. PERCIVAL. (London: Sir Isaac Pitman & Sons, Ltd.) Pp. xxi.+109. 3s. net.

Mr. Percival's booklet forms one of the "Common Commodities and Industries" series. After a brief historical introduction, four chapters are devoted to a description of processes involved in the making of incandescent lamps, including glass manipulation, preparation of filaments and lamp machinery, and the salient features of vacuum and gasfilled tungsten lamps are summarised. Two further chapters deal with arc lamps and vapour lamps; in these cases the author confines himself to a description of the lamps, without dealing with processes of manufacture. Final chapters (which might perhaps have more fitly preceded those dealing with vapour lamps and arc lamps) deal with automobile and other special incandescent lamps and capping, and testing. We notice that the author states that the output of incandescent lamps in the United States attained 240 million in 1914, but we believe that this figure was only attained last year.

The Kinema Operator's Handbook. By W. S. IEBETSON. (London: E. & F. N. Spon.) Pp. vi.+151. 4s. 6d. net.

In his introduction the author points out the importance of a kinema operator being familiar, not only with the manipulation of the lantern and accessories, but with the underlying principles of cinematography. He accordingly takes the reader through a series of six chapters dealing successively with the optical system and projector mechanism, and electrical matters such as wiring, fuses and care of generators, the upkeep of apparatus, cleaning and repairing of films, &c. A final chapter describes a few typical standard and new projectors. An operator who conscientiously studies this work should be well equipped for his job, so far as theoretical knowledge is concerned; it is doubtless a case where practical experience is an essential supplement to theory. The contents of the book will also prove quite interesting to many others generally interested in cinematography who will gain some insight into such questions as the relation between size of picture and illumination, effect of distance of projection, &c., points on which misunderstanding, even amongst those vocationally concerned with the kinema industry sometimes exists.

Correspondence.

EDDY CURRENT LOSSES.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: In your issue of July 15, a letter appears from Mr. A. Press, which has just come to my attention. Mr. Press refers to his article of May, 1920, in the "Physical Review," in which he purported to point out a fundamental error in the estimation of eddy current losses given in a Paper before the American Institute of Electrical Engineers in 1905, and generally accepted hitherto. The "Physical Review" article contested the statement of one of the boundary conditions in the Institute Paper, and substituted another, which was claimed to be correct. Upon examination, the two will be found to be equivalent as far as the problem in question is concerned, and should lead to the same final result; but Mr. Press proceeded to give his result, which was materially at variance with the Institute result. Unfortunately, he omitted his analysis, and therefore no effective rejoinder seemed possible, but in view of the continued publication of his views, it may be worth while to point out that his results would follow naturally were certain erroneous assumptions made, which appear at first sight somewhat plausible. I can only suggest, therefore, that Mr. Press publish his analysis, and thus throw the matter open to intelligible discussion. In an article in the "Electrical World," for September 29, 1906, the results were given of a series of careful experimental tests for a first and second layer conductor in an exaggerated case; the actual kilowatt losses were measured directly by watt-meter under conditions giving a power factor exceeding 50 per cent. and the possible errors of measurement were examined and shown to be limited to a few per cent. Taking, as illustration, the test at 65 cycles given there, the measured total loss in the winding was within 5 per cent. of the Institute result, but was 80 per cent. higher than would correspond to Mr. Press' result.—I am, &c.,

Marple, August 12, 1921.

A. B. FIELD.

Electrical Progress in Switzerland.

A report on the economic situation in SWITZERLAND by Mr. J. R. Cahill, late Commercial Secretary to H.M. Legation at Berne, deals at some length with the serious effect of the collapse of foreign exchanges on the economic position of that country. In this country we have suffered from a depreciation in currency, but the great appreciation of the Swiss franc in relation to other currencies, except those of the U.S.A., Japan and one or two other countries, has been equally embarrassing, and has hampered the sale of Swiss goods in foreign markets. It has also adversely affected imports. As Switzerland is dependent to a large extent on the import of raw materials and semi-manufactured products, the principal industrial firms had a difficult time in 1920, though they were not alone in this respect, for in practically every country manufacturers had to cope with many unusual problems arising out of the war.

ANGLO-SWISS TRADE.

British iron and steel goods, textile fabrics, &c., rightly enjoy a high reputation in Switzerland, and in 1920 the value of British exports was 466 million francs, notwithstanding keen competition from American, German and French exporters. This trade would probably have been great did not British representation and publicity methods leave much to be desired. Especially is the entrusting to French and German non-resident agents with British interests in Switzerland to be deplored.

Of the great Swiss manufacturing industries, the machinery branch was fourth in order of importance, the value of the exports in 1919 being 224 millions. There was a considerable increase in the trade with Spain, China and Japan, Argentina, Scandinavia, &c., particularly in metals and electrical machinery.

ELECTRIC TRACTION ON FEDERAL LINES.

As readers of THE ELECTRICIAN already know, steady progress is being made with the conversion of the Swiss railways to electric traction and in the development of hydro-electric power; but, even so, at the end of January last only 196 km. (121.5 miles) of the total length of line (2 843 km.—1 763 miles) had been electrified. Work is proceeding on 308 km. (191 miles), but it will not be completed until January, 1923, when the total length of electric lines will be 17.8 per cent. At present no main lines have been totally electrified, although 90 km. (56 miles) of the Gotthard route have been converted. By the end of 1924, 215 electric locomotives are expected to be operating, and, apart from those already built (about 60), over 80 are being built in Swiss shops for the Federal Railways. The construction programme has been hindered by lack of capital. In 1919 and 1920 about 90 millions was spent, and 300 millions more are required. The Federal Railways programme is on a large scale, and includes the erection of its own power stations, with an eventual total capacity of 500,000 H.P. Of the four principal stations one of the two on the Gotthard line, (Ritom 52 000 H.P.), in the south valley, has been completed; the second, Amsteg, in the north valley, 65 000 H.P., will be in operation within the next 12 months; the remaining two of greatest power, Barbarine, 50 000 H.P., and Rapperswil, 78 000 H.P., will not be completed for nearly two years.

OTHER RAILWAYS AND TRAMWAYS.

Although only 196 km. (121.5 miles) of the Federal system have been electrified, about 400 km. (288 miles) of other normal gauge railways have adopted electric traction, so that 17 per cent. is operated electrically. 1 023 out of 1 503 km. (932 miles) of the narrow gauge lines, 68 out of 109 km. (68 miles) of the cog wheel lines, and all the Swiss tramways (494 km., or 306 miles) are now operated electrically.

WATER-POWER.

Switzerland is fortunate in having large resources of water-power, officially estimated at over 4 million horse-power. Only one-fourth of this is obtainable from rivers, the remainder being from lakes and mountain streams. At the beginning of the year, 171 hydro-electric works, of over 500 H.P., had been built or were in course of erection, while 190 works of over 1 000 H.P. had received, or had applied for, authority to commence construction. Of the power stations built or building, five are from 60 000 to 68 000 H.P., and altogether there are 18 stations (from 20 000 to 720 000 H.P.) in operation, while 15 of from 600 000 to 200 000 H.P., and 11 of 50 000 to 55 000 H.P. are projected. At present about 26 per cent. of the available water-power is being utilised, against 12½ per cent. in 1914, though eight large works (representing about 400 000 H.P.) are nearing completion, and when these are in operation the percentage will be 37.5.

ELECTRICAL ENERGY FOR TRACTION.

The normal system of generation is three-phase, 50 cycles, and as railway experience in Switzerland is said to have found the single-

phase 16-cycle system more suitable, the Federal Railways are providing their own power stations. The inter-linking of the existing power stations is also projected in order to provide against contingencies, and in order to safeguard the winter supply of energy the establishment of storage reservoirs in the mountains is being taken in hand. The Swiss Power Transmission Company (Schweizerische Kraftübertragung A.G.) has been formed for remedying the inequalities in power production (through shortage or irregularity of water supply) or distribution (through irregularities in demand, whether seasonal or daily). The majority of the works in Central and North East Switzerland are associated with the new company, and it is hoped that those in French Switzerland also will participate. Energy is being distributed in many cases over distances up to 100 miles, and it is also exported to Germany, France, and Italy under Federal licence.

The progress in water-power development has caused attention to be paid to internal river navigation. The construction of two works alone (Eglisau and Mühleberg) caused an addition of 16½ miles to the Swiss navigable waterways, and when the present projects have been completed it is expected that nearly 200 additional miles of navigable riverways will have been secured. Internal navigation is largely bound up with the question of connection with the watercourses flowing into France and Germany, notably the Rhine and the Rhone. The French Government project for obtaining electrical energy from the Rhone will apparently lead to the rendering of the Rhone navigable up to Geneva. The development of water-power has also caused great attention to be given to the "regularisation" of Swiss lakes, and in some cases measures have been taken to raise artificially the level of the water in lakes so as to provide greater reserves of water, especially for the winter.

The A.B.C. of Wash Day.

It has often been said that we are slaves to our conventions. If we postulate that washing is a convention, this is very true unless, the SUN ELECTRIC COMPANY would have us add, we use an A.B.C. super-electric washer. In order to persuade the many thousands who at present either have their clothes churned into tatters by the professional laundress or enjoy on one or more days of the week pounding them themselves in an atmosphere of steam that there are better and brighter ways of dealing with their soiled garments and bed linen, the Sun Electrical Company have issued a series of leaflets dealing with the advantages that must follow the use of the apparatus they are marketing for this purpose. The most imposing of this literature is a pamphlet entitled "The A.B.C. of Wash Day," or a booklet on electrical clothes-washing as done in the home by the A.B.C. electric laundress. It draws a pleasing picture of the modern wash day and gives some excellent illustrations of the apparatus at work. It tells us all about the A.B.C. super-electric washer and what it does, gives expert advice on the right way to machine a wash (not wash a machine) and adds some information about the A.B.C. 100 per cent. ironer which is a necessary accessory to the washer. In case the prospective consumers who are anxious and willing to improve their present lot should be driven from this policy at the thought of the sum all this apparatus will cost, a leaflet giving details of very easy hire-purchase terms is included. We understand that in the possession of these washers lies the true solution of the servant problem, so that our readers might do worse than provide one as a wedding, birthday or Christmas present for the lady who presides over their destinies.

The End of E.P.D.

The majority of engineering firms are interested in the provisions of the Finance Bill relating to the winding up of the Excess Profits Duty, and in the conditions laid down for the valuation of stocks, &c. As might be expected, these clauses of the Bill are complicated and require careful consideration, but special attention may be drawn to the notice recently issued by the Commissioners of Inland Revenue on the subject.

With regard to the relief allowed in respect of the fall in the value of trading stock, the Commissioners point out that notice of any claim for relief, specifying under which parts of the schedule the claim is to be made, must be given in writing to them before March 31 next.

If a claim for relief is made under Part I. of the schedule to the Bill (which gives all firms and companies the right to re-value on Aug. 31, 1921, the stock which was in hand at the end of the final accounting period, thus placing all those liable to the duty on the same basis), the accounts of the trade or business affected must be made up to Aug. 31.

If a claim is to be made under Part II. of the schedule, stock must be "actually taken on Aug. 31. Part II. allows a period of two years from Aug. 31 for companies and firms to ascertain by actual sale the value of all the stock held on that date. If the amount realised by sale in that period is less than the cost or value on Aug. 31, an allowance will be made in computing profits for the final account period.

B.T.H. Improves Motor Cycling.

The BRITISH THOMSON-HOUSTON COMPANY have long been honourably associated with heavy electrical engineering development. Not content with this, however, they recently turned their attention to the design and construction of magnetos with results that have already been chronicled in THE ELECTRICIAN. Now they

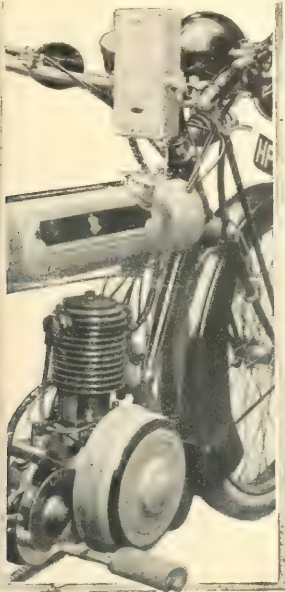


FIG. 1.—GENERAL VIEW OF B.T.H. COMBINED LIGHTING AND IGNITION SET.

have gone a step further and have devised a flywheel magneto for combined ignition and lighting purpose on motor cycles.

This set which is illustrated in Fig. 1 is mounted on a back plate (Fig. 2) which can be rotated through an angle of 30 deg. The laminated field, combined high and low-tension coils and condenser are of standard pattern, and the aero-type contact breaker is mounted

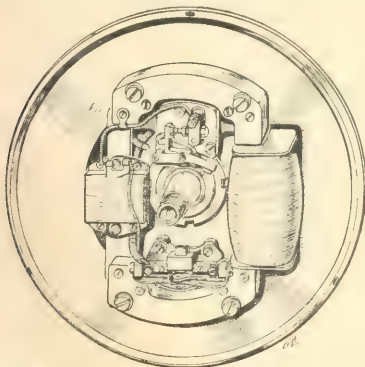


FIG. 2.—BACK PLATE, SHOWING ARRANGEMENT OF COIL AND CONTACT BREAKER, LAMINATED FIELDS AND COLLECTOR BRUSHES FOR LIGHTING SET.

on a bronze bush, the hollow spindle being lubricated by a wick feed. The flywheel is built up of the same 40 ton bronze as is used for heavy turbine work. Into an inner ring are cast the laminated poles, and round this ring lie two semicircular magnets having ground contact surfaces and attached to the poles by screws, while surrounding the whole is an outer case of the same 40 ton

bronze. Carried on the boss of the rotating member (Fig. 3) is the contact breaker cam which operates the rocker arm in a normal manner.

NO SEPARATE LIGHTING COILS.

Current for lighting purposes is obtained by using the idle maximum, which occurs in all engine speed single-cylinder magnetos, to charge an accumulator. The collecting brushes revolve idly on brass strips in the distributor until the engine attains about 600 revs. per min., at which speed the distributor is moved laterally by the action of spring-controlled centrifugal weights. Lateral motion of the distributor brings the necessary segments into contact with the collecting brushes, and above 600 revs. per min. the accumulator is

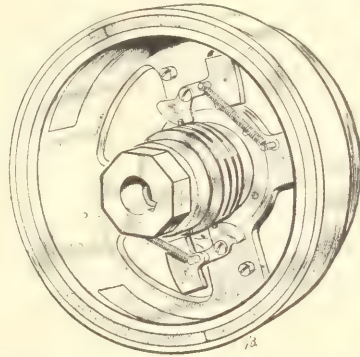


FIG. 3.—ROTATING MEMBER SHOWING CONTACT BREAKER CAM AND DISTRIBUTING SEGMENTS.

always on charge. A spun aluminium cover protects the instrument from water and dust. A special 5 c.p. bulb has been introduced by the B.T.H. Rugby works to suit the new set. The accumulator, which is similar to that used with the Sparklight, has, when fully charged, sufficient capacity to provide light for 10 hours, even without the additional charge which is constantly being provided. Carried on the handle-bars in an aluminium case this accumulator is readily accessible, the whole of the back plate complete with switch being detachable after removing six screws. The two terminal wires are easy of access, and the accumulator may be withdrawn by means of protecting flaps formed as part of the rubber packing.

It is claimed that the new instrument, besides providing lighting current, is cheaper than a magneto, since it saves a drive, provides better slow running and allows increased fuel economy.

"The Awakening of Peterkin."

Since "Romeo and Juliet" first startled an unsuspecting world, certainly since the "Doll's House" first fluttered the dovescoots of Victorianism, never has there been so poignant and yet so light a tragedy-comedy as "The Awakening of Peterkin." The anonymous author of this monumental work is of the school of Turgeneff. The unrelieved gloom of the opening recalls "Les Misérables" and the use of slang to force home a lesson Miss Marie Corelli. But soon there is a change. From an opening in a minor key we pass through a wealth of closely studied characterisation to a deft erection of the plot in which humour and pathos, comedy and tragedy, journalism and good English are subtly blended for our instruction and delight. We are shown the chemical reagent of a woman's intuition working on the inert potentialities of a man's mind until the high explosive of the combination brings the long-expected conflagration. The only difficulty, of course, is that they are married already.

As a matter of fact, it's all about a man who tried to sell electric cookers and didn't use them. And what a fool he was in consequence. And what he did when his wife went for him about it, and how they lived in luxury for the rest of their days. It is well worth reading, is published by the British Electrical Development Association, and can be obtained from them in lots of six at the rate of 4d. per copy.

A BUREAU OF INFORMATION has been opened at Cambridge House (the Cambridge University Settlement), 131, Camberwell-road, S.E. Files are being made of various industries, including engineering, iron and steel, railways, &c.

Parliamentary Intelligence

TELEGRAPH (MONEY) BILL.

THE TELEGRAPH (MONEY) BILL was considered last week by a Standing Committee of the House of Commons, and was reported to the House without alteration.

COUNTY OF LONDON BILL.

THE COUNTY OF LONDON ELECTRIC SUPPLY COMPANY'S Bill was read a third time in the House of Commons last week. The measure has already passed the House of Lords.

CARDIFF EXTENSION BILL.

The Bill for the confirmation of the Ministry of Health Provisional Order, extending the boundaries of the Borough of CARDIFF, including the electricity supply area, has been suspended till next session.

SPECIAL ELECTRICITY ORDERS.

The following seven Special Orders, made by the Electricity Commissioners under the Electricity (Supply) Acts, 1882 to 1919, and confirmed by the Minister of Transport, were formally approved by resolutions of the House of Commons on Monday: Panteg, Bedwas and Machen, Mynyddislwyn, and Risca (Mon.), Eston (Yorks.), Stranton parish (Hartlepool) and Guildford Corporation.

TELEPHONE SERVICE.

In reply to Sir H. BRITTON, Mr. KELLAWAY stated that the Post Office had considered many suggested methods of registering telephone calls, some of which were "automatic" in the sense that they did not call for any specific action on the part of the operator. None, however, had passed the requisite tests, and the experiments which had been made had not so far produced any device of this nature which appeared likely to meet essential requirements satisfactorily.

LONDON GOVERNMENT ROYAL COMMISSION.

In a written answer to Sir F. Hall, Sir ALFRED MOND stated that the terms of reference for the Royal Commission on the Local Government of Greater London had now been approved, and were as follows:—

To inquire and report what, if any, alterations are needed in the local government of the administrative county of London and the surrounding districts, with a view to securing greater efficiency and economy in the administration of local government services, and to reducing any inequalities which may exist in the distribution of local burdens as between different parts of the whole area.

RESULT OF THE NEW TELEPHONE RATES.

In reply to Mr. C. Percy, in the House of Commons last week, the Postmaster-General stated that the total number of subscribers giving up the telephone service as a result of the increased charges is estimated to be 28 500, and the number of extension instruments surrendered 21 500. The rental value of these services at the new tariff would be approximately £265 000. The number of new installations provided at the new rates is about 35 000 subscribers and 30 000 extensions.

TRAMWAYS AND MOTOR VEHICLES.

In answer to Sir Walter De Frece, who suggested an inquiry as to the increasingly serious effect of the COMPETITION BETWEEN THE TRAMWAY SYSTEMS AND MOTOR TRANSPORT, Mr. A. Neal (Parliamentary Secretary to the Minister of Transport) said that his information did not warrant the Minister in taking the course suggested. The provisions of the Roads Act empowered the Minister when appeals were made to him from the refusal of local authorities to license vehicles to ply for hire to impose such conditions as were necessary to prevent improper competition with existing tramway undertakings.

THE RECENT LONDON INQUIRY.

Two or three questions relating to the recent inquiry by the Electricity Commissioners into the LONDON AND HOME COUNTIES ELECTRICITY DISTRICT were asked in the House of Commons on Monday. Mr. Herbert asked the Minister of Transport what was the cost of the inquiry to the Government, and whether he could give any estimate of the costs and expenses incurred by local authorities and other bodies or persons.

In reply, Mr. NEAL said the cost of the Electricity Commissioners had been about £160. That was not a charge on the Government, but would ultimately be recoverable from the industry as provided for by the Electricity (Supply) Act. The Commissioners had no knowledge of the costs incurred by other parties.

In answer to another question by the same Member, Mr. NEAL said the announcement made by the chairman of the Commission just before the conclusion of the inquiry that he had every reason to believe that the Minister of Transport would re-introduce the Electricity Bill next session and endeavour to secure its passage into law was made on the authority of the Minister.

SUBURBAN RAILWAY OVERCROWDING.

COMPLAINTS of overcrowding on the London suburban railways continue to be made, and in the House of Commons on Monday the Minister of Transport was asked to state what percentage the number of standing passengers using the suburban railways in the metropolitan area on an ordinary week-day bore to the total number of passengers carried on those lines.

In reply, the Secretary to the Ministry (Mr. A. NEAL) said he was unable to give the figures. The Minister was aware that in some instances overcrowding existed in suburban services during certain hours, largely owing to the concentration within a shorter period of the "peak load," due to the general introduction of shorter working hours, but he knew from discussions which had taken place with the railway companies concerned from time to time that they were doing all they could within economic limits to introduce measures of relief. The improvement of suburban services by the companies depended upon their ability to undertake the necessary expenditure, which was considerable, as it was not only a question of provision of additional rolling stock, but of increasing the capacity of the line by electrification or other means.

Legal Intelligence.

American Wireless Patent Litigation.

District Judge J. M. Mayer, of the Southern District of New York recently delivered an important judgment in an action brought for infringement of the Armstrong patent (No. 1 113 149, of Oct. 6, 1914) for a "wireless receiving system." The plaintiffs were Mr. E. H. Armstrong and the Westinghouse Electric & Mfg. Company, and the defendants were the De Forest Radio Telegraph Company. The patent is known as the Armstrong "feed-back" or "regenerative valve" circuit patent, and among the defences was anticipation by other patentees. The judge held that the Armstrong specification and claims showed that the invention was for an instrumentality; it was the provision of an arrangement for transferring oscillating current energy from the plate circuit to the grid circuit, whereby oscillations present in the grid circuit are assisted. He held that if Armstrong invented a new instrumentality he was entitled to the fruits of all its uses, whether he understood them or not, and whether his theory of operation was right or wrong, comprehensive or limited. The invention was a particular use of an otherwise old circuit by an adjustment of the constants so as to produce re-amplification. The invention was made while Armstrong was a student, and the judge found that the apparatus for the feed-back circuit arrangement was in existence in January 31, 1913. The Meissner (German) patent was filed in April, 1913, the Schloemlich and Von Bronck patent in March, 1913, and the Reisz patent in April, 1914, so that the priority defence broke down. Dealing with the work of De Forest, he pointed out that it was not until September, 1915, that De Forest filed any application showing what he claimed to be a feed-back circuit. The invention of the ultradion circuit in February, 1914, the failure to recognise it as a feed-back circuit, and the filing of the ultradion applications without "including any circuit of the 1912 notes of De Forest," negated the idea that the latter had invented the feed-back circuit in 1912. Therefore he held that Armstrong was the first inventor of it, and that all the claims of the invention had been infringed.

Electrical Apparatus Co. v. J. Concord & Co.

At Lambeth County Court recently the plaintiffs sued for the return of £98, the price of a new power press which, they alleged, contained a latent flaw in the frame which caused the press to break, after having been used only intermittently for about three months. The defendants, who had offered to repair the machine by welding the broken part but declined to replace the fractured casting with a sound new one, contended that the machine must have been improperly used and subjected to too great a strain. The plaintiffs' evidence was to the effect that this had not occurred, but that the fractured part showed that there had originally been some welding at that part before the machine was delivered to them, and that the fracture was due to a resulting local change in strength. Judge Parry held that this was the explanation of the fracture, and that in respect of the welding in the frame the machine when sold and delivered was not up to the proper standard of fitness or quality, and he gave judgment in favour of the plaintiffs for the amount of the price which they had paid and costs.

Institution Notes.

In a Paper read before the ACADEMIE DES SCIENCES (Paris) M. Mailhe described a process for manufacturing motor-spirit from linseed and other vegetable oils by passing the vegetable oil over a special apparatus which deprives the oil of its water and hydrogen. The resultant volatile product is then passed over nickel and M. Mailhe claims that it is then in all respects similar to petrol.

As already announced, the autumn meeting of the IRON AND STEEL INSTITUTE will take place in Paris, the headquarters being at the Comité des Forges de France, 7, Rue de Madrid, which is close to the St. Lazare Station. The meeting will be held on Monday and Tuesday, Sept. 5 and 6, and on its conclusion alternative visits have been arranged to works in Lorraine, Burgundy and Normandy. Among the Papers to be read are those by Mr. E. L. Dupuy on "An Experimental Investigation of the Mechanical Properties of Steels at High Temperatures"; by Mr. L. Guillet on "The Situation of the French Metallurgical Industry in the North and in the East of France: its Destruction and Reconstruction"; by Mr. K. Honda on "Does the Critical Point Depend on the Strength of the Magnetising Field?" and by Capt. H. W. B. Swaby, C.B., and Mr. R. Genders, M.B.E., on "Manufacture of Shells in Canada during the War, 1914-1918."

Electricity Supply.

The proposal to light the town of LLANTOVERY by electricity has been dropped.

It has been decided to light the main streets of IRVINE with electricity.

ANNELEY PLAIN Urban Council propose to borrow £1,000 for electricity meters and services.

The Duke of York has promised to open, in October, SHEFFIELD'S new electricity power station at Blackburn Meadows.

Application has been made by GRIMSBY Corporation for sanction to borrow £6,000 for electricity meters and services.

BARNSELY Town Council have been authorised to borrow £9,000 for the provision of charging plant for electric vehicles.

The Electricity Commissioners have granted permission to SOUTH SHIELDS Town Council to borrow £1,890 for boosting plant.

The accounts of MAIDSTONE Electricity Committee show a loss of £3,775. Sanction has been obtained to increase the charges.

WHITEHAVEN Town Council has applied for a loan of £1,300 for the laying of a feeding main in connection with the extension to Kelts.

HODDYLAKE & WEST KIRBY Electricity Supply Committee have decided to erect a sub-station at Meols at an approximate cost of £483.

WINCHESTER Town Council has received sanction to a loan of £17,800, made up as follows: Plant, £11,000; mains and services, £5,600; and meters, £1,200.

At a meeting of the AYR Town Council last week it was decided to proceed with the scheme of electricity supply for the Burgh of Ayr at Loch Doon.

ERITH Urban Council propose to borrow £10,000 for cables, transformers and switchgear in connection with the supply of electricity to Messrs. Vickers, Ltd.

GLOUCESTER Electricity Committee recommend that an additional feeder cable be laid immediately in the Bristol Road district at an estimated cost of £3,000.

The OSWESTRY Town Council have decided to approach the directors of the Electric Light & Power Company with a view to acquiring the undertaking for the Town Council.

On the recommendation of the Electricity Committee, LYNN Town Council have decided to discontinue the fittings department and to give a month's notice to the five men concerned.

MAIDENHEAD Town Council has decided to apply to the Electricity Commissioners for sanction to borrow £5,500 for extensions in connection with the electricity undertaking.

EDINBURGH Corporation Electricity Department propose during the present year to incur a capital expenditure amounting to £1,068,000, chiefly in connection with the new station at Portobello.

WORKSOP Urban Council have been authorised to borrow £25,000 for the Electricity Department's extension scheme; £12,800 being repayable in 25 years, £10,800 in 20 years, and £1,400 in 10 years.

BRADFORD Electricity Committee have been authorised to borrow £7,000 for sub-station building. The Committee propose to acquire new offices and showrooms at a cost, including alterations, of £42,230.

PETERBOROUGH City Council propose to apply for an order authorising an extension of the area of supply defined in the Peterborough Electric Lighting Order, 1894, in order that 20 additional parishes may be included.

Application to the Electricity Commissioners is to be made by LYME REGIS Town Council for a grant authorising the supply of electricity in Lyme Regis and Uplyme and for permission to acquire the Lyme Regis Light & Power Company, Ltd.

In order to provide a motor vehicle charging station and plant at LEYTON power station the Electric Lighting Committee propose to borrow £2,700. Permission is also being sought for a loan of £15,000 for the provision of a new electricity sub-station.

NEWPORT (Mon.) Town Council has referred to the Works Committee a proposal to convert a vacant warehouse in Dock Street into offices for the Electricity Department, in order that the present offices may be let which would, it is claimed, bring in £2,000 a year.

SEAHAM HARBOUR Lighting Committee have engaged the services of an electrical engineer to inspect the district, confer with the Durham County Electrical Power Distribution Company, and make a general report on the advisability of lighting the town by electricity.

BOOTLE Electricity Department, after consideration of a proposed agreement regarding the amalgamation of the Liverpool and Bootle electricity undertakings, forwarded by the Town Clerk of Liverpool, report that they are prepared to agree to the scheme, subject to satisfactory terms.

LEICESTER Corporation Finance Committee has approved an expenditure of £125,000 for transformers, switchgear and supply cables.

At a recent meeting of the Town Council the scheme for the re-organisation of electricity supply in the East Midlands was submitted and approved. It provides for a joint authority for the district and the linking-up of existing stations. There would be four main stations at Leicester, Nottingham, Derby and Burton-on-Trent.

BANGOR City Council have adopted the recommendations of the Gas and Electricity Committee that another 100-kW Diesel engine

be installed at an expenditure of £4,630, and that the Electricity Commissioners be applied to for sanction to borrow that sum and a further £2,000 for expenditure on mains and services.

GREAT HARWOOD District Council have approved of Blackburn Corporation supplying electricity for public and private purposes in the townships of Great Harwood, Clayton-le-Dale, Wilshire and Ramsgrove, and selling electrical fittings and apparatus. This will involve a revocation of the Great Harwood Electric Lighting Order of 1912.

HACKNEY (London) Borough Council has authorised the adoption of electric lighting for the roads across Hackney Marsh. There will be 34 lanterns, each fitted with one 200 W gas-filled lamp. The cost of the cable work, posts and switchgear is estimated at £2,000, while the annual maintenance charge will be £615. For gas lighting the annual cost would work out at £652.

The announcement last week that the SHEFFIELD Electric Supply Committee had rejected the offer of a German firm to supply generating plant at £40,000 less than the lowest British offer is followed by a refusal by ALDERSHOT Council to accept the tender of a Belgian firm for electrical plant. Although their price was £600 less than the lowest British tender the latter was accepted because spare parts will be more easily obtainable.

The North Metropolitan Electric Power Supply Company are applying to the Ministry of Transport for permission to increase their charges in Southgate to 8d. per unit provided that they may charge any consumer (a) in respect of each of the quarters ending March 31 and Dec. 31 respectively, for any amount up to 15 units 10s.; and (b) in respect of each of the quarters ending June 30 and Sept. 30 respectively, for any amount up to 10 units 6s. 8d.

The application of the NORTH SOMERSET ELECTRIC SUPPLY COMPANY to increase their maximum charges from 8d. to 1s. has caused a storm in a teacup. Owing, apparently, to a badly worded postcard, the consumers affected thought this increase in price was to be immediate. But at the inquiry that was held by Col. T. C. ERIS it was pointed out that this was only the company's way of protecting their shareholders against a possible loss of revenue owing to the decreased demand of a shipyard and another power user, which between them took three-quarters of the million units supplied by the company, and that as such applications could only be made once in five years it must be made now before it was too late. There the matter remains for the present.

The financial position of WREXHAM electricity undertaking has been the subject of two special meetings of the Town Council recently. It is agreed on all sides that there is room for very great economy, and the engineer, Mr. G. D. Coe, appears to have been working under difficulties. At the last meeting he said that as the works were at present he would not be responsible for them. He had asked for certain things to be done, and they had either been turned down or delayed. Before the coal strike was threatened he asked if he might get a stock of coal in, but he was instructed not to do so. The committee did not anticipate a strike, they said; but personally he had no doubt about it. The mistake cost the department £500. As the chairman of the Electricity Committee, Alderman E. Hughes, was unable to be present discussion was further postponed in order that he might report the result of an interview with the directors of the Dolgarrog hydro-electric scheme respecting a bulk supply, and also the result of an interview with the men's union as to wages.

The salary of Mr. J. W. Barnes, commercial assistant in the electrical department, which more than once has been before the SHEFFIELD City Councillors, was the subject of a long discussion at last week's meeting. Mr. Barnes has been paid at the rate of £490 7s. from April 1, 1919, and at the rate of £600 per annum since July, 1919, and claims to be entitled to £630 from April 1, 1919, £666 from Jan. 1, 1920, and £702 from June 1, 1920. Although some members were of opinion that Mr. Barnes had been badly treated in that his name had been mentioned in a list for increased salaries, which in every case, with the exception of his, had been granted, the majority were of opinion that the increase was unjustifiable. He was not a member of the E.P.E.A. at the time he was appointed to his present position; he was simply a commercial manager, and though he had some technical ability, all engineering matters were dealt with direct by the general manager. An amendment that the minutes be approved with the exception of the reference to increase the salary of Mr. Barnes was carried by a large majority.

In a recent issue we mentioned that the WARRINGTON Corporation electrical engineer, Mr. F. V. L. Mathias, had been instructed to prepare a report upon the possibility of utilising the water power of Wolston Weir for the generation of electricity. In his report Mr. Mathias now states that the power derivable from Wolston Weir would be a very small proportion of the power required in Warrington, either at present or in future. The maximum load in Warrington is over 5,000 kW, with the certainty of a considerable increase in the near future; possibly an average of 150 kW with a load-factor of 50 per cent. would be the figure for Wolston Weir. This would represent about 600,000 units per annum, and the capital cost, provided no exceptional difficulties were encountered, would be about £25,000. The total expenses would be, roughly, £4,000 per annum, representing 1.45d. per unit generated. This figure was comparable with steam coal at the present price of coal. He points out that if the Corporation embark upon the scheme, they would assume responsibilities with doubtful financial benefit to themselves. We understand the project will be deferred until conditions are more normal.

Municipal Electricity Accounts.

For the year ending March 31 the accounts of the WINCHESTER Electricity Committee show a net profit of £1 922, as compared with £2 686 5s. 11d. in the previous year. The decrease is chiefly due to the fact that no supply was given to the aerodrome in the neighbourhood.

The past year's accounts of the TAUNTON electricity undertaking showing a deficit of £1 073, the Town Council have authorised the Electricity Committee, if they think it necessary, to increase the charges from 110 per cent. to 120 per cent. above the pre-war scale, provided that in no case the charge exceeds 1s. per unit.

The net profit on the WARRINGTON Corporation electricity undertaking for the year ending March 31 was £12 037, against a loss in 1920 of £1 850. The revenue increased from £90 188 to £123 365, the expenditure from £80 613 to £92 212, and the gross profit from £9 575 to £31 153. Increased revenue from current sold per meter amounted to £27 557, for that utilised by the tramways £1 738, and for street lighting £64.

CARLISLE electricity department's accounts for the year ended March 31 show total revenue £54 617 compared with £48 971 in the previous year, and gross profit £13 126 (£14 316). Repayment of capital required £7 995, and interest on loans £4 676, leaving a net profit of £455 (£2 301). Units sold were 6 220 535 (6 216 678). The maximum demand was 3406 kW (3 343 kW). The new customers were 178 (113), a figure in excess of any previous record, and making the total 1 299.

The capital expenditure of the BARROW Corporation Electricity, at March 31 was £267 746, against £236 951 in 1920. Total revenue was £87 068 (£59 147), and after deducting working costs (£68 663, against £46 368), the gross profit was £18 405 (against £12 779), but as interest required £10 024 and sinking fund £10 921 there was a deficit of £2 539 (against £4 488), due to the miners' strike in October last, and to increased taxation. The equivalent of 500 105 30 W lamps is connected (against 449 121) and the units sold amounted to 9 282 017 (6 648 423). The works costs were 1.775d. per unit (1.674d.) sold, and the average price was 2.218d. (2.123d.). The hiring out department, which has made good progress in the supply of motors and domestic apparatus, has been of material assistance in increasing the output.

The BOLTON Electric Supply Department has had a very successful year, notwithstanding the greatly increased cost of fuel. The total revenue was £273 531 (against £200 569), and the working costs were £186 360 (£140 249); leaving a gross profit of £87 180, an increase of about £27 000. After providing for interest, loan repayments and sinking fund, and also allocating £5 000 to depreciation and renewals fund, a balance of £27 778 has been allocated to the payment of capital items out of revenue, leaving £5 409 to be carried forward, against £1 760 last year. The total units sold amounted to 30 298 980 (against 24 944 906); total works cost was 0.949d. (0.826d.), the inclusive cost was 1.38d. (1.205d.), and the average price 1.55d. (1.29d.) per unit. Though the cost of fuel per unit increased from 0.414d. to 0.543d., owing to the high prices of fuel during the period, the total cost is still below 1d. per unit, and at present day prices the average price obtained of 1.55d. is quite reasonable.

PERTH electricity rates are to be increased by 1½ per cent. Submitting the accounts of the Electricity Department for the past year, Convenor Robert Stewart stated that the gross revenue amounted to £26 197, exceeding the estimate by £1 329. The total expenditure amounted to £21 066, an excess of £976 over the estimate. There was a gross profit, however, of £5 131, and the reserve fund stood at £8 086. A sum of £8 038 had been borrowed during the year, but £7 600 of this had been spent on extensions approved by the Electricity Commissioners. Dealing with the estimates for the current year, Councillor Stewart said that owing to the increased price of fuel, wages, and higher rates of interest for loan capital it would be necessary to increase the charges to consumers by 1½ per cent. The apparent gross profit was required to pay interest and sinking fund, £500 being placed to reserve. The estimates and increase in the rate were agreed to.

The annual accounts of the STOKES-ON-TRENT electricity department were recently submitted to by the Corporation. The gross receipts were £151 167, against £124 370 in 1919-20, and the expenses £107 823, against £74 392, the gross profit being £42 205. Of this sum £34 500 was paid in redemption of capital, interest, &c., leaving a net surplus of £4 000, which was carried to reserve. The chairman of the Electricity Committee (Ald. Leese) stated that they had generated over one and a half million more units of electricity than in the previous year, and would have shown a much more favourable financial position but for the coal strike of last year, which cost them £1 000 a week. The accounts were approved.

In his annual report the Electrical Engineer (Mr. C. H. Yeaman) stated that there was no falling off in the demand for electric lighting, power, domestic heating and cooking. The only limit at present was the ability of the department to meet the demand, and it was desirable that further plant should be put on order at once as the generating machinery now being erected had already been covered by applications received and deferred pending the regular commercial use of such plant. The gradual changing over to three-phase supply of areas where the load was most dense and the steady modernisation of details in the system had led to a further reduction in coal consumption. Amongst the year's improvements were new pump-houses in the Burslem and Stoke sub-works; converting the rotaries at Burslem into the modern self-synchronizing type, re-laying feeders in Longton and elsewhere as the old wooden troughs had perished; the substitution of over-ground net-working pillars for below-ground boxes, and the alteration of stoker-drives in the power house from reciprocating to rotary type.

Electric Traction.

The annual accounts of the LIVERPOOL municipal tramways show a loss of £33 000.

NEWPORT tramways were run at a loss of £4 303 for the year ending March 31 last. In addition, £10 368 was spent on permanent-way renewals during the year.

Unless the noise caused by the trams at LEAMINGTON is abated, the Corporation threatens to obtain Parliamentary powers and facilities to run municipal motor omnibuses.

The proposal to run trams on Sundays between ROTHESAY and ETTRICK BAY is arousing considerable opposition, and the question is to be further considered at the next meeting of the local Council.

In reply to a question in the House of Commons on Monday, Sir J. Baird announced that from Oct. 1 no EXCESS PASSENGERS would be allowed to stand INSIDE TRAMCARS and OMNIBUSES in the Metropolitan police district.

A start has been made on the reconstruction of BELFAST Corporation tramway lines, and it is expected that the work will extend over two years. Ex-service men, of at least 12 months' residence in the city, are to be employed for the work.

Various suggestions, including the re-institution of the halfpenny fare, having been put forward with regard to the GLASGOW Corporation tramway fares, the Tramways Finance Committee have requested the general manager to report on the whole question of fares.

ST. HELENS Corporation Tramways Committee has accepted the quotation of the Bristol Tramways & Carriage Company, Ltd., for the hire of two 'buses (including four drivers), for three months, while the St. Helens Junction section of the tramway track is being relaid.

The inquest on the five victims of the recent tramway accident at NORTH SHIELDS was resumed on Tuesday, when a verdict of accidental death was returned, the driver and conductor being held free from blame. Chief Inspector E. Almond and Driver Hill gave evidence, and attributed the accident to the greasy nature of the rails.

CHESTER Corporation tramway accounts for the past year show total revenue £34 190, working expenses £21 852, leaving a gross profit of £12 337. The traffic expenses were £947 greater than the previous year, general expenses £861, permanent way £600, electrical equipment of line £39, cars £1 854 and power £640. The average revenue per car-mile was 20.45d.

IESWICH Electric Supply and Tramways Committee reported at a recent meeting of the Town Council that the total cost of relaying the tramway lines had amounted to £21 197 4s. Application is to be made to the Ministry of Transport for permission to borrow £13 016. The balance of £8 181 4s. will be charged against the permanent way renewals account.

The Government, on account of lack of funds, have refused to make a State grant towards the construction of the HALWILL-TORRINGTON LIGHT RAILWAY. Alternative schemes are already under consideration, and every effort is being made to prevent the railway from becoming defunct. If carried out it would mean employment for three years for between 2 000 and 3 000 men.

The results of recent tests at LEEDS Corporation tramway power station into the relative costs of coal and oil fuel show that oil is yet a long way from beating coal in this respect. Eight boilers had been converted to the use of oil during the coal strike to maintain the tramway service. Both the Gretina-type burner (two per boiler) and the Johnson type (four per boiler) were used. The cost was 1.115d. per unit of electricity generated, as against the average cost of coal, based on last year's figures for the same boilers, of 0.560d. per unit. After making allowance for labour saving, it was found that in order to compete with coal at £1 16s. per ton, oil would have to be obtainable at £2 17s. per ton, or £2 19s. per ton to compete with coal at £1 17s. 6d. As a matter of fact, the cost of generating electricity from oil fuel had reckoned out at £5 5s. per ton.

Business Items, &c.

Messrs. PERRY, SAVAGE & COMPANY, electrical engineers and power specialists, have opened premises at 28, Conway-street, Birkenhead.

Harry Hartland and Vernon Thomas Ridgway, trading as HARTLAND & RIDGWAY, electrical and mechanical engineers, 286, Monument-road, Ladywood, Birmingham, have dissolved partnership.

Mr. EDWARD ARNOLD and Mr. A. L. MUMM, who have been in business as publishers together for more than 25 years, have just taken into partnership Mr. B. W. FAGAN and Mr. F. P. DUNN. The firm will in future trade under the style of Edward Arnold & Company.

Ferdinand Giladjan and Ernest John Lord, trading as the KILBURN MAGNETO & ENGINEERING COMPANY, electric magneto and general engineers and dealers in electric lamps, 238, High-road, Brondesbury, have dissolved partnership. Debts received and paid by E. J. Lord.

A first and final dividend of 7½d. in the £ in re Charles Thomas Stanton, trading as the SOUTHERN ELECTRIC ENGINEERING COMPANY, 25, Beckenham road, Penge, Kent, electrical engineer, is payable, Aug. 29, at the offices of the Official Receiver, 132, York-road, Westminster Bridge-road, S.E.1.

Messrs. YARROW & COMPANY have decided to close temporarily their works on the Clyde, with the exception of the experimental and research department, on or about Nov. 30. The works are to be re-opened, they state, when conditions enable business to be carried on with some chance of success.

Imperial and Foreign Notes.

The **DUFF ARTHUR** (Ontario) Shipbuilding Company is installing an electric furnace to supplement the existing foundry plant.

As the experimental plant erected at ZHELAN (TASMANIA) for testing the West Coast zinciferous ores has proved successful, it is now proposed to install more extensive plant.

The **LITHGOW** (N.S.W.) Council has been authorised to borrow £5 000 for poles, electric lighting wires, &c., for the supply of electricity in the town. Bulk supply will be taken from the Hoskins Iron & Steel Co.

The importance attached to the development of electricity in New Zealand was shown in a speech by Mr. Massey, the Prime Minister, when visiting Bradford last week. They were going to be able to provide electricity in New Zealand for motor purposes, he said, in almost every industry in which they were concerned. They were developing their water powers to deal with this, and he believed that within five years' time every dairy farm in New Zealand having over a dozen cows would have its machinery driven by electricity. The Government of the country was confident that it was on right lines and was going to spend £11 000 000 on the work.

The report of the **NEW SOUTH WALES ELECTRICAL INSPECTOR OF MINES**, which is included in the Annual Report of the Department of Mines for 1920, states that electrical plant is installed in 53 collieries, though two small plants are temporarily out of service. There was no electrical accident during the year, and it is stated that little progress is being made with the introduction of electric safety lamps. In practically all cases electricity is used for lighting, but there are only 171 electric coal cutters. In several instances electricity is also employed for haulage, pumping, ventilation and other purposes. The strong trade union element among the workers is not sympathetic towards the introduction of labour-saving machinery.

The Commission appointed by the Government of Ontario to report on the advisability of the province guaranteeing bonds for the construction of electric railways throughout Ontario are of opinion that such a system would not be self-supporting. They suggest that until the *Chippewa* power scheme, which it is estimated will cost \$60 000 000 (£15 000 000), is completed, and gives a revenue equal to the cost of operation, and in view of the authorised expenditure of \$25 000 000 (£2 500 000) on roads, the Province should not assume responsibility for an electric railway system at an initial estimated cost of \$45 000 000 (£11 250 000). Mr. Bancroft, the Labour representative on the Commission, submits a minority report in favour of Government guarantees.

The **SWEDISH GOVERNMENT** has granted permission for the electrification of the *Vadstena-Fagglesta* Railway.

According to the **PRUSSIAN TRADE MINISTRY'S** report for July, the electrical industry in Germany is rapidly improving.

Three new **SUBMARINE CABLES** from Casablanca to Tangier, Tangier to Ocran, and Casablanca to Ocran—direct—have just been laid.

Work on the laying of a **SUBMARINE CABLE** between Sweden and Germany will be commenced next month. The cable has been manufactured in Cologne by the *Deutsche Seekabelwerke*.

It is reported that a group of American engineers are prepared to make a big experiment in utilising **TIDAL POWER** in the Bay of St. Michel, France. A barrage of 12½ miles would be erected from the Point du Roc to Le Ligouet, but as the cost would be over £83 000 000, there may be difficulty in finding the necessary capital.

Applications for stands at the forthcoming **UTRECHT Fair** which will be opened on Sept. 6 are still being received. The total number of exhibitors so far recorded is 706 Dutch and 372 foreign. Among the latter 92 German firms are directly represented, and 64 indirectly through Dutch agents. The United Kingdom has 47 direct and 30 indirect exhibitors.

The draft of the new **SPANISH TARIFF** has been published for general information. Serious increases of duty on electrical plant and apparatus are proposed, but the Spanish Customs Board will be prepared to receive representations on the subject until Sept. 8. The Board of Trade, the Federation of British Industries and other organisations are taking steps to deal with the matter.

In a report received by the Department of Overseas Trade from H.M. Commercial Secretary at Madrid, the following local trade openings are mentioned: In the **BARCELONA** district water turbines are likely to be largely required for the numerous power plants which are being put up all over the country. At present this trade is almost wholly in the hands of Swiss and German manufacturers, but it remains to be seen what effect on this demand will follow the Royal Decree of June 14 obliging future holders of water-power concessions to use Spanish machinery wherever possible. Centrifugal pumps are also largely required.

A **TERRIBLE ACCIDENT** occurred in France last week, apparently due to the carelessness of a foreman. A gang of 15 men began laying a new electric line on the railway at Argeles, in the Midi, after the last train had passed on Thursday evening. The foreman rang up the power station as usual, to ascertain if the current had been cut off, but could get no reply. After waiting a few minutes he appears to have assumed that all was well and gave the order to begin work. The accident occurred immediately. Four men fell to the ground dead at once, and the remaining 11 were unable to remove their hands from the wire and were terribly burnt as they could not be disengaged from the wire for some time.

Miscellaneous.

It is proposed to remove the electric standards in the centre of the Great Western-road, **GLASGOW**, and re-erect them on the pavements.

The names of the members of the proposed **BUSINESS COMMITTEE** which is to advise the Treasury respecting national finances are: Sir E. Geddes (chairman), Lord Inchcape, Lord Faringdon, Sir Joseph Maclay and Sir Guy Granet.

The shaft of **HUCKNALL No. 2 Colliery** is now under repair, and it is hoped that within seven or eight weeks' time the men will be able to return to work. But for the fact that the mine contains some very valuable machinery underground, including electric coal-cutters, miles of cabling, and various electric appliances, the company would probably not have undertaken the repairs on account of the heavy loss involved.

A Works Committee has been set up for **IPSWICH** Electric Supply and Tramways Departments, and will act as the first link in the chain between three National Industrial Councils, i.e., the Tramways Industrial Council, the Electricity Supply Industrial Council, and the Electrical Contracting Industrial Council, the contact with the latter being in connection with the men employed in the Installation Department.

The works of the **HUMBER PORTLAND CEMENT COMPANY** which cover an area of 600 acres on the Humber bank, ten miles west of the city, and will shortly be turning out 2 000 tons of high-grade Portland cement weekly, are run entirely by electricity from mains laid by the Hull Corporation. A 10-mile cable conveys from the Hull power-station 35 000 units a day, or, over 10 millions a year, so that the company's annual bill for electricity alone will be somewhere about £50 000.

Acting on the recommendation of the **N.J.I.C.**, it has been decided to reduce the wages of the Electricity Department staffs in **ABERDEEN**. A reduction of 3s. has been made from July 15, with a further 3s. after Sept. 16, for all employees whose wages are regulated by district schedules. Where consolidation of wages has taken place, the respective amounts will be 3s. 4½d.—3s., plus the proportion of 12½ per cent. The reductions will not affect skilled tradesmen who are paid standard rates fixed by the District Council.

The following **REDUCED SCALE OF CHARGES** for parcels dispatched by aeroplane to Paris came into force on Wednesday: up to 1 lb. 1s. 6d.; 2 lb. 2s. 3d.; 3 lb. 3s. 3d.; 4 lb. 4s. 0d.; 5 lb. 4s. 9d.; 6 lb. 5s. 9d.; 7 lb. 6s. 6d.; 8 lb. 7s. 3d.; 9 lb. 8s. 3d.; 10 lb. 9s. 0d.; 11 lb. 9s. 9d. It is further announced that parcels sent by the aeroplane service will be delivered at the house of the addressee on payment of the small extra charge. In future, therefore, delivery should normally be made on the day of dispatch from London.

The work of unwatering **POLTON COLLIERY**, near **BONNYRIGG**, which was flooded by 700 000 tons of water, is being carried out by two turbine electric pumps made specially for the purpose and capable of raising 1 000 gallons a minute to the surface. In spite of the fact that night and day 2 000 gallons of water are being raised to the surface it will be about six months before work can be resumed in the mine. The main roads and airways will have to be put in order, new electric haulage gear introduced in place of the submerged plant, and a complete set of new coal-cutters provided.

BENN BROTHERS, LTD., have secured prominent stands for the display of their journals and scientific and technical books at many forthcoming exhibitions including the Shipping, Engineering & Machinery, Exhibition at Olympia from Sept. 7 to 28, and the Ideal Homes Exhibition at Kelvin Hall, Glasgow, which opens on Sept. 19. Their publications will also be on view at the Annual Conference of the Library Association, College of Technology, Manchester, in September, and the firm will be strongly represented next year at the British Industries Fair in Birmingham. Further particulars of the exhibits and positions of the stands will be announced as the times for the exhibitions approach.

American newspapers report that an ex-soldier named Walter Bunton has discovered the **PROCESS OF TEMPERING COPPER**, which he has sold to the United States Steel Corporation for \$1 000 000 and a royalty of 2 cents per lb. on the copper tempered by the process. At present the process is being kept secret until the foreign patents have been completed, but it is stated that it is effected in three stages. The first stage makes the copper harder than copper before being alloyed; the second stage makes the copper as hard as steel, and the third stage leaves the copper so hard that it cannot be cut by the best saws, files or chisels. We give this with all due reservations.

For engineering firms, exporting houses and others who have occasion to make calculations of weights, measures and prices in the metric system, or to convert one system into the other, the "**FOREIGN TRADE TABLES**," compiled by Mr. A. J. Lawson, M.L.C.E., should prove very useful. This is the third (English-Italian) edition of the work and the contents appear to have been carefully revised and greatly enlarged. In addition to numerous price-conversion tables, metric weights and measures and British equivalents, multipliers for converting metric and British measures, interest, sinking fund and exchange value tables, there are a number of special engineering tables and data which should appeal to the engineer. Though the book is printed in English and Italian, it can be used for commercial calculations for any country. Copious notes and examples of the use of the tables are given, and as a reference book it should effect a considerable economy of time and prevent errors in the conversion of prices and estimates. The book is published at 21s. net by Messrs. Thomas Skinner & Company, Gresham House, Old Broad-street, E.C.2.

Personal and Appointments.

Sir GEORGE HADCOCK, a director of Armstrong, Whitworths, has joined the board of the Still Engine Company.

Mr. HILLIER FLEISCH has been appointed chairman, and Mr. W. H. MARTIN vice-chairman of Maidstone Electricity Committee.

SENATOR G. MARCONI, who has paid visits to the North Wales wireless stations this week, is making a short stay at Aberdovey.

Major F. J. CHAPPEL, D.S.O., formerly of the British Electric Traction Company, has been appointed general manager of the Yorkshire (Woolden District) Electric Tramway Company in succession to Mr. E. A. Paris, who has retired.

On the completion of fifteen years as general manager of the St. Anne's Council Tramways (formerly the Blackpool, St. Anne's, and Lytham Tramways Company) Mr. H. W. LAING has received silver presentation gifts from the staff.

Mr. H. P. PHILPOT, Assistant Professor at University College, London, has been appointed to the Professorship of Civil and Mechanical Engineering at the Finsbury Technical College; and Mr. A. J. HALE, Chief Assistant in the department of Applied Chemistry, to the Professorship in that department.

Mr. F. N. RENDALL BAKER, power-station superintendent at St. Helens Corporation Electricity Works, has been appointed acting electrical engineer for a period of 12 months, at a salary of £650 per annum, on the resignation of Mr. B. T. HAWKINS, who has been appointed borough electrical engineer to the Wallasey Corporation Electricity Works.

On his retirement from the position of borough electrical engineer and manager of the Wallasey Electricity Works, a post which he has filled for the past 25 years, Mr. J. A. CROWTHER has been presented with a solid-silver tea-and-coffee service by the staff. The presentation was made by Mr. Starkey, the mains superintendent.

Mr. D. H. BRAYMER has been appointed co-editor of the "Electrical World," with Mr. W. H. OSKEN, junr. Of the two editors our contemporary now possesses, Mr. Onken has been connected with the paper since 1906, when he was appointed managing editor, becoming editor ten years subsequently. Mr. Braymer was first connected with the "Electrical World" in 1915 as engineering editor. In 1917 he resigned to become editor of the "Electrical Record," rejoining the "Electrical World" as managing editor in 1919. He has been an electrical journalist since 1910.

Mr. P. J. WATTS, first assistant electrical engineer, who has been at the head of the electrical engineering department at Sheerness Dockyard since July 5, 1917, as electrical engineer (acting), has been promoted electrical engineer on the death of Mr. A. G. Newington. In the same department Mr. A. R. REEVES, inspector of electrical fitters, who has been employed on Admiralty overseeing duties in the Birmingham district for some years past, has been appointed second assistant electrical engineer in the place of Mr. A. E. Frankling.

Telegraph and Telephone Notes.

AN INTERNATIONAL POST AND TELEGRAPH CONFERENCE began at Riga on Monday, and is attended by representatives of Great Britain, Latvia, Estonia, Lithuania, Russia, Finland, Poland, Germany, Denmark, Norway, the free port of Danzig, and the Great Northern Telegraph Company.

FRENCH FOREIGN TELEGRAM RATES, which up to the present have been fixed by the Telegraph Administration in gold francs, are in future to be fixed in "French francs," that is to say, at the current value of the franc. An average equivalent of 1 fr. 80 c. for the French franc, as compared with the gold franc, has been decided upon.

THE SOUTH AFRICAN GOVERNMENT has allocated £450 000 for extending the telegraph and telephone system of the Union during the current financial year. British manufacturers secured £107 505 out of the £124 703 spent last year. It is to be hoped they will receive at least as large a portion of the much larger amount which is now to be laid out.

Mr. KELLAWAY formally opened yesterday (Thursday) at Leafeld, near Oxford, the first completed station in the IMPERIAL WIRELESS CHAIN. It is estimated that in the most favourable circumstances Leafeld will be able to communicate direct with Australia, and at other times messages will pass through intervening stations. The next station to be completed will be Cairo. It is expected to be ready before the end of the year. Construction of other stations will be commenced in 1922, and in two years' time the full chain will be completed.

Many improvements have recently been completed in the ABERDEEN telephone district. In the southern area two additional circuits have been erected between Brechin and Montrose. In the north the junction line workings from Craigellachie have been rearranged. The Aberlour-Craigellachie No. 2 circuit has been connected direct to Elgin, making the Aberlour-Elgin junction line, and the second Dufftown-Craigellachie circuit has been connected direct through to Elgin, making a direct Dufftown-Elgin line, and leaving lines at Craigellachie to Elgin, Roghes and Elgin, Aberlour, Dufftown, and Ballindalloch. This arrangement will save through-switching at Craigellachie of the Aberlour and Dufftown calls, and thus provide a much speedier service. A second Aberdeen-Banff trunk circuit has been brought into use, a new trunk circuit between Banff and Turiff has been erected, and three rural call offices have been opened at the sub-post offices of Findochty, Portessie and Portknockie, on the Moray Firth coast. It is the Department's intention to establish open call offices in every rural sub-telegraph office in the north eastern district.

Companies' Reports, &c.

The directors of the LIVERPOOL OVERHEAD RAILWAY COMPANY do not see their way to declare an interim dividend on the preference or ordinary shares.

THE BRITISH COLUMBIA ELECTRIC RAILWAY COMPANY announces an interim dividend of $3\frac{1}{2}$ per cent., free of tax, on the deferred ordinary stock, payable Aug. 18.

THE WASTE HEAT AND GAS ELECTRICAL GENERATING STATIONS have declared an interim dividend of $1\frac{1}{2}$ per cent. on share capital in respect of the half year ended July 31.

BROMPTON AND KENSINGTON ELECTRICITY SUPPLY have declared an interim dividend for the half-year to June 30 on the ordinary shares at the rate of 9 per cent. per annum (less tax). The dividend a year ago was the same.

The County of Southland (New Zealand) Electric Power Board proposes to issue £750 000 of Six per cent. debentures at 96 per cent. The bonds will be repayable in 33 years' time, but may be paid off after 15 years at the option of the board. The interest and capital will be guaranteed by the New Zealand Government.

The Transfer Books and Register of Members of the South Metropolitan Electric Light & Power Company, Ltd., are closed until August 31, for the preparation of warrants for dividends payable on and after that date, in respect of the 7 per cent. cumulative first preference and 6 per cent. cumulative second preference shares.

The report of the directors of MARCONI'S WIRELESS TELEGRAPH COMPANY, LTD., for the year 1920 states that many matters remain unsettled and the accounts cannot, therefore, reflect the true strength of the company's position. The credit balance for the year amounted to £297 682 which, added to balance brought forward, makes £1 242 134. Deducting the dividend on the preference shares (£17 500) and the interim dividend of 5 per cent. on the ordinary shares (£130 459), there is a balance of £1 094 175 for distribution. The directors recommend payment of further dividends for the year of 10 per cent. (making 15 per cent. for the year) on the ordinary shares (£261 108), and 5 per cent. (making 12 per cent. for the year) on the preference shares (£12 500), leaving a balance to carry forward of £820 567.

A large amount of the company's business during the year has been with foreign countries, and in consequence of the unfavourable rates of exchange substantial sums of money have been retained abroad on deposit or invested in Foreign Government securities. There has still been no settlement with any of the Government Departments in respect of any of the company's claims arising out of the war or the services rendered during the war. Some progress, however, has been made. An important and controlling patent used very largely by the Navy, Army and Air Force was challenged by the Admiralty. The matter was referred for arbitration to the late Lord Moulton, who found on Aug. 2, 1920, that the patent was valid, and was infringed. The amount payable to the company under the decision has not yet been assessed.

Presiding at the annual meeting of FELLOWS MAGNETO COMPANY, LTD., in London last week, Mr. V. L. Fellows, the chairman, said that taking into consideration all the difficulties experienced in the past year, the results of the year's trading gave cause for deep satisfaction. The net profit was £31 961, against £22 645 in the previous year. Until towards the end of the year there was, he continued, a steadily increasing demand for magnetos, which, with the large contracts already booked, was taxing their factory to the utmost, and necessitated further building extensions and equipment. The buildings were delayed through the low output of labour, and, although they were in urgent need of the extra space, they could not get possession of it. (These buildings are now complete.) Their difficulties were greatly increased by the large competitive demand for raw and partly manufactured material, which was intensified by the after-effect of the moulders' strike. They and other firms were actually rationed by some manufacturers. The ration was not half enough for their immediate requirements and deliveries could not be contracted for, and they were compelled to buy in any market that could offer the goods. On the other hand, they were constantly pressed for larger deliveries, and were compelled to place large orders firm for delivery forward. Suddenly and without appreciable warning all fresh demand ceased and instructions to cancel delivery were received from every quarter. When they protested that delivery must be taken, they were in most cases informed that if they insisted payment could not be made. They at once took steps to cancel or suspend deliveries of raw material, but were met in most instances with a refusal and by an intimation that goods would be delivered and payment demanded. Only after long negotiations and many interviews were they able to secure a considerable modification of those terms.

With reference to the accounts, plant, machinery, and other similar assets had been written down, as in former years. Goodwill and patents stood at £11 390. 14s. 8d., an increase of £2 500 over last years. They had purchased some very valuable patents on favourable terms, and the actual value was considerably in advance of the book figure. A gratifying feature of the accounts was the absence of any debentures, mortgages, or other registered charges upon the properties.

With regard to the future they looked forward most hopefully. Deliveries under old contracts were rapidly expanding and demands increasing daily. Since the first two months of the year their returns had steadily increased month by month, and there was every prospect of largely augmented demand in the near future.

The death occurred on Saturday, at Coldash, Newbury, of Sir ALFRED DALE, late Vice-Chancellor of the University of Liverpool, aged 65.

Tenders Invited and Accepted.

THE HIGH COMMISSIONER FOR INDIA invites tenders for telegraph cable. Particulars from the Director-General of Stores, India Office, Whitehall, S.W.1. Tenders by 2 p.m., Aug. 30, to above address.

Tenders are invited by DURBAN CORPORATION for supply of two 500-kW rotary converters, switchgear, &c. Tenders to Town Clerk's Office, Durban, by Sept. 18. Specifications at the Department of Overseas Trade.

LONDON County Council invite tenders for the supply and erection of h.-t. and l.t. switchgear for sub-stations. Specifications from the Clerk of the Council, Spring-gardens, S.W.1, to whom tenders by Sept. 5.

WEST HAM Guardians require tenders by Sept. 8 for three months' supply of electrical fittings, engineers' oils and sundries, &c. Forms of tender from the Clerk, Union-road, Leytonstone, London, E.11.

SOUTHAMPTON Corporation invites tenders for the supply and laying of extra high pressure three phase cable, &c. Specification and form of tender from the Borough Electrical Engineer. Tenders to the town clerk, Mr. R. R. Linthorne, by Aug. 30.

THE VICTORIAN GOVERNMENT RAILWAYS invite tenders (by Sept 28) for the supply and delivery of a lifting-magnet and generating set, with control apparatus and accessories (Contract No. 34241). Specifications at the Department of Overseas Trade, 35, Old Queen-street, S.W.1.

Tenders are invited by Oct. 5 for the supply of bronze wire (schedule 536) to the Postmaster-General's Dept., State of QUEENSLAND. Specifications, &c., from the office of the High Commissioner for Australia, Room E.5, Australia House, Strand, W.C.2.

Tenders are also invited by Oct. 12 for the supply and delivery of galvanised iron and steel wire (schedule 537); and by Oct. 19 for the supply and delivery of insulated wire (schedule 538) to the Postmaster-General's Department, State of QUEENSLAND. Tender forms, &c., from the office of the High Commissioner for Australia, Room E.5, Australia House, Strand, W.C.2.

THE RAND WATER BOARD invites tenders (by September 28) for supply and erection at the intake pumping station, Vereeniging, of two centrifugal pumps, direct-coupled to electric motors, one 10-ton travelling crane, and the supply and erection at the main pumping station site of two centrifugal pumps coupled to electric motors. Specifications of the Department of Overseas Trade, 35, Old Queen-street, S.W.1.

The Secretary of the NEW ZEALAND PUBLIC WORKS TENDER BOARD (Wellington) invites tenders (by Nov. 1) for the supply and erection of new or secondhand auxiliary plant for the Roturua electric supply as follows:—One oil engine (200 to 250 B.H.P.) and one three-phase 50 cycle alternator of 190-kW (power factor of 0.8) with exciter and switchgear. Specifications at Department of Overseas Trade.

PRETORIA (Transvaal) Municipality requires tenders by Oct 4 for coal handling plant (contract No. 6), 6 600 V cables (contract No. 7), induced draught and ash-handling plant (contract No. 8), and feed pumps, steam, air, and water piping, &c. (contract No. 9), for the electric light and power department. Specifications, &c., from the General Manager, or Mr. G. M. Clark, 40-42, Meisje-buildings, Johannesburg.

DURBAN CORPORATION invite tenders for the supply and delivery, C.I.F., Durban, of one 3 000 kW 3-phase, 50 period, 6 600 V turbo-alternator with condensing plant, circulating water pump and piping. Specifications from the Agents, Messrs. Webster, Steel & Company, 5, East India-avenue, E.C.3. Tenders to agents by Aug. 31.

THE VICTORIAN RAILWAY COMMISSIONERS invite tenders for the supply and delivery of (1) water cooler, including accessories for Newport workshops (Contract No. 34 381); (2) three-phase motors, starters, circuit-breakers and switches (Contract No. 34 181). Tenders to the Victorian Railways Commissioners, Melbourne, up to Aug. 31, in the case of (1) and Oct. 19 in the case of (2). Specifications may be seen at the Department of Overseas Trade.

BELFAST Corporation invites tenders for the manufacture and erection of one 12 600-kW turbo-alternator with condensing plant, accessories, four water-tube boilers, with super-heaters and forced-draught fans, four fuel-economisers, two steel chimneys, with four electrically-driven suction draught fans and one electrically-driven centrifugal pump. Specifications from Messrs. Preece, Cardew & Rider, 8, Queen Anne's-gate, Westminster, S.W.1, or the city electrical engineer, Mr. T. W. Bloxam. Tenders to the Town Clerk, City Hall, Belfast, by Aug. 22.

THE GREAT WESTERN RAILWAY invite tenders for the supply for three months from Sept. 1 of (18) telegraph instruments; (19) electrical apparatus (insulators, &c.); (20) electrical wires and cables; (21) telegraph ironwork and tools; (22) telegraph drysalteries. Samples may be seen at Swindon from Aug. 15-19, between 10 a.m. and 5 p.m., on application at the office of the Stores Superintendent, Swindon, from whom forms of tender may also be obtained. Tenders by 10 a.m., Aug. 22, to A. E. Bolter, Great Western Railway, Paddington Station, London.

THE ADMINISTRATION OF THE SOUTH AFRICAN RAILWAYS AND HARBOURS invite tenders for the supply, for 12 months ending December 31, 1922, of 85 500 incandescent train lighting lamps (tungsten filament) for 24 V, 8 to 10 c.p.; 8 125 engine headlight lamps, 150 W, 32 V (gas-filled 1/2 W type with concentrated filament); 50 472 incandescent lamps (tungsten filament); 5 545 incandescent lamps (carbon filament). Tenders by noon, November 7, to the Secretary, Tender Board, South African Railway Headquarter Offices, Johannesburg. Particulars from the Department of Overseas Trade.

THE NEW ZEALAND Public Works Department invite tenders for the manufacture, supply and delivery, ex ship's slings at Auckland, of six sets of three-phase air-brake switches suitable for operation upon 50 000-V circuits in connection with the Waikato Electric Power Scheme. Tenders to the Secretary, Public Works Tender Board, Wellington, by noon on Sept. 27. Telegraphic tenders also accepted if handed in for transmission at any telegraphic office and formal tender lodged at any district office of the Public Works Department in New Zealand not later than above hour. Specification may be inspected at the Department of Overseas Trade, 35, Old Queen-street, London, S.W.1. A copy is also available for loan to firms established in the provinces.

THE VICTORIAN RAILWAY COMMISSIONERS invite tenders (by Aug. 31) for the supply and delivery of accumulator cells and accessories (Contract No. 34 171), including (a) 100 sets, 140 Ah capacity in sets of 12, and (b) 32 sets, 200 Ah in sets of 12 cells (electrolyte not included); also for electric lighting equipment (axle generator system), including (a) 45 sets, 30 A set for passenger car, (b) 10 sets 30 A set for van, (c) 16 sets, 40 A set for special car; (d) 72 main car switches (chopper or rotary type), and an extra battery, &c. Tenders to the Commissioners, Spencer-street, Melbourne, and must be accompanied by a preliminary deposit of 1 per cent. of the total offer. Local representation is essential. Specifications at Department of Overseas Trade.

The following contracts have been let by ALDERSHOT Urban Council: Metropolitan-Vickers Electrical Company, high-tension switch gear, £973 15s., low-tension gear £780 10s.; Bruce Peebles & Co., Ltd., converting plant, £6 147.

LEEK Lighting Committee recommend the acceptance of the tender of the National Gas Engine Company, Ltd., for the supply and erection of a 600-H.P. vertical gas engine, complete, with producer gas plant, &c. for the sum of £10 750. The matter has been referred to the General Purposes Committee.

THE VICTORIAN ELECTRICITY COMMISSION recently placed an order with Messrs. Babcock & Wilcox, Ltd., for the installation of the boiler plant at the Newport "B" power house. The value of the order is £178 000 and it covers the steel frame boiler house, coal bunkers, the boilers, air heaters, induced and draught fans, feed pumps, &c.

Catalogues, Price Lists, &c.

A four-page pamphlet of the Falkirk Iron Company, Ltd., contains prices and particulars of the "FALCO" "ELECTRIC TAILORS" IRONS, which are becoming popular in tailors' workshops. The irons are supplied in two weights, with cool grip handles and fitted with heavy steel-clad double-pole connector, but without flexible.

The subject of ball bearings is one of interest equally to electrical men as to automobile and other engineers. The former class should therefore take steps to obtain from the Sales Department of RUDGE-WHITWORTH, LTD., Reddings-lane, Sparkhill, Birmingham, a copy of the new edition of their ball-bearing catalogue, which contains an amount of useful and well set out data that they cannot afford to be without.

List No. C.R. 1921 of the CRESSALL MFG. COMPANY, 40 & 41, Stainforth-street, Birmingham, deals with "Cressall" controller resistances for cranes, lifts, hoists, &c. Other lists set out the rating, &c., of standard resistances and include illustrations of the woven wire net, the cast-iron grid and porcelain pot types. These resistances have been developed for use with drum type controllers and are essentially of the heavy type.

If the latest list that we have received from the SIMPLEX CONDUIT LTD. is anything to go by, now is the time to buy Plexism appliances in preparation for the forthcoming winter, which our weather experts assure us is going to be severe. Whether it be the Plexism heat bar fire with a loading of 2 000 W and a price of 38s., or "Peter the Heater," a device for starting motor engines at a price of 21s., or even the Plexism small kettle with a capacity of 1½ pints and a loading of 400 W at 15s. 6d., good value for money in every way will be obtained by interested readers.

A neat and well illustrated pamphlet on LOOM MOTORS for TEXTILE MILLS has been prepared by the Metropolitan-Vickers Electric Company, Trafford Park, Manchester. As is well known, the electric drive is being increasingly employed in textile factories, both in this country and abroad, and the company may be truly said to be pre-eminent among those who have specialised in this important branch of electrical engineering. The advantages of the individual electric drive are clearly and succinctly stated, and there are several good illustrations showing the company's motors driving looms.

A pamphlet on the coupling of shafting has been issued by the WELLMAN-BIBBY COMPANY, LTD., 35, Kingsway, W.C.2. For a shaft to run freely it is essential that all the bearings should be in line, as the slightest want of alignment puts additional stresses on the shafts, and increases the friction in the bearings, causing wear and continual loss of power. In electric drives any yielding or wear of the machine bearings throws an undesirable load on the motor shaft and bearings. The Wellman-Bibby shaft coupling, which is described and illustrated in the pamphlet, will compensate for want of alignment of the shafts without setting up cross pulls, and thus ensure easy running; it has exceptional elasticity under all loads, and it possesses other advantages. The coupling can be used advantageously in electrically-driven rolling mills, haulages, winders and cranes, steam and water turbine generator sets and for a variety of other purposes. Dimensions, speeds, &c., of small and large couplings are included.

Bankruptcies, Liquidations, &c.

Claims against ALBERT LORD, electrical contractor, 33, Westgate, Burnley, are to be sent by Aug. 31 to Mr. C. H. Plant, Official Receiver, 13, Winkley-street, Preston.

Claims against FREDERICK THOMAS JOHNSON, 60, Elmsley-avenue, Newham, Cambridge, electrical engineer, are to be sent by Aug. 30 to Mr. Howard William Cox, Official Receiver, 5, Petty-cury, Cambridge.

Claims against JOHN WILLIAM GLADWIN, 81, Burcot-road, Meersbrook, Sheffield, and 14, Meersbrook Park-road, Sheffield, electrical engineer, are to be sent by Aug. 27 to Mr. Charles Turner, F.C.A., 155, Norfolk-street, Sheffield.

Claims against Albert Edward Dickinson, carrying on business at 157, Hunslet-road, Leeds, under the style of THE CROWN ELECTRICAL COMPANY, electrical engineer and contractor, are to be sent by Aug. 31 to Mr. H. C. Bowling, Official Receiver, 24, Bond-street, Leeds.

Claims against CHARLES HENRY STEEL, lately carrying on business at 53, Queen-street, Cardiff, and 65, High-street, Merthyr Tydfil, electrical engineer, are to be sent by Aug. 27 to Mr. Ellis Owen, Official Receiver, 117, St. Mary-street, Cardiff.

THE SUTTON-IN-ASHFIELD MOTOR & ELECTRICAL ENGINEERING COMPANY, LTD., is to be wound up voluntarily, and Mr. James Keetley, Chartered Accountant, King John's Chambers, Bridlesmith Gate, Nottingham, has been appointed liquidator.

A meeting of the creditors of the OLDHAM, ASHTON & HYDE ELECTRIC TRAMWAY, LTD. (in liquidation), will be held at Electrical Federation Offices, 88, Kingsway, London, W.C.2, on Aug. 26, at 12 noon. Particulars of claims to be sent by Sept. 22 to the liquidators, P. M. Rossdale and T. H. Underhill.

A first and final dividend of 4s. in the £ in the matter of Arthur Kershaw and Charles Herbert Wood, carrying on business in co-partnership together at 9, Bradford-road, Dewsbury, under the style or firm of KERSHAW & WOOD, Electrical Engineers and Merchants, is payable Aug. 22, at the Offices of Poppleton, Appleby & Turner, 155, Norfolk-street, Sheffield.

New Companies.

The following list is compiled from information supplied by Messrs. Jordan & Sons, Ltd., company registration agents, 116 and 117, Chancery-lane, London, W.C. 2:—

DEWURSTS (1921) LIMITED. (176 156).—Registered Aug. 8, 25, Victoria-street, Westminster, S.W. Engineers, founders, &c. Nominal capital, £15,000 in 15,000 shares of £1 each. Directors to be appointed by subscribers.

SHIPLEY TANK COMPANY, LIMITED. (176 076).—Registered Aug. 2, Bowling Ironworks, Bradford. Makers of gas engine, oil engine and other tanks. Nominal capital £500 in 500 shares of £1 each. Directors: W. H. Thornton, 3 Park Grove, Frizinghall, Bradford; A. Brookbanks, 53, Paley-road, Bradford.

Benn Brothers' Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"The Cabinet Maker": "Furnishing and Decoration of American Hotels"; "Pierced Decoration in Furniture"; "Inexpensive Machine-made Furniture."

"The Chemical Age": "Co-operative Societies and Chemical Research"; "United States New Chemical Plant"; "Merchants' Protest against Board of Trade Dyestuffs Policy."

"Farm and Home": "Revolution in Rural England"; "Dairy Farming in Switzerland"; "Ready for the Coming Trade Revival."

"The Fruit-Grower": "Pershire Commercial Fruit Show" (illustrated); "Nursery Work after the Drought"; "Black Currant and Growing Problems."

"Gardening Illustrated": "Deep Cultivation"; "Flowers and the Drought"; "A London Garden" (illustrated); "Lilium Giganteum" (illustrated); "Vegetable Marrows" (illustrated).

"The Hardware Trade Journal": "Hardware for China"; "Works Accidents and How to Avoid Them"; "Steam Raising, Yesterday, Today and Tomorrow."

Books Received.

(Copies of the undermentioned works can be had from THE ELECTRICIAN Offices at reduced subscription prices, plus postage.)

"Boiler Inspection and Maintenance." By R. Clayton. (London: Sir Isaac Pitman & Sons.) Pp. 118. 2s. 6d. net.

"British Antarctic Expedition, 1910-1913. Terrestrial Magnetism." By Charles Chree, M.A., F.R.S. (London: Harrison & Sons.) Pp. xii + 168.

"Liquid and Gaseous Fuels." By V. B. Lewis. Second Edition, revised and edited by J. B. C. Kershaw. (London: Constable & Co., Ltd.) Pp. xiv + 353. 12s. 6d. net.

"The Electronic Conception of Valence and the Constitution of Benzene." By H. S. Fry, Ph.D. (London: Longmans, Green & Co.) Pp. xviii + 300. 10s. net.

Forty Years Ago.

(THE ELECTRICIAN, AUGUST 20, 1881.)

PRESIDENT GARFIELD AND THE NEW CABLE.—We learn that the first message sent over the new American cable was one of sympathy with President Garfield.

THE TELEPHONE IN THE PROVINCES.—At a recent meeting of the Town Council of Derby the Town Clerk said that an experiment had been made with the telephone for three months, and it had been found to answer admirably.

THE ELECTRICAL EXHIBITION.—News from Paris says that the technical committee of the Exhibition are about to organise a series of elementary lectures on some of the inventions exhibited. The grand display of electric lighting has been deferred till the end of the month.

THE AGGRIEVED TELEGRAPHISTS.—The long-deferred discussion on the revised scheme of pay for Postal Telegraph Clerks took place in the House of Commons on Tuesday evening last, when a number of members advocated the cause of the clerks very warmly. The general upshot of the debate, however, was simply this, that the Postmaster-General adhered to his scheme, and obtained the money for carrying it out.

UNCEREMONIOUS BEHAVIOUR OF THE ELECTRIC LIGHT.—To show, we suppose, that it is no respecter of persons, the electric light employed in the Voralberg Tunnel, now being constructed in the Tyrol, suddenly went out whilst the Emperor of Austria and party were inspecting the works, leaving them in utter darkness. The Emperor is said to have been highly amused by the occurrence. We are glad to say his Majesty was soon rescued by workmen with lamps, and we believe came out of the tunnel with whole shins.

LONG DISTANCE TELEPHONING.—The operator says: The telephone was successfully worked between Buffalo, N.Y., and Paterson, N.J., a distance of 350 miles. The series of experiments made were conducted by Mr. J. F. Noonan, Paterson Manager Metropolitan Telephone & Telegraph Company, who claims to have discovered a method of adjusting batteries so as to produce good results in communicating over long distances. Although the results of the test were not wholly satisfactory to Mr. Noonan, enough had been accomplished to show the value of his discoveries and to ensure the possibility of long-distance telephoning. Listeners in the Buffalo exchange could distinctly hear Mr. Noonan's "Halloo, Buffalo," and songs sung at Paterson were recognised at this end of the line. In talking, the voice could be plainly heard, but the words could not be distinguished amid the heavy sputtering and snapping noises caused by induction from the wires. Telephone men feel confident that, if a wire can be obtained remote from the wires devoted to telegraph business, conversation can be easily carried on under Noonan's method. As it was, the results of the experiments are considered of great practical value.

Prices of Metals, Chemicals, &c.

			TUESDAY, Aug. 16.	
			Inc.	Dec.
Copper—				
Best selected.....	per ton	£70 5 0	£0 5 0	—
Electro Wirebars ...	"	£75 0 0	—	£0 10 0
H.C. wire, basis	per lb.	0s. 11½ d.	—	½ d.
Sheet	"	0s. 11½ d.	—	½ d.
Phosphor Bronze Wire (Telephone)—				
Phosphor-bronze	—	—	—	—
wire, basis	"	1s. 3½ d.	—	½ d.
Brass 60/40—				
Rod, basis	"	0s. 8d.	—	—
Sheet, basis	"	0s. 10½ d.	—	—
Wire, basis	"	0s. 11½ d.	—	—
Pig Iron—				
Cleveland Warrants .	per ton	£6 15 0	—	—
Galvanised steel	—	—	—	—
wire, basis 8 SWG ..	"	£25 0 0	—	—
Lead Pig—				
English	"	£24 15 0	—	£0 5 0
Foreign or Colonial ...	"	£23 12 6	—	£0 2 6
Tin—				
Ingot	—	£155 10 0	—	£6 10 0
Wire, basis	per lb.	2s. 2½ d.	—	½ d.
Salammoniac. —Per cwt. 65s.-60s.				
Sulphur (Flowers). —Ton £13.				
" (Roll-Brimstone).—Per ton				
£13.				
Sulphuric Acid (Pyrites, 168°). —				
Per ton, £9 17s. 6d.				
Rubber. —Para fine, 11d.; plantation 1st latex, 9d. lb.				
		Copper Sulphate. —Per ton £36.		
		Boric Acid (Crystals). —Per ton		
		£69.		
		Sodium Bichromate. —Per lb. 7½ d.		
		Sodium Chlorate. —Per lb. 4d.		

Rubber.—Para fine, 1½ d.; plantation 1st latex, 9d. lb.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd.

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Notes.

The I.E.E. Royal Charter.

THE news that the Institution of Electrical Engineers has been granted its Royal Charter, and that H.M. THE KING has been graciously pleased to intimate his willingness to become the Patron of the Institution, will be received by electrical engineers with unalloyed gratification. For ourselves we had never any doubt that the petition to the Privy Council would eventually be favourably received, but we had not expected that the Charter would have been obtained with so little opposition. The ease and celerity with which the matter has been put through is not only an indication of the light in which the Institution is regarded in official circles, but a tribute from other similar bodies to the position which it has attained. Members have now to determine how their fresh status is to be used not only for their own betterment and for the improvement of the Society to which they belong, but for the general furtherance of the electrical idea among the general public. We have no doubt that in attaining these objects the Royal Charter will have its uses, and the thanks of members will therefore be given unreservedly to the Council, and especially to the President, Mr. LEWELYN ATKINSON, for the enterprise and success they have shown in that direction.

Signalling by Invisible Rays.

SOME enjoyable newspaper stunts during the war were worked up on the subject of invisible signalling, and some equally imaginative methods of how this was being done by the enemy were published in some of the more unsophisticated of our contemporaries. Nevertheless, it was generally known in scientific circles that this problem was being examined, and the account of the work of Dr. LOUIS BELL and Mr. NORMAN MARSHALL in this direction, which is published in the current issue of the "Electrical World," is therefore less of a surprise than might otherwise be the case. In essence the method depends not on the use of ultra-violet rays, but on the radiation which lies between 400μ and 350μ . Using this range has enabled Mangin mirrors to be employed instead of fragile quartz lenses, while an ordinary gasfilled

lamp was found to be a satisfactory source of light. A screen suitable for cutting out the visible spectrum was not obtained without difficulty, but eventually this problem was solved by a combination of special glasses, of which no further details are given.

The "Chemical" Eye.

So much for transmission! But even greater difficulties had to be faced in obtaining a suitable receiving equipment. Many substances which respond to ultra-violet rays were found to be quite unsuitable for use in the light ranges employed in these experiments. And even when the best substance was finally found it proved to be difficult to prepare it for use, especially when it was essential to make the whole equipment as light and portable as possible. Finally, a barium-platinum-cyanide fluorescent screen was found to be most efficient in every way as a "chemical" eye. The practical apparatus tested in the field consisted of a metal cylinder containing a 6 V 2 A gasfilled lamp. This lamp was placed at the focus of a Mangin mirror, and between the mirror and a filter 10 mm. thick. This cylinder complete weighed only $1\frac{1}{2}$ lb. In the most developed form of apparatus two telescopes are placed side by side, one for transmitting and one for receiving signals. Perhaps the most remarkable thing about the system is the small amount of energy required for its operation, a range of 2 km. being obtainable with an expenditure of 20 W. The results obtained with it show that it would have been of the greatest use during the war, and it is to be hoped that it will also find a useful application in the less exciting arts of peace. Its inventors are to be congratulated on the success of their researches.

Forging the Wireless Chain.

AFTER many years of discussion, false starts and facing difficulties, both engineering and political, it is pleasant at last to be able to record an achievement by the Post Office towards forging the Imperial Wireless Chain. For whatever may be the future of this scheme, and however it may be necessary to modify present plans, nothing can detract from the interest which the completion of the Leafeld station will cause among

those really concerned in this development. From the detailed description of the engineering and the more purely wireless features of the plant, which we give on another page of this issue, it will be seen that advantage has been taken of recent improvements in the continuous wave system to employ the Poulsen arc as a generator. In our view there seems to be no reason why this experiment (as some will call it) should not be a success as the Poulsen arc, as modified by Mr. C. F. ELWELL, is already in efficient use at Lyons, Honolulu and other places. At Leafield two 250 kW arcs and auxiliaries have been installed, and in general design and construction the equipment follows the traditions adopted by this firm and outlined recently in *THE ELECTRICIAN*. For the present the station is to be used for both transmitting and receiving purposes, though it is eventually intended that the receiving shall be carried out at Banbury. We are informed that the Cairo station, whose history has also been not unaccompanied by those vicissitudes which seem inseparable from wireless development, will be ready for use in the autumn of this year. This station, which will be a second link in the wireless chain, will also be worked on the arc system, so that the Post Office and its advisory wireless experts should before long, with the equipment of various kinds now at their command, be in a position to decide in the most certain way upon the relative advantages of the conflicting wireless methods and apparatus that are now available for commercial use.

An International Asset.

BUT while it is only natural that electrical engineers should on this occasion find their greatest interest in the engineering details of the station and the equipment generally it must not be forgotten that, as the POSTMASTER-GENERAL said at the official opening of Leafield Station last week, the occasion is truly an historic one. Much has been written inferentially and much more might be written explicitly on the difficulties and dangers which have been caused by the lack of proper communication, not only between persons, but between nations. And while we view with some dismay the prospect of being rung up from Australia by means of wireless telephony to discuss some trivial matter connected with our last week's issue, we can comfort ourselves with the flattering unctious that this useful means of communication is not likely to be developed to such a point within our lifetime. At the same time the possibility of communication of this kind being available at a very much earlier date for high national and state purposes must not be forgotten, and the closer touch which wireless telephones will enable to be maintained between heads of governments should not be without a far-reaching effect on the peace of the world.

From a Scientific Desert.

IT is a widely held opinion that inventors, poets, musicians and even journalists do their best work when they are nearly starving; and that the quality of their work diminishes as their surroundings increase in splendour and comfort. It might be argued that there is another side to this question, and for ourselves we prefer to forgo any slight glimmering of genius with which fate may have blessed us in favour of a financial state which at any rate corresponds with Mr. MICAWBER'S ideas of happiness. But whether it be correct or no that the classes of workers we have mentioned flourish best in a state of indigence it is certain that the scientific investigator requires some financial resources, either of his own or belonging to the institution with which he is connected, in order that he may perform any useful function at all. We have recently called attention in these columns to the plight of scientific workers in Russia. Not only is their bodily condition as bad as, or worse

than that of the other inhabitants of that unfortunate country, but a full stop has been put to their useful activities, and they have been practically cut off from any communication with the world of science. This in itself is not surprising. Politicians as a class have in popular phrase "no use" for science or scientists. This indifference, in the case of the Bolshevik Government, has been raised to the nth power, and not unnaturally, considering the tenets that they hold, has been accompanied by open hostility.

The Measurement of "Ageing."

IT was therefore with that gratification which naturally accompanies the sight of enterprise in the face of difficulties, that we recently received and now publish an article by Prof. CLAUDIUS SHENFER, of Moscow University, on "The Influence of Partial Demagnetisation upon the Permanency of Magnets." In this article he discusses the well-known phenomenon of magnetic "ageing," and describes the means which he took to measure this factor. He concludes that for every magnet there is a certain value of the demagnetising field which renders its magnetic properties insensible to subsequent mechanical shock, and that it is possible by the means he describes to mature the magnets used in electrical measuring instruments instead of as at present ageing them by time or artificial means. These results should prove of general interest as giving a numerical value to a factor which has not yet been closely measured, but it would be still more interesting to know the shifts and expedients which Prof. SHENFER had to devise to obtain them under what must have been extremely trying and difficult circumstances.

No Standard Electric Traction.

THE final report of the Advisory Committee on Electric Traction is in some ways a disappointment and in some ways a relief. It is a disappointment because there is so little in it to criticise and a relief because we are glad to find that no heroic attempt has been made to standardise either system or equipment. Indeed, within certain wide limits it leaves the railway companies to do what they like, for, with the approval of the Minister of Transport, they need neither use the standard system nor the standard equipment which is tentatively and almost diffidently suggested. The report would also relieve the railway companies from interference from such bodies as the Greenwich Observatory and the National Physical Laboratory on such matters as potential drop effects, and is in general a very mild document. In our view this is, however, no cause for criticism. As we have said before if electric traction systems should be standardised, which we doubt, this is no time to do it. And if systems are not to be standardised there is nothing to be said for standardising equipment. Good design and quality of product can and must be achieved without either of these artificial aids.

The Safeguarding of Industries.

IN spite of the searching criticisms of politicians, traders, manufacturers and consumers, the Safeguarding of Industries Bill has become law. And it has become law in a most unsatisfactory way. For the discussion in the House of Commons on its provisions was largely artificial even on the part of those who were its declared opponents, while the SPEAKER'S ruling that it must be certified as a money bill made its progress through the House of Lords practically automatic. It may, indeed, be said that never has so important a Bill had so curious a history, and its future is quite likely to be more extraordinary than its past. In our view it represents another "of those pieces of experimental legislation of which we have recently seen more than one, which, however fascinating they may be in theory, in practice prove quite incapable of improving

the shortcomings which they are designed to overcome, and even add still further to the disabilities which they are supposed to remove. But the Safeguarding of Industries Act has another claim on our attention. For concealed or unconcealed it is an attempt on the part of the Government to retain a control over the developments of British trade, which is being reluctantly given up in most other directions, and to legislate for a condition which it is evident is not permanent. We have never concealed our opinion that there are many ways in which the Government can assist the industries of the country. But paradoxical as it may seem, Government gives the greatest assistance to industry when it interferes least with the industrial machine. It can provide information, it can organise an efficient consular service and it can make smooth the ways of our merchants in foreign lands. If it does these things it performs a useful function, but when it attempts to interfere with economic laws it not only performs no useful function but its experiments are foredoomed to failure. If the Act is ever worked at all, this is what will happen in this case.

Nobody Satisfied.

No good purpose would therefore be served by explaining at length what the Safeguarding of Industries Act is supposed to do or by criticising in detail the inconsistencies which its clauses disclose. The amendments that were made to the Bill during its passage through the House of Commons disappointed its supporters and failed to satisfy its opponents. In more normal times there would be much to be said for a straightforward tariff on imported goods if only to give us a weapon with which to fight the operations of our competitors in foreign markets. But times are not normal, and the Safeguarding of Industries Act will not assist to make them so. We therefore agree with Mr. ASQUITH that our best hope for recovery at the present lies in reliance on the opening of markets and the free interchange of goods. However, we are not so downhearted as perhaps we ought to be, as the Act is so devitalised that its effect on trade can be but small. But it is a pity that so much of the time that was taken up in discussing it was not given to more useful work—the Electricity Supply Bill for instance.

Three Years of Peace.

WHEN the war ended the most far sighted in the various classes into which industry is divided saw that the best hopes for stable reconstruction lay in a frank discussion of difficulties, and in a determination on everyone's part to carry on to the utmost of their ability in accordance with economic laws. Unfortunately reconstruction on these lines was too slow, and non-spectacular for the more vocal among both employers and employed. And the result has been that in the last three years we have seen attempts to bring back wages by short cuts to the 1914 level countered by strikes, followed by a general rise in costs and by seismological disturbances striking at the very foundations of our financial stability. It is now obvious that cuts and strikes and high prices have brought good to no one and have been accompanied by a decrease rather than by an improvement in national prosperity. It is, therefore, gradually being borne home to everyone that a pooling of ideas must take the place of class war and that evolution must replace revolution.

The Jettisoning of a Bad Policy.

THE pronouncements which have been made during the past few days by Mr. HERBERT SMITH and Mr. ROBSON at the annual conference of the Miners' Federation, by Mr. CLYNES at the annual conference of National Federation of General

Workers, and in a manifesto addressed by certain trade unionists to their fellows, are all indications of the awakening of this new spirit, and of the desire for new methods of dealing with industrial disputes. The strike weapon, if not already broken, is weakening, the extremist is losing his power, to use trades-union organisations for political ends has been shown to be a failure; the next move is towards co-operation, arbitration, and the fulfilment of honest purpose. We need hardly say how glad we are to be able to record this change of front on the part of those who are the leaders of the labour movement, a change of front which we hope will spread until it permeates the whole of the thoughts and actions of that great body.

The Place of the Whitley Council.

As the "Call to Labour" truly says: "The starting-point of a new social energy is by the development of new relations between men. . . . What has to be done is to enlarge the circle of consumers, and consequently increase production and open a wide road by putting capital and the instruments of labour within the reach of every man offering a guarantee of good will and capacity." In our view these ideals can be attained in no better way than by the assistance of the Whitley Councils. These bodies have recently been undeservedly under a cloud simply because the true spirit which must direct their actions has too often been wanting. But with the dawn of what we hope is a brighter day the true soundness of the idea which underlay their genesis will become clear, and the will to peace should quickly be translated into the deed by the crystallisation of their deliberations into performance.

An Electricity Supply District in Being.

AMONG the welter of schemes, enquiries, and discussions which now surround the attempts of the electricity supply industry to reorganise itself it is perhaps not unnaturally forgotten that something very like an electricity supply district is already in successful operation. We, of course, refer to the electrical position which exists on what is conveniently called the North-East Coast, or to be more explicit in parts of the counties of Northumberland, Durham and Yorkshire, where by a combination of enterprise and happy circumstance one electricity undertaking supplies almost exclusively a district whose electrical activities and possibilities are, if equalled, certainly not excelled by any other part of the country.

TWENTY YEARS' WORK.

In the article which we publish on another page of this issue we give a bird's-eye view of what has been done during the last twenty years to bring this position about, and we think we are right in saying this is one of the most important articles which has recently appeared in THE ELECTRICIAN. We not only call attention to many of the interesting engineering features which have naturally accompanied the extraordinary growth of one body, but give some historical details which indicate the ingenious no less than the enterprising way in which the system generally has been built up until, with the exception of one or two towns where a supply from a municipally-owned station is still given, the whole of an area of some 1400 square miles obtains its electricity supply from one undertaking.

The variety of problems that have had to be dealt with have naturally been both engineering and commer-

cial. As a result Carville is a name to conjure with in the electrical world; while Dunston, a station which was originally designed to equalise the load on the network in the immediate neighbourhood of Newcastle, is only second to it. Further, we are promised that the North Tees station which is now in course of erection will out-distance them both in more ways than one. In a more particular way the district has been the home of the steam turbine, of the ironclad type of switchgear, of various devices which improve distribution and of several of those types of protection whose object is to ensure the necessary continuity of supply.

A MUTUAL SUPPLY SYSTEM.

It has always been the policy of the company to co-operate closely with the other industries in the district to their mutual advantage. This has enabled not only a generating station to be taken over from a coal company with good results both to the supply company and to its original owners, but has made possible the development of an interesting system of using waste heat from coke ovens and blast furnaces to generate electricity for the supply of these works and to feed into the line with the surplus. This arrangement not only cuts down the generating costs of the system, but gives the particular consumer a security of supply which he would not otherwise obtain. The advantage of this arrangement was fully emphasised during the recent strike.

THE NEED FOR CONTROL.

To supply over such a large area in such a variety of ways, however, introduces problems of its own. One of these lies in the necessity of keeping a most careful control over the various switching operations, so that these are carried out with an eye on the requirements of the district as a whole. For this purpose, as we point out elsewhere, some supervision from a central point is necessary. The system used, which has been extended as required, allows a close touch to be kept with everything that is going on in the whole area, and ensures not only an equal loading of the various generating plant, but continuity of supply and freedom from danger to men working on the various parts of the wide network.

AN EXAMPLE FOR OTHERS.

We have no doubt that there are some who will see a reverse side to the glowing picture we have painted. It may be argued, for instance, that the company is fortunate in operating in an area of a kind whose like is not to be found in any other part of the country. We agree, but the success which they have achieved has not been obtained at all easily. While it is true at the moment colliery owners and other power users are waiting their turn to be connected to the system, in earlier days the idea that electric power could help in the development of these industries was scoffed at. The war and industrial troubles has, however, taught some people a great deal. The same state of affairs which is, in fact, the common lot, was found when attempts were made to develop the domestic load. For the company, while connecting on the one hand mine motors of large horse-power, have not neglected to employ to the utmost that great outlet for electricity which comes from applying electricity to domestic purposes. So much is this the case that in Newcastle it has been necessary to adopt an ingenious system of alternating-current interconnectors to relieve the original direct-current network of the load now imposed upon it. It is found that the electric heating devices are receiving an increasing application, for reasons with which electrical engineers are well aware, and this tribute to the usefulness of this apparatus in a town whose bleakness during the winter months is proverbial is one at both which the company and electrical engineers generally may well be gratified.

TAKING ONE'S OWN MEDICINE.

It may be added that the Newcastle Company is no Peterkin (*vide* B.E.D.A.'s latest effort). That is, it believes not only in the electric idea for its consumers, but for its employees as well. The erection of an electrically-equipped village at Billingham is an excellent instance of taking one's own medicine, and we have no doubt that the result, of which we hope to hear something in due course, will be satisfactory to all concerned.

We hesitate to subscribe the obvious moral to all this, which was indeed the reason why this article was written, that with the will there is no real reason why the state of electrical affairs which exists on the North-East Coast should not become general throughout the country. It is a commercial matter which should be dealt with commercially.

The Telescope and the Microscope.

It is, perhaps, hardly fair to the Electricity Commissioners "to create an atmosphere" by discussing in any detail the proposals that have been put forward for solving the complicated problems connected with electricity supply in London and elsewhere. These they are now considering, we might almost prophesy, with feelings of despair, were it not that they have not yet shown themselves lacking in courage. But, in any event, their task is difficult enough without troubling them with outside suggestions. Were it, in fact, possible to enclose them in a vacuum, accompanied only by the necessary sustenance and the sheaf of documents and transcripts of the evidence which the recent Inquiry has thrown up, and to insulate them entirely from those ætheric influences which must consciously or unconsciously be now troubling their deliberations, in the midst of what is cynically termed the holiday season, we should not envy them their job.

SOME GENERAL PROBLEMS.

Nevertheless, we propose to discuss certain problems connected with electricity supply in London, problems which also have a more general application, not primarily from what may be termed an inquiry point of view, but in the most general way, in the hope that by so doing we may throw a little light on certain matters which are now difficult and obscure. If in so doing we embarrass the deliberations of the Commissioners, we apologise in advance, for that is neither our intention nor our desire. We do not, however, think that this discussion will have that effect, for the questions we have in mind need only indirectly trouble the Commissioners at all. On the other hand, they must be the first duty of those who are considering how best to develop their individual undertakings.

AN UNWIELDY MONSTER.

The problem of electricity supply in London, as viewed through the spectacles of the inquiry, appears mainly financial. The sum envisaged to secure that reorganisation which is sorely needed runs into many millions, while the engineering part of this colossal Siamese twin can be measured in thousands of kilowatts. Here, then, are two problems of equal interest and equal difficulty. For even by discarding capital stations for the time being, and sticking solely to an inter-luking policy on the most economical lines, large sums of money will have to be raised and spent, and how both are to be done in the wisest way is not yet clear. It is, however, evident that in time new stations of considerable size will have to be erected; but where and by whom has yet to be decided,

though the problems of their design must be, and are already being, tackled. But supposing that with a fairy's wand we could in a moment solve these two problems, straighten out their crooked places and policies, and illuminate their darkest corners, much that is difficult in connection with electricity supply in London would still remain, and to the experienced onlooker, though perhaps different in appearance, the aspect would seem just as dark and difficult as it is at present.

AN ELECTRICAL PARABLE.

Leaving aside for the moment finance and heavy engineering, we will try and state the facts as we see them in the form of a parable. A short time ago a description appeared of a telescope which had been erected at Mount Wilson in the United States. This instrument has an object glass some 100 in. across, and by it stars whose diameter is estimated at 215 000 000 miles can faintly be seen. On the other hand, microscopes are now available whereby micro-organisms of almost unbelievable smallness can be detected and watched; and it seems within the range of possibilities that objects which approach molecular size will shortly become visible by means of some such device. That is our parable. But no parable is worth its salt without an explanation.

LOOKING AT THE STARS.

For the past few weeks, in London at any rate, we have all of us been looking at the electricity supply industry through the Mount Wilson telescope. We have been thinking in millions of miles, or, to change the metaphor, our brain cells have failed to respond to anything smaller than 15 000 kW and many thousands of pounds. It has been an instructive and suggestive exercise. But the time has come when we must turn from the telescope to the microscope, and consider the electricity supply problem from the other end. If not, we shall lose our true perspective, and land ourselves in fresh difficulties just when we are fondly imagining a solution is in sight.

Mr. MERZ, who in quite a complimentary way may be termed the Sir ERIC GEDDES of the electrical industry, loves to think in capital stations equipped with plant supplied at £3 per kilowatt, and holds as a reason for getting such plant to work without delay that there must be plant available to meet the demand as it arises. We agree with him. But if money is to be spent by thousands of pounds, we should equally like to be assured that there will be the demand efficiently to employ that plant when it is ready to supply. And it is to ensure that this shall be so that we feel that no time must be lost in giving a close consideration to those problems of distribution which have perhaps, not unnaturally, been a little neglected of late.

AN INTERESTING MICRO-ORGANISM.

If, then, we consider the London Electricity supply problem through the microscope rather than through the telescope, we find, what of course we knew before, that it is not only a medley of systems, voltages and frequencies, but that in many if not in most areas the distribution network is already too small to perform the work now being imposed upon it, and that it must certainly be largely supplemented before the load can be developed to any great extent. Unless, therefore, we start at once to tackle this problem, it may arise that a supply will be available at the outskirts of the district from some capital or semi-capital station and at the same time there will be no adequate means present to distribute it. To make a supply from a capital station available in such an area not only will transforming and converting machinery be necessary in almost every case, but large sums will have to be spent both in laying fresh mains and in supplementing those which at present exist; while a selling campaign will

have to be started to secure consumers to take advantage of the new facilities. That is the dual problem which every undertaking must tackle at once with all its energy.

REORGANISATION NECESSARY.

The exact nature of the problem to be solved varies, of course, in each particular area. In one the power load is predominant both in extent and in revenue-earning capacity. In another the lighting (we should like to write domestic) load is the staple. But in both cases, if there is to be any development some reorganisation of the distribution system is necessary, and this reorganisation is necessary not only in nearly every supply area into which London is divided, but in nearly every supply area throughout the country. This can only fail to be true if electricity supply has reached saturation in a particular area, as some people would have us believe. But then there is no need either for capital stations or wide schemes of interlinking.

THE FUTURE LOAD.

Now, as we have said before, and repeat it here for it is not yet generally realised, the domestic load is the load of the future. Unfortunately, or is it fortunately, in this country the domestic load is non-existent with a few exceptions even in London. In some areas the power load is predominant, but there are obvious limits to its extension, and the same may be said of lighting, especially in the West End of London and the residential districts of large provincial towns, where saturation is being rapidly reached and where a revolution most harmful to the supply authorities concerned may occur if the introduction of the $\frac{1}{4}$ W lamp is to take place on a commercial scale. There is one residential area where this problem has been successfully tackled, and there is no reason why equal success should not follow equal enterprise in others. For the future of electricity supply in London with its miles of residential streets, its thousands of offices and shops, its acres of docks and factories, and its network of railways will largely depend on the domestic load. But that domestic load cannot be developed with safety in the majority of areas simply because the network has been designed with a view to a lighting load only and a very insignificant one at that. And that is the whole point which nearly every supply engineer has to tackle even at the expense of sleepless nights.

A SURVEY OF DOMESTIC REQUIREMENTS.

At the microscopic end of the scale the problem of electricity supply in London therefore resolves itself into this: the need for a careful survey of the electric domestic requirements of each area and of each street and house in that area. A consideration of the probable expansion of the housing in each district and the electrical requirements caused by this expansion. A judicious tempering of the results obtained with diversity factor and the laying out of a distribution system based on the figures obtained.

At present it is true the generating plant available in London is not equal to the demand. But thousands of kilowatts can be added to the generating plant much more easily than to the service connections, so that no fear need be felt on that score. At the other end, however, there is real ground for anxiety. For inadequate distribution systems not only prevent necessary expansions but introduce risk of a cessation of supply. And continuity must more and more be considered an essential in the future of electricity supply.

Fortunately this is a problem which requires no inquiry. A reorganisation on the lines we have laid down can be undertaken by each undertaking on its own responsibility. The Commissioners have in hand one end of the problem, but when it is solved there must be nothing to prevent a free development as speedily as possible.

An Electricity District in Being.

Recent Developments in Power Supply on the North-East Coast.

It is a question of power supply. The power demand simply would not be met by a normal line, and the area is not the size of the area covered by the Cape Town supply. We are talking about an area which is roughly bounded by the South-West Coast. This comprises the two main rivers, the Orange and the Tzitzis, and a part of the North-Bank of the Orange. There are many reasons for wondering whether the power demand will be met by the power supply. But the power supply is not a question of capacity, it is a question of cost. But the solution is not to be found in the power supply, it is to be found in the demand. With its excavation, that the North-East Coast is electrically already, and contains all the features

to say that the North East Coast was the pioneer of electrified areas, and whether we consider its extent or the number of kilowatt-hours consumed, there is no other district in the United Kingdom that compares with it.

A POLYMER OF COORDINATION.⁹

Delving further into the history of the development of the Newcastle Company, it is interesting to discover that the policy followed has been very much the same as that which the Electricity Commissioners are now trying to introduce into the country generally. In the first place a process of concentration of generating plant took place which involved the scrapping of a number of the smaller

generating stations. This process of concentration was brought about by the amalgamation of the Newcastle-on-Tyne Electric Supply Company with the County of Durham Electric Power Supply Company, the Cleveland & Durham Electric Power Company and several other supply undertakings. The interlinking of the transmission and distribution systems of the various companies logically followed, necessitating, in some cases, an alteration of pressure and frequency. It is interesting to note that the latter has now been standardised at 40 throughout the company's area.

THE EXTENT OF THE AREA.

The area now supplied by the Newcastle Electric Supply Company and its associate undertakings is shown on the map in Fig. 1. It covers about 1,400 square miles. It falls naturally into five sub-areas, that round Newcastle, which comprises an excellent lighting and power load of the usual character, especially shipbuilding and engineering works, and a growing domestic load; that on the banks of the river Wear which is of a similar nature; that round Middlesbrough, where there is also an extensive power load in shipbuilding yards and iron and steel works, notably at the works of Messrs. Doorman & Long, with the usual amount of lighting and a certain domestic development as will be seen later on. The other two areas are the Northumbrian and Durham coal fields respectively. The map indicates the high-pressure cable distribution over this wide area,

The accompanying curves (Fig. 2) show the development of the undertaking since 1904. It will be noticed how steady and rapid the progress has been. A notable feature of this progress is the speed with which disconnections, due to cessation of work in munition factories and other war industries, were made good by the connection of an equivalent amount of industrial power.

A SEEMING PARADOX.

We have said above that the North-East Coast is what an electricity district should be, in epitome, but this statement, although not perhaps needing qualification, requires a certain amount of explanation, owing to the interesting policy that has been followed of utilising the waste heat from the numerous coke

ovens and blast-furnaces in the area for the purposes of generating electricity, this electricity being then supplied into the system. At first sight such a policy seems a contradiction of the modern notion that generation should be concentrated in a few large stations, but in a district where so much energy is available in the form of waste heat, special treatment of the problem is required, and this can be given without affecting the truth of the general proposition. **We** need only add that the policy that has been adopted by those responsible for the fortunes of the Newcastle Company has been justified by results.

Judged as an ideal electricity supply area the North-East Coast is, however, on another score, not without its blemishes, for though a number of local authorities have adopted the reasonable policy of taking a supply in bulk from the company's network a few of



FIG. 1.—Sketch Map of the North-East Coal System.

where α is the scaling factor. The α parameter is chosen such that the model is able to learn the most informative features for the classification task.

last but not least, electric furnaces, the supply of which has special problems of its own. All these are industries in which the use of electricity plays a considerable part and it would be surprising if that development is also in great part due to the enterprise of the supply companies, all of which are now controlled by the NEWCASTLE-ON-TYNE ELECTRIC SUPPLY COMPANY, LIMITED. It would be interesting to know

the larger corporations, including especially Sunderland, South Shields and Darlington still have their own generating stations, and so form small islands in the otherwise widespread flood of the Company's activities. In addition, West Hartlepool has its own generating station, but also take supply in bulk. It is interesting to speculate what will be the eventual outcome of this individualism.

THE COMPANY'S COAL-FIRED STATIONS.

Turning to the generation side of the Company's work, a short description may be given of the two coal-fired stations in the Newcastle area, which are situated at Carville and Dunston respectively and of the coal-fired station at Philadelphia where coal, which is of such inferior quality that it is unsaleable, is used. In addition, we give some details of the 13 waste heat stations which are connected into the system at various points in the Cleveland and Durham portions of the area; this concentration being due to the fact that the coke ovens and blast furnaces are situated in these districts.

The Carville power station of the Company was started to work on July 1, 1904, the capacity then being 11 000 kW. It has since then been repeatedly extended, and has now a capacity of 101 800 kW. It is divided into "A" and "B" stations, in the first of which are installed three 6 600 kW Westinghouse turbo-alternators, and three 5 000 kW and two 6 000 kW Parsons turbo-alternators. In the "B" station there are five 11 000 kW Parsons turbo-alternators. Fig. 3 is an illustration of this station, and is indicative of the modern design which is followed throughout.

At the time it was first built Carville was distinctly novel from the fact that each main generator with its auxiliary plant formed a group running almost as an independent station. In addition, large steam turbines and water-tube boilers, of what were then the most modern type, were employed and an independent switch control house was also a feature.

THE INDEPENDENT UNIT SYSTEM.

This complete unit system has been carried through all the Carville extensions up to the present time, that is, each generating set has its own condenser, exciter and set of boilers and pumps, while on the electrical side there is also a complete set of independent 6 000/440 V transformers, connected through a switch direct to the alternator terminals, and a low-tension distribution board controlling the alternator ventilating fan motor, the exhaust valve motor, the air-pump motor, the oil-pump motor and the circulating pump motor, this last being situated in a pump-house which is built on the river-side. From each low-tension distribution board there are two circuits supplying a switchboard in the boiler-house which in turn controls circuits supplying the economiser, scraper motors, the stoker motors, the induced-draught fans and the ash exhauster. These distribution boards are arranged in pairs with interconnecting leads in such a way that if one machine is not running, its auxiliaries may be driven from one of the others. Each pair of generating sets has a common boiler-house, coal bunker, chimney and railway sidings, and, indeed, it may be said that the only things common to the whole station are the main bus-bars which are in duplicate, the circulating water system which is also in duplicate, and the railway sidings.

SWITCHGEAR AND BOILER PLANT AT CARVILLE.

The main panels in Carville "B" switch-house are of Reyrolle's latest "M" type ironclad pattern. In this design the conductors are so arranged that it is impossible to see or obtain access to live apparatus, and in its general robustness the switchgear is eminently suitable for dealing with the large quantity of power which must be handled in modern stations. The apparatus is similar to that installed at the Dalmarnock station of the Glasgow Corporation, which was described in *THE ELECTRICIAN* of Sept. 10, 1920. The original switchboard in the Carville "A" station is equipped with apparatus manufactured by The British Thomson-Houston Company, Ltd., and is of open-type moulded concrete design.

The steam-raising plant in the "A" station consists of 10 Babcock

& Wilcox cross-type marine water-tube boilers, each with an evaporative capacity of 28 000 lb., and 16 Stirling 4 drum boilers, each with an evaporative capacity of 33 000 lb. In the "B" station the steam-raising plant consists of 12 Babcock & Wilcox cross-type marine water-tube boilers, each with an evaporative capacity of 50 000 lb. The boiler pressure in the "A" station is 200 lb., and in the "B" station 275 lb., an interesting example of the way in which these pressures are being forced up. In the "B" station the steam temperature is 700°F.

DUNSTON POWER STATION.

At Dunston station the general lay-out is similar to that just described for Carville. Further details of this station will be found in *THE ELECTRICIAN*, Vol. LXXVII., p. 495, and Vol. LXXIV., p. 643. At present it contains two 7 200 kW A.E.G. turbo-alternators, one 6 250 kW Brown-Boveri turbo-alternator, one 13 200 kW Brown-Boveri turbo-alternator and three 15 000 kW Parsons turbo-alternators. The last of these is now in course of erection, making the total station capacity 78 850 kW.

The steam-raising plant consists of 24 Babcock & Wilcox cross-type marine water-tube boilers, each with an evaporative capacity

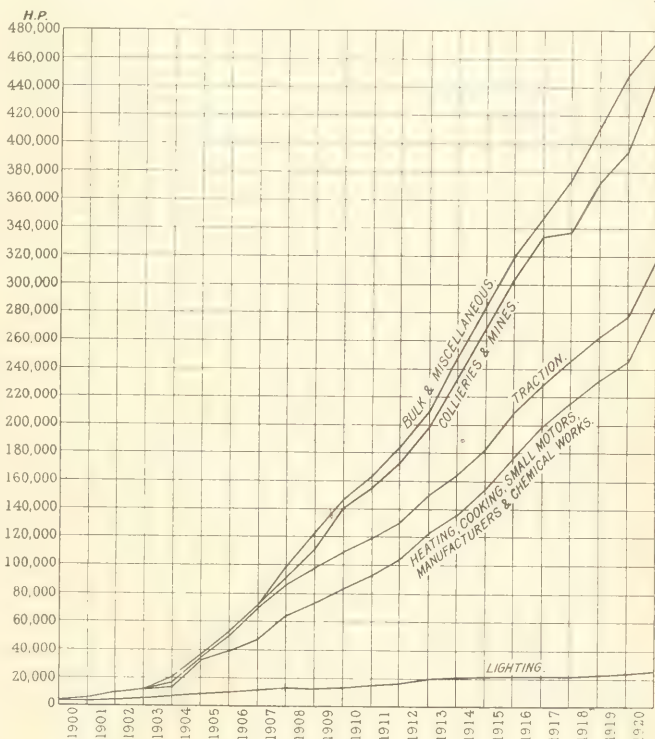


FIG. 2.—CHART SHOWING TOTAL HORSE POWER CONNECTED IN NORTH EAST COAST AREA TO DEC. 31, 1920.

of 30 000 lb., and of four Babcock & Wilcox land-type gas-fired boilers, each with an evaporative capacity of 16 000 lb. The boiler pressure in each case is 200 lb. and the steam temperature 600°F.

As an aid to generation this station is supplied with gas from a coking plant 1½ miles away through a 14 in. pipe, and is, therefore, at once a coal-fired station and a gas-fired station. It should be pointed out that Dunston is on the opposite side and higher up the Tyne than Carville and was originally designed to balance the latter in supplying the Newcastle area. The interconnection of the two stations is effected by cables through a tunnel under the Tyne constructed by the company specially for this purpose; also by cables across the King Edward and High Level bridges of the North-Eastern Railway, and finally by cables laid direct in a specially dredged trench in the Tyne river bed.

It should be further added that Dunston was one of the first generating stations to be provided with a separate switch-house. This consists of a building 135 ft. long by 33 ft. broad and 32 ft.

high. It has two floors and is divided into two divisions, one of which is devoted to the switchgear itself, while the other provides accommodation for offices and the control-room.

THE PHILADELPHIA STATION.

Philadelphia is a coal-fired station using in the main an inferior class of coal known in the district as "refuse coal," for which there is little or no demand. The station is the property of the Lambton and Hetton Collieries, Ltd., but is operated by the Newcastle Company on their behalf, the current generated being used for the supply of the colliery company's mines, the surplus current being supplied into the Newcastle Company's system. By such an arrangement the colliery company is relieved of all responsibility and inconvenience in generating their own current and at the same time, due to the station being interconnected with the Power Company's general system, they are able to obtain a standby supply in case of necessity. Philadelphia contains two 6 250 kW Howden-Vickers sets and two 2 000 kW Parsons sets. The steam-raising plant consists of 12 Babcock & Wilcox land-type boilers with an evaporative capacity of 20 000 lb. working at 200 lb. steam pressure and a temperature of 650°F. Arrangements are made whereby surplus

The first of these stations to be erected was that at Blaydon, where are installed a 2 950 kW Parsons geared turbine and a 1 200 kW Parsons' direct-driven turbine. These turbines are supplied by steam from five Babcock and Wilcox land-type water-tube boilers, with an evaporative capacity of 16 000 lbs. which are fired by waste heat and gas from 80 coke ovens owned by the Priestman Colliery Company. The gas liberated in the process of coking is most of it burnt under the ovens, the products of combustion before reaching the chimney being used to heat the boilers. The remainder of the gas not required by the ovens is burnt under the boilers in Merz type burners, which are designed to give complete combustion with a varying quality and quantity of gas without the introduction of more than a minimum of excess air. The station is fitted with cooling towers owing to the absence of a satisfactory water supply. The steam from the boilers is superheated before it is used in the turbines, and in the case of the geared turbine it is reheated before it enters the low-pressure cylinder.

PORT CLARENCE, AYRESOME, TEES BRIDGE AND NEWPORT.

The Port Clarence and Ayresome Waste Heat Stations are similar. They each contain one 2 400 kW mixed pressure turbine, which is

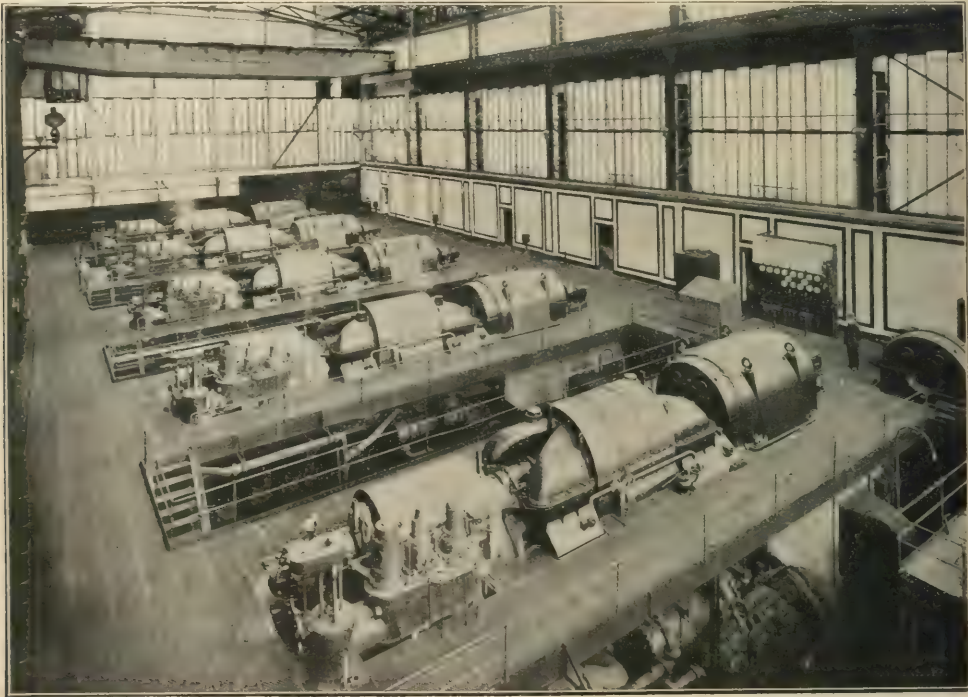


FIG. 3.—INTERIOR OF CURVILL "B" GENERATING STATION SHOWING TURBO-ALTERNATORS.

gas from the colliery companies' coke ovens, can be used under two of the boilers.

It may be added that the station is shut down at week-ends. It is also interesting from the fact that the generating plant was changed over from operating at a frequency of 50 to the standard of 40 in order to make its connection with the main system possible. For economic reasons the decision of the Collieries Company to arrange with the Power Company to operate their generating station is to be commended. By doing so they are not only able to take advantage of the resources of the supply company, but are at the same time rid of any responsibility with regard to generation, both very important factors.

DETAILS OF THE WASTE-HEAT STATIONS.

The positions of the various waste-heat stations of the Company are shown on the map (Fig. 1). With one or two exceptions they all generate at 3 000 V, whence the premises on which they are installed are supplied directly, the surplus to the main system being fed out through step-up transformers.

driven by exhaust steam from blast engines at 1½ lb. gauge. They also take any surplus steam at high pressure from the boilers in the ironworks, which are fired by blast furnace gas. At Tees Bridge Waste Heat Station there is one 1 250 kW low pressure turbine, which receives exhaust steam in the same way from the adjacent ironworks, while at Newport there is one 500 kW Brush non-condensing high-pressure turbo alternator; two 1 280 kW Westinghouse and two 1 350 kW Willans low-pressure turbo-alternators. The latter are driven by exhaust steam from blast furnace blowing engines, supplemented by the exhaust from the Brush high pressure machine.

AN INTERESTING ARRANGEMENT.

At the waste heat station situated at Messrs. Dorman & Long's steel works at Warrenby there is one 2 000 kW mixed-pressure turbine and one 3 000 kW mixed-pressure turbine. These turbines are run with exhaust steam from the cogging mill engines. The latter engines exhaust into accumulators from whence the turbines are fed. This is necessary from the fact that cogging is an intermittent operation, and were some arrangement of this kind not made

the supply of steam to the turbines would be very irregular. While the cogging engine is not at work high-pressure steam is fed direct to the turbines, the change-over from one type of supply to the other being effected by a relay, which is operated by the pressure in the accumulators in conjunction with a governor. At the iron-works of Messrs. Dorman & Long, at Redcar, are installed one 1 000 kW and one 750 kW mixed pressure turbines. These work off the exhaust from the blast engines, and also any surplus steam that

area, for only in districts where there are collieries or iron and steel works is it possible to obtain a surplus power in this way. It may be added that the largest possible size of machines is always used in these stations, so as to absorb the waste heat in the most efficient way. Where apparent exceptions to this rule are visible in the course of our description they are due to the fact that the stations have been extended owing to more waste heat becoming available than was originally estimated.

FUTURE GENERATING STATIONS.

With regard to the future development on the generating side of the company's activities, it is probable that this will take the form of the erection of further coal-fired stations, rather than in developing the waste heat idea, as the latter, though economically sound, is capable only of small and relatively limited application. At the present moment a large coal-fired station is nearing completion on the banks of the Tees, near Stockton, with a view to equalising the generating needs of the Middlesbrough area, and in the distant future it is not improbable that a further generating station will be required in the extreme north of the area to carry not only the increasing load there, but to assist in greater equalisation.

DISTRIBUTION SYSTEM.

The distribution system of the company is yet another example of the way the supply of electrical energy has developed on the North East Coast since the earliest days. The original distribution system of the company was designed for the supply of Newcastle only, and consisted of a single-phase alternating current network supplying current at 2 000 V with transformers on individual consumer's premises. As will be seen a little later on an interesting reversion to this arrangement is shortly to be employed.

With the extension of the company's activities, a 6 000 V three-phase trunk network was laid down, through which energy for use in the works and shipyards in the Newcastle area was supplied. This was stepped down to 440 V at the works, while a supply for power, lighting and traction was also given through the same network and suitable converting plant at 240 and 480 V direct current. The supply to the North Eastern Railway suburban lines, which began in 1903, is given through a system of 6 000 V three-phase cables, which feed the railway sub-stations, whence direct current at 600 V is delivered to the third rail.

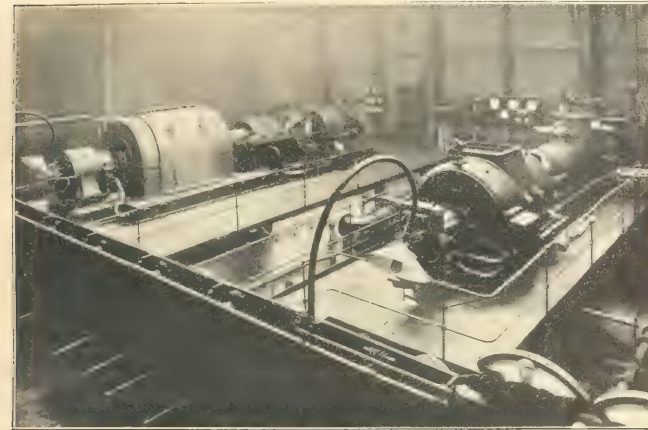


FIG. 4.—ENGINE ROOM AT BLAYDON WASTE HEAT STATION.

may be available direct from the boilers. It will be gathered from these details that the use of waste heat is not without its difficulties, and give rise to a number of problems which have to be solved more or less ingeniously.

At Shotton colliery there is one 1 000 kW low pressure turbine, which is driven by the exhaust steam from compressors and winding engines, accumulators being used in the same way as described above. The Horden "A" station is exactly the same as that at Shotton colliery, while in the Horden "B" station is one 3 000 kW turbine, which is driven by steam from boilers fired by coke-oven gas.

At Bankfoot there are two 1 450 kW and two 1 500 kW turbo-alternators. Two of these are high-pressure self-contained machines; the other two operate separately, but are inter-dependent in that one alternator is driven by a high-pressure turbine from which exhaust steam is supplied to a low-pressure turbine driving the other. At Bowden Close there are two 2 400 kW high-pressure turbines, which obtain steam from boilers fired by gas and waste heat, this fuel being supplemented by tar burnt in liquid fuel burners. At Weardale there are four 1 500 kW high-pressure turbines and one 1 250 kW Fullagar patent balanced gas engine, the latter running on coke oven gas. The steam for the turbines is obtained by burning coal under the boilers in conjunction with coke oven gas, or coke oven gas may be used separately. Typical views in a waste heat station are given in Figs. 4 and 5.

THE ADVANTAGE OF THE WASTE HEAT POLICY.

The remarks which we have made above regarding the policy adopted by the owners of the Philadelphia station apply equally to those concerns which supply the Companies with waste heat. By so doing they are enabled to enjoy the resources of a very large electricity supply concern, and are at the same time rid of any responsibility for generating the electrical energy they require. The advantages of this policy were very evident during the recent stoppage of the coal mines, those concerns which were connected to the company's mains being enabled to continue operations without anxiety regarding their power supply.

As mentioned above, the practice is made of supplying the manufacturers on whose premises waste heat stations are built with electrical power at the generated pressure, and generally it may be said that the whole problem of the proper utilisation of waste heat has been dealt with in the most efficient manner, so that the axiom that generation must be concentrated in as few a number of places as possible is subject to a very striking exception on the North East Coast. Such a policy, of course, is not of universal application, and depends entirely on the nature of the industries in any particular



FIG. 5.—6 000 V SWITCHBOARD AT BLAYDON STATION.

As time went on additional 6 000 V cables were laid over the high-level bridge at Newcastle, this pressure being found sufficiently high for the purpose as long as supply was confined to the Newcastle area and the adjacent neighbourhood. With, however, the spreading out of the company's activities into the county areas of Northumberland and Durham, the what was in those days very daring step was taken of raising the transmission voltage to 20 000 V. This step received further justification from the fact that it enabled the three

companies then operating in the counties to interconnect their systems, and thereby to obtain the greater economies and additional security of supply which result from interlinking, a policy which, as is obvious from this article, has since been followed to the fullest

The overhead system is gradually increasing in length and importance, and in the original lines is usually carried on wooden A poles, H poles being used for terminal purposes and where the lines cross roads. In all recent lines the conductors are carried by H poles



FIG. 6.—VIEW OF A TYPICAL POLE LINE ON THE NEWCASTLE SYSTEM.

possible extent. Due to the increasing demand, the companies are now arranging to adopt a still higher pressure for main transmission,

INTERLINKING ARRANGEMENTS.

Interlinking was facilitated by building a tunnel underneath the river Wear, similar to that already constructed under the river Tyne, whence an underground cable was laid to the north bank of the Tees, the actual connection of the original Newcastle and Durham company with the Cleveland company's system being effected at this point. The inter-connection which is tapped for supply where necessary, is made up as follows: 14 480 yards of 0.15 sq. inch cable and 32 000 yards of 0.1 sq. inch cable, the latter being divided into six sections, varying in length from 8 405 yards between South Hyton and Ryhope, to 1 882 yards between Easington and Shotton. Since then, as shown on the map, connection has been made the more secure by laying additional interconnector cables between Carville and Casebournes, where the generating pressure of 11 000 V of the Cleveland system is stepped up to the standard transmission pressure of 20 000 V.

Another interesting interconnector cable is that which, as will be noticed on the map, runs from Bankfoot waste heat station to Castle Eden, via Bowden Close and Spennymoor. This interconnector is run overhead, and has a total length of 45 000 yards, varying in area from 0.05 to 0.15 sq. inch, the longest section being 14 500 yards and the shortest 6 300 yards.

DETAILS OF THE TRANSMISSION SYSTEM.

The company's area is supplied through 580 miles of high-pressure underground cable and 150 miles of high-pressure pole lines. The greater part of the 20 000 V distribution network is laid underground, paper-insulated lead-covered cables being employed. The underground system is, of course, invariably employed in the city area and the surrounding congested districts and is largely used at other places, notably on the Middlesbrough interconnector. Short lengths of cable are also frequently employed where the transmission lines cross important main roads. Except on the older part of the networks, the cable is armoured, and is laid direct in the ground, being protected from damage by wooden planking when laid along the public roadway.

Where underground cables are used in the mining districts, and subsides are, therefore, not uncommon, a good deal of trouble was at first experienced owing to the copper cores of the cable buckling or pulling at the joints and breaking down, or open-circuiting in consequence. This has now been overcome by the use of a special expansion joint, known as the Vernier joint, consisting of strips of flexible copper braid laid longitudinally along the conductors and then bound tightly with copper wire, the joint being afterwards soldered. Joints made in this way greatly increase the conductivity of the cable as compared with ordinary types.

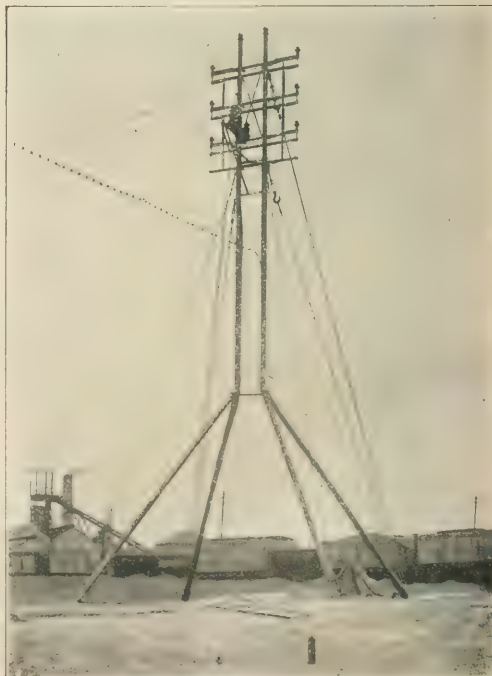


FIG. 7.—VIEW OF THE STEEL POLE LINE BETWEEN SETON BURN AND HAZLERIGG.

throughout. A typical pole line is shown in Fig. 6. In an exceptional case, however, *i.e.*, from Seaton Burn to Hazlerigg, a steel pole line is employed (see Fig. 7).

As is well known, the Newcastle company's system forms the

pioneer example of the employment of the well-known Merz-Price protective arrangements, which have been used extensively both for overhead and underground lines, while, in addition, the split conductor protective system, known as the Merz-Hunter, has also been employed, one or other of the two systems being used in accordance with the circumstances of each case.

LOW-TENSION NETWORKS.

As regards low-tension networks in Newcastle, the main lighting, power and domestic network is on the three wire continuous-current system, with 440 V across the outers. Owing to the development which has taken place during recent years, this system has now become loaded up to its safe limit, not only due to the increasing numbers of new consumers, but to the fact that existing consumers have added to their demands by employing electricity for heating and cooking purposes. This is especially the case with the local restaurants, where electric cooking is becoming common practice. To overcome this strain on the network without undue expenditure, the interesting arrangement has been made of laying a special 6 000 V three-phase interconnector cable across the centre of the city. From this cable tappings are made at convenient points, and transforming stations are there erected on the premises of large blocks of offices and shops. From these transforming stations a single-phase supply is given to the large consumers themselves and to other adjacent consumers. In this way large blocks of lighting and domestic load will be supplied, and while the power load demanded for lifts and other uses will, of course, continue as at present to be on the direct-current system, the change over will, it is hoped, relieve the existing networks to a sufficient extent to allow for a

considerable time to come existing consumers to extend and fresh consumers to be taken on to the mains. This question of distribution is, indeed, one of the most pressing the company has to face just now, and it is interesting to see the ingenious way in which it is being met.

In certain country districts, notably Bolden, Wickham, Wasington, Birtley and Ponteland, low tension distribution for lighting and other requirements is made on the overhead system, special attention being paid to carrying out the work in accordance with the amenities of the district. In some instances steel lattice poles are used throughout with this object.

TELEPHONE SYSTEM.

In order to operate the special form of system control described later, the Newcastle company has a very extensive and complete telephone system connecting up its power stations, sub-stations and administrative offices. This system consists of 550 telephone instruments and the cables forming it are invariably carried on the pole lines or laid with the transmission cables, insulated cable being used for the purpose in every case. This telephone system is laid out with a sufficient margin for future extensions, and no trouble has been experienced owing to its contiguity to the high-tension lines, as high impedance "drainage coils" have been fitted between pairs wherever inductive interferences might be expected. Troubles with the crystallisation of the lead sheath on pole lines caused by movements due to unequal wind pressure have also been eliminated by the use of a special leather hanger.

(To be concluded.)

Partial Demagnetisation: Its Influence upon the Permanency of Magnets.

By PROF. CLAUDIUS SHENFER
(Of McGill University)

If a piece of steel in the shape of a bar or horse-shoe is magnetised to saturation, and then left for several days, its residual magnetic flux is reduced to a certain extent, and this change of flux gradually becomes less and less. This phenomenon of magnetic "ageing" is to a greater or lesser degree observed when using all the known sorts of magnetic steel. There are, however, several methods of obtaining a really permanent magnet, which does not change its force with time, is insensible to mechanical shocks, weather, and the effects of external magnetic fields.

One of them is as follows: The magnet magnetised to saturation is left for several months and even years, until its molecules attain the stationary state and there is no further residual flux decrease. The second method gives a quicker result. In order to make the magnet really permanent it is exposed to artificial "ageing." For this purpose the magnet is kept in boiling water for 20 to 24 hours, and is then exposed to mechanical shocks, &c.

PARTIAL DEMAGNETISATION AND AGEING.

The partial demagnetisation of magnet, previously magnetised up to saturation, gives approximately the same effect as the artificial "ageing." This peculiarity of partial demagnetisation has been known for a long time, but the value of the relation between the loss of magnetism from shocks and the effects of outside magnetic fields and the degree of partial demagnetisation has not been up to now ascertained. The subject of the present investigation is, therefore, to find these relations, and to discover by several examples that degree of partial demagnetisation which gives the minimum loss of magnetism.

For this purpose three horse-shoe magnets of equal size, but of different chemical composition were tested.

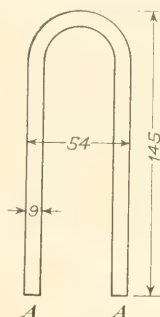


FIG. 1.

Magnets N1 and N2 were of steel and N3 of cast-iron. All samples were hardened in water.

Fig. 1 shows one of these magnets. Table I. gives the coercive force H_c , residual magnetic induction at the closed magnetic circuit B_c and residual induction on open magnetic circuit B for the test magnets. The closing of magnetic circuit of a horse-shoe magnet was affected by means of a piece of soft iron with polished surfaces.

Table I.

N of magnet.	B_c	B_c	H_c	Material.
1	11 700	7 200	43	Steel.
2	10 400	8 000	50	Steel.
3	5 700	3 000	50	Cast iron.

EXPERIMENTAL DETAILS.

The course of the experiments was as follows:—

- (1) The horse-shoe magnet was magnetised up to saturation by means of two magnetising coils set on each pole A (in Fig. 1.) of the magnet (the magnetic circuit being closed by the armature).
- (2) After the armature had been removed and the magnetic circuit having thus been opened, the residual induction B was measured by means of a ballistic galvanometer.
- (3) After mechanical shocks (the magnet being dropped ten times from a height of 1 m. on to a pinewood plank) the residual induction B was measured, and the percentage decrease in magnetic induction was found to be

$$\gamma = \frac{B - B'}{B} \cdot 100.$$

- (4) The magnet was again magnetised to saturation, and then partially demagnetised in a constant magnetic field H_d (the magnetisation and the partial demagnetisation being effected in a closed magnetic circuit). The residual induction B_d (on open magnetic circuit) was then measured, and the percentage decrease caused by the partial demagnetisation was found to be

$$\delta = \frac{B - B_d}{B} \cdot 100.$$

(5) After the same mechanical treatment of magnet as above its residual induction B_d was measured and the loss of magnetism was found to be

$$\gamma_1 = \frac{B_i - B_d}{B_i} \times 100\%$$

(6) The tests given in (4) and (5) were afterwards repeated with different demagnetising forces H_d .

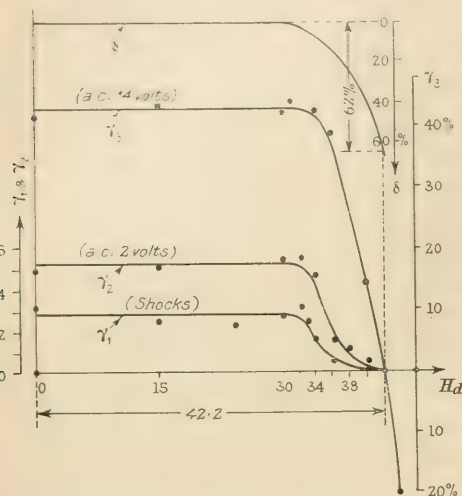


FIG. 2.—EXPERIMENTAL RESULTS FROM MAGNET No. 1.

Table II. shows results of testing the magnet N 1, and Fig. 2 is based on these data, and indicates how the value of γ and δ depend on the demagnetising field H_d .

Table II.

Demagnetising field.	After magnetisation to saturation.	After partial demagnetisation.	After shocks.	Percentage loss due to shocks.	Percentage induction decrease due to partial demagnetisation.
H_d .	B_i .	B_d .	B_d' .	δ_1 .	δ .
0	7 200	7 200	6 980	3.05	0
15	7 200	7 200	7 030	2.37	0
30	7 200	7 200	7 010	2.67	0
32	7 200	7 200	6 980	3.05	0
37	7 200	7 070	6 970	1.42	2.23
35	7 200	6 860	6 800	0.88	4.70
36	7 200	6 520	6 710	0.76	9.40
38	7 200	5 750	5 760	0.17	20.2
40	7 200	4 680	4 670	0.21	35.0
42	7 200	3 170	3 170	0	57.5

EXPLANATION OF THE CURVES.

Fig. 2 shows that curves γ_1 and δ when $H_d < 32$ run parallel to the abscissæ axis. We can explain these curves by examining Fig. 3, which represents part of a hysteresis loop and the "shear line" OA for the magnet N1; this figure shows that, after the armature has been taken off, the residual induction diminishes from $OD=11700$ to $OE=7200$, due to the demagnetising effect of "free" poles of the magnet; when demagnetising the magnet (after taking off the armature) by the field H_d , which is less than $OC=32$, the same value of residual induction $=OE$ is always obtained; but we obtain a residual induction less than OE only when we demagnetise the magnet by a field $H_d > OC$.

Curves γ_2 and γ_3 in Fig. 2 were obtained by testing the magnet in an alternating magnetic field. The alternating current (with $f=50$) was passed into the magnetising coil. The alter-

nating current pressure being in one case $v=2$ V (curve γ_2), in the other $v=14$ V* (curve γ_3). During this test in the alternating field, the magnetic circuit was open.

It is obvious from Fig. 2 that curves γ_2 and γ_3 cross the abscissæ axis at the same point $H_d=42.2$; after this, they pass into the region of negative ordinates; i.e., by partially demagnetising the test piece in a magnetic field of $H_d > 42.2$ and then exposing the magnet to the effect of an alternating

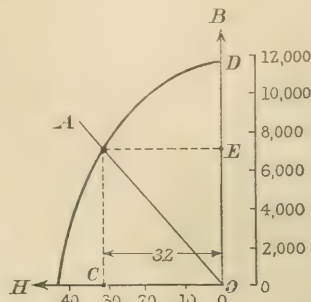


FIG. 3.—HYSTERESIS LOOP OF THE MAGNET N1.

field we obtain not a decrease in the residual induction, but an increase. With demagnetising force $H_d=42.2$, the value of the residual induction does not, however, change.

INSENSIBILITY TO MECHANICAL SHOCK.

It follows, therefore, that if we wish to make the magnet N1 quite insensible to mechanical shock and the effects of outside magnetic fields, it should be partially demagnetised in a magnetic field of $H_d=42.2$. Fig. 2 shows that with $H_d=42.2$ there is a considerable decrease in residual induction, as compared with the residual induction at saturation, e.g., $\delta=60$ per cent. (approximately).

Fig. 4 represents curves γ_2 and γ_3 obtained for magnets N2 and N3 (with currents of $v=2$ V and $v=14$ V). From

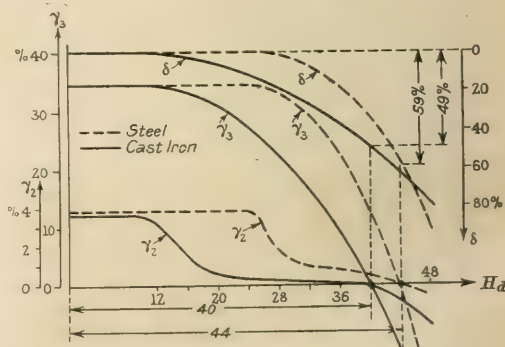


FIG. 4.—MAGNETS No. 2 AND No. 3.

these we see that for the magnet N2 curves γ_2 and γ_3 cross the abscissæ axis at a point $H_d=44.0$, at which $\delta=59$ per cent. For the magnet N3 we have $H_d=40.0$ and $\delta=49$ per cent.

Fig. 5 shows the change of residual induction resulting from the effect of the alternating field at various strengths (magnet

* Knowing the number of turns on the magnetising coil $w=1020$, the area of cross-section of the magnet $\theta=3.15$ cm², and ignoring the inductive and non-inductive resistances of the magnetising coil, we find the amplitude of the alternating magnetic induction as follows:—

$$B = \frac{v \cdot 10^8}{4.44 f \cdot w \cdot \theta} = \frac{2 \cdot 10^8}{4.44 \cdot 50 \cdot 1020 \cdot 3.15} = 282.$$

In the same manner, for $v=14$ V, we find

$$B=1950.$$

N1). In this curve the abscissæ represent the value of alternating current voltage and the ordinates—the corresponding residual induction changes :

$$\gamma = \frac{B_d - B'_d}{B_d} \cdot 100;$$

Curve 1 was obtained with the magnet demagnetised in the field $H_d = 40$, Curve 2 with $H_d = 43$, curve 3 with $H_d = 44$ and Curve 4 with $H_d = 45$.

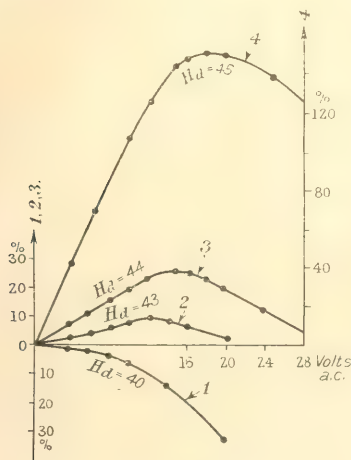


FIG. 5.

From Fig. 5 it appears that the more the tested magnet is demagnetised the greater is the increase of the residual induction. Thus, with $H_d = 44$ according to curve 3, the maximum increase of residual induction is equal to 27 per cent., but with $H_d = 45$ (curve 4) this increase amounts to 150 per cent.

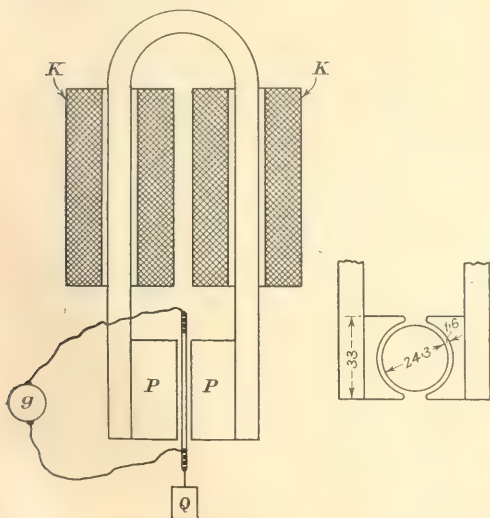


FIG. 6.

FIG. 7.

PRACTICAL DEGREE OF PARTIAL DEMAGNETISATION.

We are faced now by the question, to what degree we must partially demagnetise the permanent magnets used in electric measuring instruments (galvanometers, voltmeters, ammeters, &c.).

In order to answer this question the author made the following tests : (1) The horse-shoe magnet N1 was magnetised to saturation in a closed magnetic circuit; (2) the magnetic circuit was opened (*i.e.*, the armature taken off); as a result the magnet was partially demagnetised due to the effect of "free poles"; (3) the iron pole-shoes $P-P$ (Fig. 6) were screwed to the magnet. The air-gap and the size of pole-shoes were so arranged that the average magnetic resistance for the tested magnet was approximately equal to that of the galvanometer shown in Fig. 7. (4) Afterwards the magnetic flux Φ_1 of the magnet was measured. For this purpose the weight θ was dropped and the winding, consisting of 20 turns fine wire, was connected with the ballistic galvanometer g (Fig. 6). (5) An alternating current was passed for 30 secs. through the magnetising coil $K-K$, the pressure being $v=2$ V and the magnetic flux Φ_2 was again found by the method described above.

Table III. illustrates the results of these tests.

Before action of alternating current.	After action of alternating current.	Per cent.
Φ_1	Φ_2	$\frac{\Phi_1 - \Phi_2}{\Phi_1} \cdot 100$
23 300	23 400	-0.43

This table shows that after the "molecular percussions" caused by alternating current, and, with the given testing

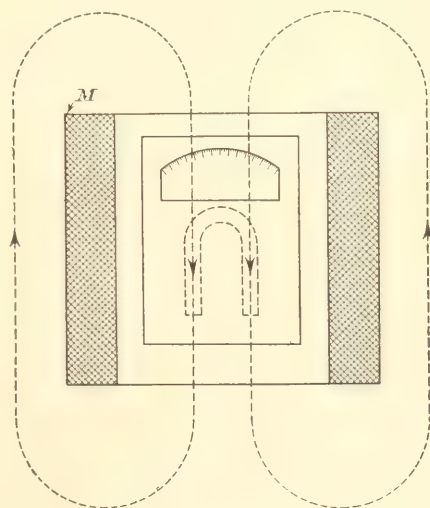


FIG. 8.

conditions, there is a slight increase in the magnetic flux of the magnet.

It follows from this test that many magnets used for measuring instruments with a partially closed magnetic circuit, as shown in Fig. 7, should not be partially demagnetised.*

In order to verify this statement the author made the

* It is presumed in this connection that the size of magnets is not very different from those shown in Fig. 1 and 7, and that the magnetic properties do not vary considerably from those of magnet N1 (Table I.). The author could not test magnets of other kinds and size; however, it is supposed that in most cases previous demagnetisation by means of direct-current of magnets used for measuring instruments, is rather useless than useful. It seems that among firms manufacturing measuring instruments there will hardly be found two which hold a similar opinion on this question. Thus, after taking a magnet from the galvanometer manufactured by one firm (Siemens-Halske, Berlin), the author found its demagnetisation equal to $\delta = 11.6$ per cent., while a galvanometer made by another firm (Kaiser & Schmidt, Berlin) $\delta = 30$ per cent.

following tests:—(1) Magnet N1 was magnetised to saturation (with the magnetic armature closed). (2) The magnetic circuit was opened (i.e., the armature was taken off). (3) The magnet was placed in the galvanometer to which it belonged. The magnetic circuit as partially closed was shown in Fig. 7. (4) Immediately after erection this galvanometer was calibrated and it was found that at a certain terminal voltage the galvanometer showed $n=100$ scale divisions. (5) The galvanometer was put into a large coil M (Fig. 8) through which an alternating current* was passed for 30 sec., and a slight increase in the magnetic flux of the magnet was found on calibrating the instrument. At the same terminal voltage

as before the galvanometer did not show $n=100$, but $n=101$ scale divisions.

The method described may be used for the artificial "maturing" of magnets employed for measuring instruments. As a rule, the magnets used in measuring instruments must be closed before the calibrating of the instruments for a certain, sometimes a considerable, time in order that they shall attain the state of equilibrium at which there is no further change of magnetic flux.

The "maturing" time of magnet may, however, be considerably reduced by means of the effect of the external alternating magnetic flux, as shown in Fig. 8.

Imperial Wireless Station at Leafield, Oxfordshire.†

By E. H. SHAUGHNESSY, O.B.E.

The Leafield Wireless Station was originally planned for a 300 kW spark installation in 1913. The site was obtained and 10 300 ft. tubular steel masts were erected by the Marconi Company in 1914, after which work on the station was suspended. During the period up to 1918 the masts were utilised to support aërials for reception and for other experimental purposes. Early in 1919, the question of the completion of the English and Egyptian stations came under review. The great development of continuous wave generators which had taken place made it clear that high power spark installations were obsolete and the methods of high-frequency generation, such as the alternator, the time spark and the Poulsen arc then available, were investigated. The arc had been developed in America, and by the Admiralty, the Marconi Company, and Mr. C. F. Elwell in this country. Several powerful installations had been erected by Mr. Elwell in France. After a careful and continuous watch of the performance of various trans-Atlantic services and the inspection of several high-power continuous wave stations it was decided that the most suitable high-frequency generator was the arc. Rough plans and estimates for equipping the English and Egyptian stations with suitable power plant, arc generators and aërials, &c., were prepared by the Post Office Engineering Department in April, 1919, and authority to proceed with the work was obtained about July of that year. Detailed specifications were prepared, tenders invited and the orders for power plant were placed with various firms in November and December, 1919, and for the wireless plant in September, 1919. Under these orders the plant should all have been delivered last year, but owing to the moulders' strike and general delays in the makers' works the plant for the English station has only recently been delivered and its erection is now nearing completion, but the power plant for Egypt has not yet been despatched. As much valuable information will be obtained from the working of these stations the delay in the completion is very disappointing.

DETAILS OF THE SITE.

The English transmitting station lies near Leafield, Oxon., on an open tableland about 600 ft. above sea level. The main buildings, constructed of local limestone, are the power house, containing the boiler room, turbine room, condenser room, workshop, office, bath-room, &c., and, about 150 ft. away, the wireless building, in which on the ground floor are the switch room, main store room and general offices, and on the first floor the arc room and the inductance room.

* Dimensions of coil were as follows: inside diameter 245 mm., length 210 mm., number of winding 200; the strength of alternating current in col. was 5 amperes.

† From the "Journal" of the Institution of Post Office Electrical Engineers, to whom we are indebted for permission to reproduce the accompanying illustrations.

On the site are also seven bungalows for the accommodation of the station staff.

The source of the water supply is a spring in a valley about a mile and a quarter distant from the station, to which the water is pumped by oil engine-driven pumps; when the equipment is completed these pumps will be motor-driven and controlled from the station. The water is rather hard and is treated in a Lassen & Hjort softener before being fed to the boilers.

COAL SUPPLY.

The isolated position of the station necessitates holding an ample reserve of coal. From the main stack a supply sufficient for some

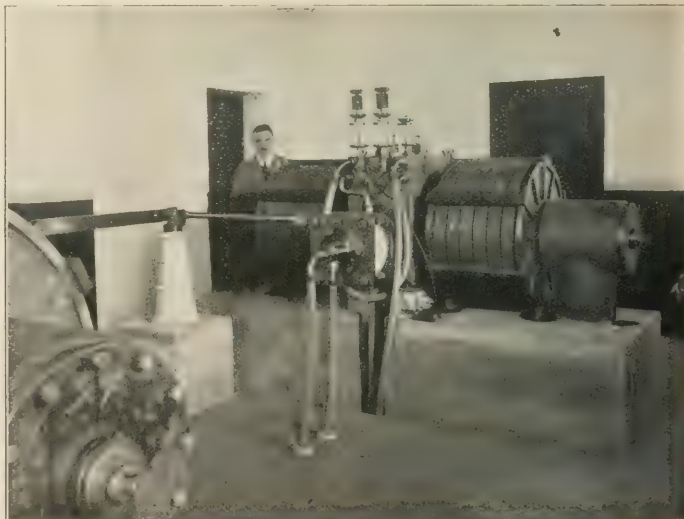


FIG. 1.—VIEW OF THE 250 kW ELWELL ARC AT LEAFIELD.

days' requirements is taken to a bunker, whence sliding doors open direct on to the firing floor of the boiler house, in which are installed two hand-fired land type Babcock & Wilcox boilers fitted with integral superheaters. Each unit is rated to evaporate 10 000 lb. of water from and at 212°F., and is capable of meeting the demands of the whole of the prime movers. The working pressure is 200 lb. per square inch; the steam supplied to the turbines is superheated 200°F., but saturated steam can also be drawn from the boilers for the water softener and the steam-driven feed pump. A motor-driven feed pump is also provided, and the feed piping is in duplicate. The products of combustion leaving the boilers pass through a horizontal brickwork flue, 7 ft. by 3 in., to the foot of a brick shaft 60 ft. high and 4 ft. internal diameter at the top. A motor-driven Sirocco fan is installed with dampers so that induced or natural draught can be used as desired: the fan motor is controlled from the firing floor. The steam main, equipped with the usual control

valves, runs behind the boilers, and branch pipes from it pass through the wall to the turbines on the first floor; the turbine room floor has been specially constructed to obviate vibration when the turbines are running.

GENERATING PLANT.

The turbo-generators with their controlling switchboard, condensers, air pumps and other auxiliaries were installed by Messrs.

the hot well through a Lea recorder. The boiler feed is taken from the hot well so that losses only have to be made up from the water supply.

As all water used has to be pumped to the site, it is essential that economy be exercised with the circulating water for the condensers, and to this end a cooling pond has been provided. The pond, which was constructed by Messrs. Groves to drawings prepared by the P. O.

Engineering Department, has a capacity of about 1 000 000 gallons. The circulating water is drawn from it and after passing through the condensers and becoming heated in the process is returned to the pond, but a portion is so separated from the circulating pump intakes by baffle walls that before the discharged water can again reach the suction pipe it must travel over a long and tortuous path, becoming cooled in the process. The main switchboard in the turbine room controls the whole of the generated energy; armoured cables from it carry the current for the arcs and auxiliaries to a two-panel board in the switchroom of the wireless building, at which Messrs. Allen's work ends.

THE WIRELESS EQUIPMENT.

The wireless equipment, consisting of two 250 kW arcs and auxiliaries, was installed by Messrs. C. F. Elwell, Ltd. In outline the arc method of generation of continuous waves consists of an oscillatory circuit shunted across an arc fed by continuous current.* The arc burns between a copper anode and a carbon cathode in a powerful magnetic field and a hydrogenous atmosphere kept cool by water jacketing the chamber in which the arc burns; the anode is also water-cooled. The arc burns between the upper edges of the electrodes, and to equalise wear the carbon is kept in continuous slow rotation by a small motor. Fig. 1 is a view of the anode side of one of the Leafield arcs. A steel yoke passes through the concrete base, and adjustable pole pieces specially shaped at the inner ends

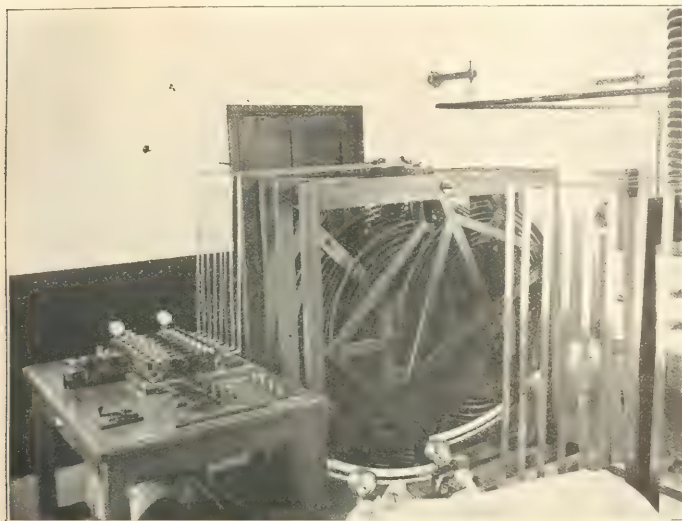


FIG. 2. —THE CREED KEY AND SIGNALLING APPARATUS.

W. H. Allen, Sons & Company, Ltd. Electrical energy is generated at two pressures, both continuous current; 750 to 1 000 V for the arc supply, and 220 V for the auxiliary motors and for lighting. Duplicate units are installed for each pressure and the switching arrangements allow the sets to be run in parallel when necessary. The turbines are of the Curtis type and run at 6 000 revs. per min. They are geared down to 650 revs. per min for the 1 000 V sets and to 1 000 revs. per min. for the 220 V sets. The 1 000 V sets are rated at 250 kW, and consist of two 500 V machines coupled mechanically and joined electrically in series, mounted on a common bedplate. To prevent possible trouble due to high-frequency effects getting back to the machine from the arcs, the 1 000 V generators are insulated from their bedplates and are driven through insulating couplings; this insulation has been tested with 5 000 V A.C. The machines are excited from the 220 V supply. The 220 V units are of 60 kW capacity. They are compound wound and the usual equaliser connections are provided for parallel running.

The exhaust from each of the 250 kW turbines is joined direct to a surface condenser with 600 sq. ft. of cooling surface. For each condenser a centrifugal circulating pump, an Allen Edwards air pump and a condensed steam force pump, all motor-driven, are provided, and the piping is so arranged that any combination of condenser, circulating pump and air pump desired can be obtained; the exhaust from either 60 kW turbine can be passed through either condenser. Automatic atmospheric exhaust valves are fixed on all the sets, so that should the vacuum fail non-condensing working is reverted to immediately. The steam consumption is measured by passing the condensed steam on its way from the force pump to

extend from the enlarged heads of the upper ends of the yoke limbs (in which the pole pieces slide), through gas-tight glands to the interior of the chamber seen in Fig. 1. The magnetic field is pro-



FIG. 3. —GENERAL VIEW OF THE AERIAL MASTS.

extend from the enlarged heads of the upper ends of the yoke limbs (in which the pole pieces slide), through gas-tight glands to the interior of the chamber seen in Fig. 1. The magnetic field is pro-

See THE ELECTRICIAN, Vol. LXXV., p. 648, December 31st, 1920.

duced by current flowing through the coils of copper strip encircling the pole pieces, seen to right and left of the chamber. This exciting current is the arc supply current in one of the windings, but through

of 40 cubic ft. capacity, driven by 9 h.p. D.C. motors, with automatic starters, has been provided and installed by the department. The compressors are started from the arc controller. The cooling water for the areas is obtained from the cooling pond, two motor-driven pumping sets having been installed by the department for this purpose. These pumps are also started automatically from the arc controller. In addition, the department have provided a low-pressure air supply for cooling the arc field coils.

A separate aerial supported on 75 ft. poles is to be used for reception at Leafield. It is necessary for this aerial to be earthed and the receiving gear protected during transmission. This operation is performed by a remote controlled switch, designed by the department, which is operated by the stop on the arc controller immediately preceding the stops operating the 1 000 V contactors. The circuit of the control wires for these contactors passes through the "send-receive" switch, so that it is impossible to start the arc until this switch has operated.

The main aerial system (Fig. 3) is supported by 10 tubular steel masts each 300 ft. high. The earth wires are buried at a depth of about 9 in. The wires were laid by the Oxford Steam Plough Company, using a modified drainage plough. The connections from the arc cathodes to the main earth are made by broad copper strips passing down outside the wall to just below ground level, where they join a similar strip running right round the building close to the walls. The radiating earth wires are soldered to this strip



FIG. 4.—THE AERIAL LEAD IN.

the other either the arc supply or current from a low-voltage generator, which will supply up to 500 A, can be passed. The hydrogenous atmosphere is produced by dropping alcohol into the arc from the sight feed lubricators on the top of the chamber; see Fig. 1, in which the cooling water pipes are also visible.

The cathodes of the arcs are earthed, and the aerial oscillatory circuit is, starting from the anode, to key inductance, thence to the lower end of the aerial tuning inductance (which consists of stranded wire with the individual wires insulated from each other to prevent losses from skin effect with the high-frequency currents) from the upper end of this inductance through the leading-in insulator, which, to ensure adequate insulation, is fixed in the centre of a large plate of glass to the aerial system; the capacity to earth of the aerial completes the shunt circuit.

SIGNALLING ARRANGEMENT.

For signalling, a spacing wave is to be used, that is, during the spaces of the Morse signals energy continues to be radiated, but on a wave-length differing from that used for the marks. The change of wave-length is effected by varying the inductance of the keying inductance in which is a spiral of copper strip in series with the aerial. On each side of this spiral are two other spirals, adjustable in position and inductively coupled to it. During signalling these side spirals are shorted in one position of the operating key and opened in the other; the effective inductance of the central spiral is varied according as they are open or shorted and the emitted wave length changes with the change of inductance. The actual short-circuiting is done by the special Creed key seen in Fig. 2.

SAFEGUARDING DEVICES.

The striking of the arc and the necessary adjustments of the apparatus are done by an arc attendant, who has on a control cabinet in front of him instruments indicating the conditions through the installation and means of varying these conditions by remote control. All changes in the 1 000 V circuits are done through contactors in the room below, operated at 220 V from the control position. Numerous automatic safeguarding devices are fitted. To maintain a steady current in the arc D.C. supply, choke coils are provided; the field winding acts on the earthed side, while the coil is on the positive side.

The wave-length is varied by changing the amount of the main inductance in circuit, tapping points being cut into it for coarse adjustments, a sliding connection on a length of copper tube at the foot of the coil giving fine adjustment.

For operating the Creed keys and extinguishing arcing at the contacts an air supply furnished by two Reavell air compressors

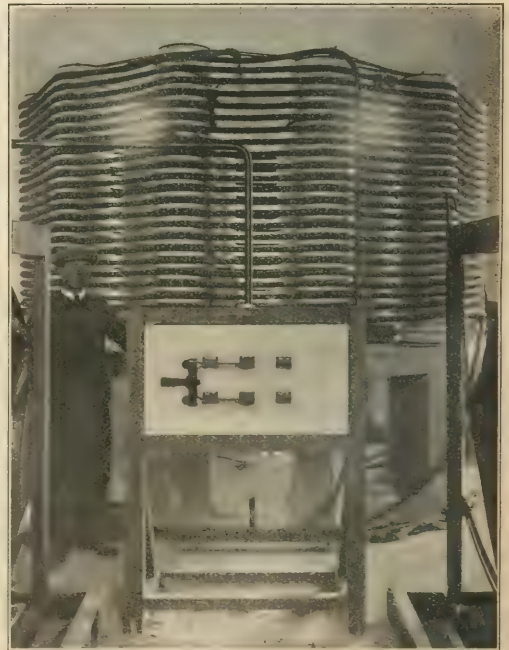


FIG. 5.—AERIAL TUNING INDUCTANCE.

surrounding the building. Incorporated in the floor of the arc and inductance rooms, and extending over the whole of their area, is a zinc plate joined to the main earth system, thus screening the plant in the ground floor rooms from high-frequency effects. Figs. 4 and 5 show the aerial lead in and the aerial tuning inductance respectively.

Up-to-Date Industrial Switchgear.

The successful design and construction of industrial switchgear necessitates the fulfilment of certain special conditions imposed by the character of the work which has to be performed, and by the environment in which this work is to be carried out. To take only a few of these conditions we may instance fool- and mistake-proofedness, weather-proofedness, dust-tightness, simplicity, strength and compactness. It is obvious that any one of these may be obtained by the expenditure of a little thought and care in design and manufacture, and it is not insuperably difficult to obtain them in combination, at, we hasten to add, a price only. In fact we are faced in this connection with an old economic problem stated in a new way: How best to combine a maximum of those good qualities which go to make a reliable piece of apparatus, to manufacture that apparatus satisfactorily and to sell it at a price which will commend its ready acceptance.

Some of the designs of switchgear recently put on the market by Mr. GEORGE ELLISON seem to fulfil these conditions in no uncertain way, and some details of the design and construction of his latest starters will therefore be of interest to our readers. We may first describe the auto-transformer starting panel for three-phase squirrel-cage induction motors, which is illustrated in Fig. 1. As will be seen this panel is ironclad, and totally enclosed. It is suitable for mounting either on the wall or on the floor, and being dust-tight, weather proof and mistake proof fulfils completely the requirements of the Factory and Mining Acts.

ESSENTIALS OF AN AUTO-TRANSFORMER STARTER.

An auto-transformer starter consists essentially of an auto-transformer and a change-over switch. The heavy current taken at starting is supplied at a low pressure from the tappings of the transformer. When the motor reaches working speed the transformer is disconnected, and the motor is connected to the mains by means of the change-over switch. This sounds simple, but is not quite so simple as it sounds. For in order that, if desired, there shall be

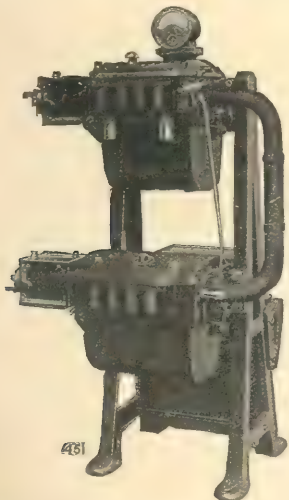


FIG. 1.—EXAMPLE OF 125 H.P. THREE-PHASE 50-CYCLE TRANSFORMER AND STARTING PANEL FOR SQUIRREL-CAGE INDUCTION MOTORS.

full protection of the motor in both the starting and running positions, a free handle automatic breaker is necessary in addition to a non-automatic change-over switch. This breaker is, of course, fitted with time lags which permit a reasonable overload setting, and a sufficiently retarded operation. The transformer obviously must be highly rated for economic reasons, while on the other hand the switch must not heat up under any load, and must be arranged to give a proper extension of the arc on heavy loads without the formation of explosive vapours.

To square these somewhat antagonistic conditions Mr. Ellison employs independent units as illustrated, proportioning each unit adequately for the duty it has to perform. In this way not only are inspection, repair and cleaning facilitated, but economy in oil is achieved, and the risk of explosion is reduced to a minimum, while the tappings can be changed or the transformer removed entirely,

while the plant is in service. It must be added that this is not the cheapest way of solving the problem, but it provides an arrangement which we think should appeal to the careful purchaser by providing long life, absence of trouble and low maintenance at the expense of some addition in first cost. It really seems worth it.

STARTER FOR SLIP-RING MOTORS.

Starters for slip-ring motors are also made, and a typical panel for this class of work is shown in Fig. 2. What we have said about the starters for squirrel-cage motors apply equally to this equipment.

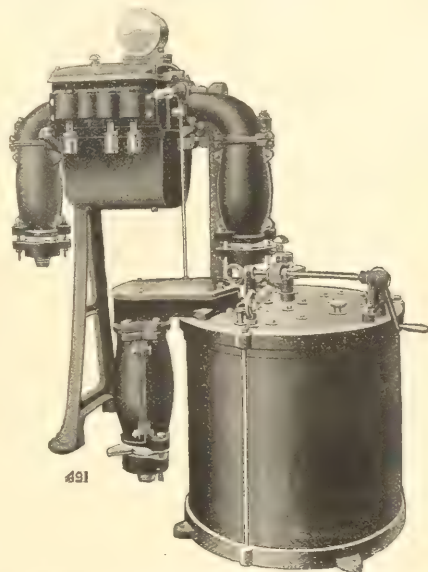


FIG. 2.—CIRCUIT BREAKER AND ROTOR STARTER WITH SEALING BOX FOR ARMoured CABLES.

The breakers and starter are mechanically interlocked in a number of ways, while where the breaker and starter are remote from each other electrical interlocking is provided. The systems of interlocking used provide not only that the breaker shall be closed before the starter is operated and that the breaker cannot be put in except when the starter is in the "off" position, but allow for a proper operation of the brush-lifting gear, that correct sequence in the various operations is followed, and that the operator completes a series of operations once he has started upon them. This question of interlocking and correct sequence is most important in many industrial plants, and the care and thought which has been given to the subject by Mr. Ellison ensures that the apparatus works properly and safely however unskilled the personnel under whose charge it may be.

SOME ELECTRICAL DETAILS.

On the electrical side this apparatus is worth some study. For instance, all the parts are standardised, and are completely interchangeable. The contact bushes are retained securely in the on position until released by hand or by one of the automatic releases. All the contacts are mounted on slate, and are bushed and insulated with mica, the brushes being operated by a steel rod which is covered with mica or "ardwenot" insulation. The fixed and moving contacts are separately fixed to their supports, are readily adjustable for wear and are easily replaced. The arcing points are well submerged beneath the surface of the oil, and there is ample space for connections to external apparatus, the leading-in cables being connected directly to accessible terminals by disc clamps or special clamp terminals which cannot loosen readily, and which have an ample contact surface. The operating lever is a massive gunmetal handle. Its travel is limited by spring stops, and no stresses are thrown on the contacts. The automatic releases are operated during the closing operation when the sparking tips meet, and the free handle breaker main contacts are prevented from completing the circuit unless the conditions are correct.

AN OIL-COOLED ROTOR STARTER.

A type of oil-cooled rotor starter made by the firm is shown in Fig. 3, the starter being removed from the tank so as to show the resistance units. In this case the moving contacts consist of heavy

copper rollers which are free to rotate and swivel on copper ball joints carried on a brass spiral. They are forced against the fixed contacts by three strong spiral springs so locked that each roller is positively controlled, and thus easily surmounts the roughness on the dial without relieving the pressure on the others. In the design of these starters the question of contact has been carefully considered, with the result that temperature rise does not normally exceed 20° F. Additional claims for this type of contact are that it cannot stick, it is suitable for the most frequent operations, the wear is distributed

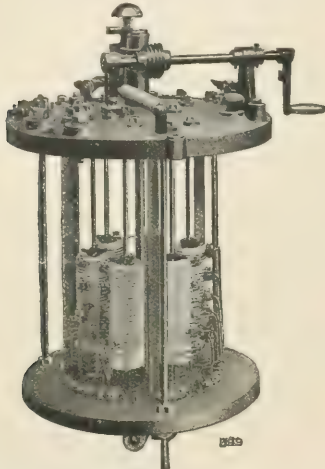


FIG. 3.—OIL-COOLED ROTOR STARTER REMOVED FROM TANK TO SHOW RESISTANCE UNITS.

over the whole surface and its life is very long, because it can be adjusted from time to time. The resistance elements consist of a wire of high-resistance alloy with a negligible temperature coefficient. This is wound on strong threaded stoneware cylinders which support it throughout its length, and effectually prevent short circuits between adjacent turns. The complete starter can be removed bodily from the tank by loosening back of three nuts.

These few examples of Mr. Geo. Ellison's productions show, we think, that he has the root of the matter in him.

The Electrification of Railways.

THE Final Report of the ELECTRIFICATION OF RAILWAYS ADVISORY COMMITTEE, which was appointed by the Minister of Transport in March, 1920, has now been published. The original terms of reference dealt with questions of standardisation of system and equipment only, but were subsequently extended to include a consideration of regulations for limiting the drop of potential in uninsulated conductors used on electric railways.

The report begins by confirming the recommendations contained in the Committee's interim report*, and then summarises the scope of the evidence given subsequently to the publication of that document. Besides hearing railway engineers, both British and foreign, evidence was taken from Sir Frank Dyson and Mr. F. E. Smith on the effect on magnetic instruments of the operation of electric railways near Greenwich Observatory and the National Physical Laboratory.

With regard to contact rail collection it is considered essential for the interchange of electrically-operated trains that the contact rails should be placed so as to enable current to be collected by the same trains both on 1500 V and 600/750 V railways. Though the top contact rail is now in general use on low-voltage systems the Committee point out that the under contact type has certain advantages in regard to the accumulation of ice and snow and the safety of men working. And as shoes can be designed to operate on either system it is not considered desirable to recommend the exclusive use of either type of rail, so as to leave the way open for future improvements.

STANDARD POSITION OF CONTACT RAILS.

The Committee consider that a standard position outside the tracks should be defined within certain limits for the contact surface of the contact rails in relation to the position and level of the running rails, and recommend that in respect to new electrically-operated lines and extensions to existing lines the following regulations should be issued

for securing the interchangeability of running: (i.) The contact surface shall be in the horizontal plane. (ii.) The gauge measured between the centre of the horizontal contact surface of contact rails and the gauge line of the nearest rail of the corresponding track shall be 1 ft. 4 in. (iii.) The vertical height of the contact surfaces above the plane of the top table of the running rails shall be—(a) for top-contact rails, 3 in.; and (b) for under-contact rails, 1½ in. (iv.) The vertical height of the contact rail (including, where required, the protection over the top of the rail) above the plane of the top table of the running rails shall be such as to provide the necessary clearance from the load gauges from time to time in use. (v.) The under-contact rail, where employed, shall provide for the engagement of the contact shoe being made from the side nearest to the running rails. (vi.) Above the level of the under-contact surface (iii.) (b) no part of the contact rail construction shall be at a less distance than 1 ft. 1½ in. from the gauge line of the nearest track rail, and below the level of the under-contact surface (iii.) (b) at a less distance than 1 ft. 7½ in. from the gauge line of the nearest track-rail. (vii.) The vertical distance between the under side of any contact shoe in the free position and the plane of the top table of the running rails shall not be less than 1½ in. The Committee recommend further that existing equipments which do not conform to the above may be continued in use and may, subject to the approval of the Minister, be extended.

STANDARDISED OVERHEAD COLLECTION.

In respect to overhead collection it is essential for the interchange of electrically-operated trains that the position of the overhead live wire and the clearances between the live wire and the fixed and the moving structures, as well as the width and operating range of the collector gear, shall be such that any train may collect current from all electrically-equipped railways. The Committee therefore recommend that in respect to new lines and new electrical equipment of existing lines the following regulations should be issued for securing interchangeability of running: (i.) The standard clearances shall be: (a) Between the underside of any overhead live wire or conductor and the maximum load gauge likely to be used on the line—(1) in the open, 3 ft.; (2) through tunnels and under bridges, 10 in. (b) Between any part of the structures and the nearest point of any live overhead wire or conductor, 6 in. (c) Between rail level and overhead conductors—(1) at accommodation and public road level crossings, 18 ft.; (2) at places where there is a likelihood of men in the conduct of their duties having to stand on the top of engines or vehicles, 20 ft. (d) Between any part of the collector gear and any structure, 3 in.

The Committee recommend that in the case of the electrical equipment of existing lines the dimensions stated in (a) (2) and (b) may each be reduced to 4 in. as a minimum, that cases of exceptional constructional difficulty may be considered by the Minister as special cases, and that existing equipments which do not conform to the above may be continued in use. (ii.) The horizontal distance of the contact wire from the plane through the centre line of the track and perpendicular to the surface of the track rails shall be within the following limits: (a) At a height of 18 ft. above rail level, 1 ft. 3 in.; (b) at a height of 4 in. above the maximum load gauge likely to be used on the line, 1 ft. 9 in. (iii.) The weight and construction of the contact wire and supports shall be suitable for the passage of collectors exerting an upward pressure of from 25 lb. to 40 lb. (iv.) The width of the renewable contact surfaces of the collectors at right angles to the track shall not be less than 4 ft., and the extreme width over the horns of the collectors shall not exceed 7 ft. 6 in. The Committee recommend that in the case of those railways that have already equipped any or all of their lines with overhead contact wires which do not conform to the above recommendations, the employment of these may be continued in use and may, subject to the approval of the Minister, be extended.

NO FURTHER REGULATIONS AT PRESENT.

The Committee confirm the views expressed in the Interim Report "that such regulations should put no avoidable difficulties in the way of the adoption in future, with the approval of the Minister, of any improvements in methods or appliances which may from time to time become available with increasing knowledge and experience," and do not consider it desirable in the interests of railway electrification, that further regulations should be issued for the time being.

With regard to limiting the drop of potential the Committee are of opinion that it is not desirable that regulations should be issued to limit the drop of potential in an uninsulated return conductor on electrically-operated railways, and that in cases where it is found impossible to dispense altogether with the present obligations which are imposed upon railway companies by the protective clauses inserted by the Board of Trade and other authorities into the Acts of the companies, these obligations should be specified definitely in each particular case.

The total cost of the Committee was £1 875. 7s. 7d.

* See THE ELECTRICIAN, Vol. LXXV., p. 421, Oct. 8, 1920.

Guided Wave Telephony.*

By CHAS. A. CULVER.

Among the various inventions marking new epochs in various fields of science, the author mentions the guided wave or high-frequency multiplex system of telephony or telegraphy, due to General Squier. Although prior to his invention, several telegraph messages could be simultaneously transmitted over a single circuit, and certain efforts had been made to develop syntonic multiplex telegraphy, it is to General Squier that the possibility of carrying 10 or more two-way simultaneous telephone conversations over one electrical circuit is due.

The fundamental principle underlying the now familiar Squier system is that of high-frequency resonance, coupled with the use of an integrating translator, and the author reproduces some of the original diagrams showing the method employed. Originally a high-frequency alternator was adopted as the source. In the circuit there are the elements of a radio-telephone installation, with the essential difference that, in place of connections to earth and the usual antenna, we have connections to the two wires constituting a physical pair. Electromagnetic waves of predetermined length are guided by the metallic circuit instead of radiating in all directions from the antenna, and the efficiency is correspondingly increased.

DIFFICULTIES WITH THE POWER UNIT.

One of the chief factors that tended to delay practical application of the new system was the nature and cost of the power unit. It was also feared by Dr. Jewett that extremely great attenuation would occur with the comparatively high frequency used. The position was altered by the introduction of the audion as a generator of high-frequency currents, and the author next describes the application of this device. Various methods of using the three-electrode tube as a modulating agent are also described. High-frequency multiplex telephony may be effected by bridging across a telephone pair several transmitting organisations, each transmitting unit being adjusted to deliver a voice-modulated high-frequency current of fixed periodicity. Corresponding receiving units are bridged across the same physical circuit, each tuned to resonance with a certain transmitting set. Speech may be carried on over any one, or simultaneously over all these super-channels. Each conversation utilises a certain carrier frequency (two such frequencies being required on a two-way conversation). If frequencies are properly selected there is no mutual interference or cross-talk; nor are guided wave conversations heard in the ordinary physical telephone apparatus. Similarly, transmission over the latter is inaudible in the multiplex equipment.

The maximum number of two-way guided wave channels that can be operated simultaneously depends on the electrical constants of the line, and on certain limitations of the multiplex system. Beats due to interference between two frequencies must be eliminated. The difference in frequency should not be less than 20 000; thus, if one carrier frequency is 100 000, the other must be at least 120 000, or not more than 80 000. Theoretically, 20 000 should be the lower limit for a fundamental carrier frequency, but in practice 15 000 may be used. The upper limit has not been determined, 500 000 is quite practicable, and possibly 1 000 000 could be used. Assuming limits of 15 000 and 500 000 the traffic-carrying capacity of a line could be increased at least sixfold; possibly in the future this figure may be again doubled.

NATURE OF METALLIC CIRCUITS.

As regards the nature of metallic circuits, copper-clad iron and aluminium wire may be used. Apparently solid copper and copper-clad conductors of equal surface have practically the same conductivity; ordinary galvanised wire will not answer, as, over a short distance, resonance effects are obliterated. High-tension lines may be used as guides for high-frequency carrier waves without interference due to the low-frequency power carried.

As has been previously remarked, the danger of interference with ordinary telephone lines is slight, but there is a possibility of interference by continuous wave radio stations, where the frequency may happen to be within 20 000 cycles of a multiplex carrier wave. Spark radio stations may also be heard if the waves have the same value. However, it is comparatively easy to avoid such interference by choosing carrier waves that are sufficiently remote from the known frequencies of wireless stations. The liability to interference from atmospheric static effects is no greater than in ordinary telephones.

In regard to efficiency the guided-wave telephone system has great advantages over radio-telephony; the author concludes that the efficiency over 100 miles is at least 20 times as great. Dealing with the dissipation of energy by radiation, which some have urged as a great drawback to the system, the author remarks that the existing

theoretical formulæ do not apply to these high frequencies, and that the attenuation is, in practice, very much less than theoretical calculations would suggest.

THE ADVANTAGES OF THE SYSTEM.

In a final summary of the advantages of the system, the author contends that guided wave transmission gives a more perfect reproduction of the voice than does wire telephony, as the distorting effect of the line is absent. The method permits of a great degree of secrecy in certain cases, e.g., in the case of leased lines between business houses. Communication can also be secured between places when the ordinary physical circuit which serves as a guide for waves is out of commission for ordinary telephone service. The flexibility of the system, and the ease with which an entire terminal equipment can be transported are also advantages. An important possible application is in train-dispatching, as communication can be established between a moving train and the fixed stations connected to one of the physical circuits paralleling the track. A radio-telephone equipment connected to a suitable antenna system may be installed on the train, and the engineer could be in regular communication with the train-dispatcher.

The E.P.E.A. Schedule and "Economy Stunts."

We have received the following letter from Mr. W. A. Jones, General Secretary of the Electrical Power Engineering Association.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: The insistent craze for economy, which is so prominent a feature in public life at the present time, is doubtless the inevitable aftermath of the orgy of expenditure during the war. The necessity for retrenchment in every direction in which such can reasonably be accomplished is obvious, and most people are awake to the fact that the spend-thrift habits acquired in recent years must necessarily be replaced by those of greater prudence. Unfortunately to many minds, economy is synonymous with low wages. "Wages must come down" is preached to us from the pulpit of the Press and shrieks at us from every hoarding.

As with wages, so with salaries, and it would be too much to hope that the "emoluments" of the technical staffs in the electro-supply industry should escape the prevalent epidemic of economy. In point of fact, there have been two recent attempts to effect a radical reduction in staff salaries and to throw overboard the E.P.E.A. Schedule, viz., at Dover and Perth. In both cases, thanks to the resolute front shown by the Members of this Association, the move was successfully countered. It is well known, of course, that the Schedule includes a sliding scale for the periodical adjustment of salaries according to the Government figures for the cost of living, but this provision evidently was not sufficient to satisfy the voracious appetite of the Hotspurs of economy, whose zeal for retrenchment rendered them oblivious of the fact that they had but recently accepted and approved of the Schedule as a fair and satisfactory scheme.

Although victory has favoured the cause of the intended victims of a *coup de main* in these two instances, there is little doubt that despite the object lessons of Dover and Perth, other attempts will be made to upset the Schedule, either openly or in ways that are less obvious, though none the less dangerous. In every case, it is the firm intention of the E.P.E.A. to resist by every means in its power. It is determined to maintain unimpaired the "Bill of Rights" which has received the approval of both sides of the National Joint Board, and which, with very few exceptions, has been accepted by every undertaking in the Kingdom to which it is applicable.

A significant feature of the attacks made on the Schedule has been the complete disregard shown by the aggressors for the machinery erected for dealing with all matters pertaining to the salaries and working conditions of Technical Engineers, that is, the District Joint Boards. It is no secret that the E.P.E.A. pins its faith to Whitleyism as the best existing means for the preserving of peace and the securing of justice in industry. Whether Whitleyism will be the ultimate solution of the problem is a matter for the future, but until a better system is devised the Association will refuse to countenance any attempt to short-circuit or to ignore the established tribunals for the consideration and settlement of grievances and disputes. It consistently adheres to constitutional procedure itself and it expects others who are parties to and are represented on the Joint Boards to do likewise.

* Abstract of a Paper read before the Franklin Institute.

In the event of an undertaking desiring a variation in the interpretation of the Schedule owing to particular circumstances, its proper course is to lay its views before the D.J.B., when due weight will be given to any arguments brought forward, and a fair decision arrived at after careful consideration of the case. The Board exists for that purpose. To resort to arbitrary methods and without reference to the body constituted for the deciding of precisely such cases is to revert to the chaotic conditions prevalent in the bad old days before the idea of Whitleyism had taken coherent form.

It is to be hoped—though one must be careful not to be over-sanguine—that the exemplary lessons of Dover and Perth have been duly noted and taken to heart by all other undertakings, and that there will be no further attempts at similar high-handed and unconstitutional action. Should such unfortunately occur, the E.P.E.A. will be found no more disposed to take it lying down than it has already shown itself, for it is after all very much like the cat, which is “un-animal méchant; quand on l’attaque, il se défend.”—I am, &c.,

London,

W. A. JONES,

August 22nd.

General Secretary,

Electrical Power Engineers' Association.

Parliamentary Intelligence

Wireless Telegraphy in the War.

In reply to Sir B. CHALMERS, who asked what steps had been taken to ascertain the methods employed by the Germans in connection with wireless communications during the war, Sir R. SANBURN stated that detailed information was in possession of the General Staff, but it would not be in the public interest to disclose it.

Telephonic Communication: Lazonby and Kirkoswald.

Sir C. LOWTHER asked the Postmaster-General when he expected to be able to fulfil the long-standing demands for telephonic communication in the Lazonby and Kirkoswald district of Cumberland?

Mr. PEASE: In order to open call offices at Lazonby and Kirkoswald it would be necessary to adapt the existing telegraph circuit for telephone working; the cost of this work would be considerable and a guarantee would be required. When the amount of the guarantee is settled, the terms will be quoted to the applicants.

New Acts of Parliament.

THE ROYAL ASSENT was given on the 17th inst. to the Burnley, Rotherham and Wigan Corporation Acts and the Hastings Tramways Act, and on the 19th inst. to the Safeguarding of Industries Act, Expiring Laws Continuance Act, Telegraph (Money) Act, Aberdeen Corporation (Electricity Works Railway) Order Confirmation Act, Airdrie and Coatbridge Tramways Trust Order Confirmation Act, Batley Corporation Act, County of London Electric Supply Company's Act, Leicester Corporation Act and South Shields Corporation Act.

Government of Greater London.

Mr. N. CHAMBERLAIN asked the Minister of Health whether, as the terms of reference to the Royal Commission on the Government of London made no mention of any town plan, he would consider the advisability of authorising forthwith the preparation of such a plan, providing for the future development of London and the surrounding districts, including the lines of main roads and the general allocation of different areas for the purposes for which they were best adapted?

Sir ALFRED MOND said he would consider how far it might be practicable to adopt the suggestion.

At the end of 1920 there were about 3000 PUBLIC ELECTRIC POWER PLANTS in the U.S.A., of a capacity of 100 kW or over. In a report by the U.S. Geological Survey it is stated that the average daily output of electricity for each month varied from 115 000 000 kWh in May to 124 000 000 in January, the average for the year being 120 000 000 kWh. The year's output was 43 900 million units, an increase of 12.9 per cent. over 1919, and hydro-electric energy represented 37½ per cent. of this total. The amounts of coal, fuel oil and gas employed to generate electricity in 1920 increased by 6, 18.4 and 13.6 per cent. respectively over the preceding year, and if the fuel oil, gas and wood so consumed were converted into the equivalent amount of coal, the coal consumption would have been 38 500 000 tons in 1919, and 41 200 000 tons in 1920, an increase of 7 per cent. This increase in the fuel consumed was, however, accompanied by an increase of 12.9 per cent. in the output, indicating a more efficient consumption of fuel. On the basis of the equivalent coal consumed in each of the two years, the public utility plants burned 3.17 lb. of coal in 1919 to produce a unit of electricity and 3.01 lb. in 1920.

Electrical Imports and Exports.

IMPORTS.—The following are official values of electrical machinery, apparatus and material imported into this country (a) during July, 1921, and (b) the aggregate figures from Jan. 1 to July 31, with increase or decrease compared with corresponding periods of 1920:—

Electrical machinery, (a) £55 921 (decrease £39 319), (b) £500 079 (decrease £94 191); telegraph and telephone cables, submarine, (a) nil, (b) (increase £50); other than submarine, (a) £7 768 (increase £7 223), (b) £59 420 (increase £55 242); telegraph and telephone apparatus, (a) £20 401 (increase £14 594), (b) £225 717 (increase £139 900); other electrical wires and cables, rubber insulated, (a) £3 975 (increase £3 675), (b) £17 664 (increase £6 260); with other insulations, (a) £6 841 (decrease £10 106), (b) £67 385 (increase £4 656); carbons, (a) £3 094 (decrease £5 873), (b) £66 038 (decrease £3 234); glow lamps, (a) £9 742 (increase £4 495), (b) £176 605 (increase £152 005); arc lamps and electric searchlights, (a) £66 (decrease £775), (b) £5 746 (increase £2 065); parts of arc lamps and searchlights (other than carbons), (a) £4 227 (increase £3 899), (b) £13 406 (increase £6 427); batteries, (a) £4 470 (decrease £4 249), (b) £86 806 (increase £45 319); meters and measuring instruments, (a) £3 699 (decrease £6 070), (b) £115 404 (increase £68 763); switchboards, (a) £243 (increase £143), (b) £7 383 (increase £6 290); electrical goods and apparatus unenumerated, (a) £40 176 (decrease £34 462), (b) £511 948 (increase £133 153). Total of electrical machinery, apparatus and material, (a) £170 673 (decrease £66 825), (b) £1 853 601 (increase £66 825).

EXPORTS.—The exports of electrical machinery, apparatus and material (a) during July, 1921, and (b) from Jan. 1 to July 31, with increase or decrease compared with corresponding periods of 1920, were as follows:—

Electrical machinery, (a) £407 954 (increase £205 992), (b) £2 875 934 (increase £1 714 806); including railway and tramway motors, (a) £25 417 (increase £22 434), (b) £143 070 (increase £120 776); other generators and motors, (a) £252 654 (increase £138 451), (b) £1 622 988 (increase £956 167); and electrical machinery unenumerated, (a) £129 883 (increase £45 107), (b) £1 609 876 (increase £637 863); telegraph and telephone cables, submarine, (a) £338 208 (increase £294 169), (b) £1 883 517 (increase £802 277); other than submarine, (a) £135 327 (increase £49 109), (b) £986 598 (increase £408 061); telegraph and telephone apparatus (a) £188 655 (increase £78 942), (b) £1 093 855 (increase £427 993); other electrical wires and cables, rubber insulated, (a) £66 499 (decrease £110 087), (b) £912 946 (decrease £11 272); with other insulations, (a) £114 354 (decrease £95 148), (b) £1 296 386 (increase £79 071); carbons, (a) £3 285 (decrease £13 648), (b) £51 727 (decrease £16 842); glow lamps, (a) £34 711 (increase £6 666), (b) £309 156 (increase £177 925); arc lamps and searchlights, (a) £95 (decrease £3 239), (b) £8 875 (decrease £3 432); parts of arc lamps and searchlights (other than carbons), (a) £306 (decrease £2 245), (b) £4 290 (decrease £3 656); batteries, (a) £51 534 (decrease £8 817), (b) £455 842 (increase £171 926); meters and measuring instruments, (a) £51 891 (increase £17 890), (b) £308 297 (increase £89 137); switchboards, (a) £24 645 (increase £16 989), (b) £130 037 (increase £78 326); electrical goods and apparatus unenumerated, (a) £148 081 (decrease £37 826), (b) £1 387 460 (increase £418 406). Total of electrical machinery, material and apparatus, (a) £1 565 545 (increase £398 747), (b) £11 704 820 (increase £4 332 726).

Wireless Notes.

The first wireless telephone service in SOUTH AFRICA has been instituted between Port Elizabeth and Durban.

As a result of a violent storm last week DOVA WIRELESS STATION, near Lyons, was considerably damaged, two of the masts, over 600 ft. high, having fallen.

The first practical use of WIRELESS TELEPHONY in connection with the Press in the EAST was made last week when, the "Times" Bombay Correspondent states, the results of Poona races were sent direct from the race course by wireless to the "Times of India."

When the R. 38 crosses the Atlantic she will have the assistance of the MARCONI WIRELESS STATION at CLIFDEN. In order that there shall be no question as to the identity of the station, Clifden will repeat her call letters (M F T) about every 15 minutes.

Captain L. CARUS-WILSON is going to Egypt to represent the War Office in the establishment of the Imperial Wireless Chain. Last year Captain Carus-Wilson passed out first of all the foreign officers sent in response to the invitation of the French War Office to the Paris school of advanced wireless.

The s.s. "MAJESTIC," which is being built for the White Star Line, and is now nearing completion, has three wireless stations installed, the largest of which will be capable of maintaining permanent connection with both America and England during the entire voyage across the Atlantic. Elaborate submarine signalling gear has also been installed to ensure the safe navigation of the vessel in fog. The life boats include two motor boats equipped with wireless. Electric baths are also provided.

The Committee appointed by the Ministry of Health to investigate complaints made by the Actors' Association regarding the injurious effect to their eyes from the powerful lights used for the production of films report that the trouble is caused by the use of open arc lights without diffusing screens. The Incorporated Association of Kinematograph Manufacturers has in consequence undertaken that its members will not permit the use of open arc lights without filters in their studios.

Electricity Supply.

The electricity supply mains in the various thoroughfares of LURGAN are to be extended.

HAYLE Lighting Committee is enquiring into the cost of lighting the town with electricity.

It is hoped that Lord Derby will open the new BLACKBURN electricity station at WHITEBIRK in October.

A new cable for electrical power has been laid under the LIFFEY from the end of the North Wall to a point opposite.

Dewsbury Town Council has appointed a sub-committee to inquire into the cost of lighting THORNHILL by electricity.

The number of street lamps (gas and electric) lighted in LIVERPOOL has been increased from 3 000 to nearly 13 000.

A scheme for lighting the principal streets and parades of SKEGNESS by electricity is shortly to be laid before the Council.

Mr. Stratton Davis has been instructed by GLOUCESTER Town Council to prepare plans for extensions to the electricity works.

Owing to the increasing demand for electricity at BLACKBURN an underground transformer station is to be constructed in Abingdon-street.

CAVAN Urban Council has entered into a seven years' agreement with the local electric lighting company for public lighting at 1s. per unit.

At a public meeting of the inhabitants of FRAMLINGHAM, Suffolk, it was decided to raise £4 000 to carry out a scheme for supplying the town with electricity.

ABRAM District Council have accepted the offer of the South Lancashire Tramways Company to light Cross, Tetley and Bryn streets, Bamfurlong, by electricity.

SOUTHEAST-ON-SEA are considering the question of supplying electricity to the Great Eastern Railway Company for the lighting of their station premises, goods sheds, &c.

NENAGH Electric Power Works are now nearing completion. The power plant was tested satisfactorily last week, and it is hoped that the entire system will shortly be working.

The Electricity Commissioners have fixed the maximum charge for electricity at SELBY at 10d. per unit, instead of 1s. as applied for by the Electrical Distribution of Yorkshire, Ltd.

CROYDON Corporation have requested Mr. R. J. Howley and Mr. J. Dalrymple, general manager of the Glasgow Corporation tramways, to advise as to the future of the Croydon tramways.

The LEEK General Purposes Committee has under consideration a report by Mr. Tulloch, the Council's electrical engineer, recommending extension of the electric generating plant at a cost of £18 500.

Extensions of the electric supply mains are to be made by HUDDERSFIELD Corporation in Horley-road and Moor-lane, Netherton. Messrs. T. Broadbent & Sons, engineers and crane builders, have expressed satisfaction with the supply of electricity during the coal dispute.

STIRLING Town Council has decided to apply for terms for a bulk supply of electricity to the Scottish Central Power Company, and to the Alloa Town Council. Application has been made for a loan of £6 700 for a generating set.

The Electricity Commissioners have granted a special Order to the Rural District Council of WHITEHAVEN for the supply of electricity for public lighting in the parish of Distington. Any objections to the confirmation of the Order must be made by Sept. 9.

A saving of £15 000 has been effected by the agreement reached by the NEWPORT Corporation and the Newport Harbour Board by which a cable from the Corporation electricity works to Messrs. Whitehead's new steel works is to be laid under the river bed instead of via Newport bridge.

The South Wales Electrical Power Distribution Company, the Glamorgan County Council, and the Dinas Powis Rural District Council have petitioned to be heard against the BILL to confirm the CARDIFF EXTENSION PROVISIONAL ORDER. This Bill has been suspended until the 1922 session.

The Midland Electric Light & Power Company, at LEAMINGTON, have obtained permission from the Electricity Commissioners to supply electricity in the parishes of Amington and Stonydelph, Bolehall and Glascoate Shuttington and Wilnecote and Castle Liberty, in the Tamworth rural district.

BLACKBURN Corporation has applied to the Electricity Commissioners for a Special Order authorising the extension of the Corporation's electricity supply area to the urban districts of Rishton and Great Harwood, and to the parishes of Wiltshire, Clayton-le-Dale and Ramsgrange, in Blackburn Rural District.

A scheme for the supply of electricity to BECKINGTON was submitted by Edmundsons' Corporation who propose to utilise an old mill in the river for water power, and it is hoped that the cost of electricity will be only 10d. per unit. A committee has been appointed to go fully into the matter with the company.

The serious financial position of WREXHAM Electricity Works is still exercising the minds of the Town Councillors. For the fourth time within a fortnight a meeting was held last week to consider the position. After a long discussion it was again decided to adjourn, and future deliberations are to be in private.

CANNOCK Urban Council have agreed to the terms of the Wolverhampton Corporation to lay the electric cable between the Urban Council

boundary at Wedges Mills and the transformer station at Cannock at an estimated cost of £2 812 7s. 11d. per 1 000 yds. Consideration of the erection of a transformer station at Hednesford has been deferred.

A profit of about £4 000 having been made on the past year's working of the GRAVESEND electricity undertaking, £1 000 is to be placed to the relief of the local rates. At a recent meeting of the Council a proposal to use £3 000 of surplus profits in free wiring the houses of flat rate consumers was rejected, but a recommendation to reduce the price of current to flat rate consumers was carried.

At a mass meeting of the employees at the TREFOREST power station it was decided to contribute 2d. per head per week towards the maintenance fund of the King Edward VII. Hospital, Cardiff. When the vote had been taken the directors of the concern, the South Wales Electrical Power Distribution Company, Ltd., announced their intention of doubling their employees' contributions.

The proposal to reduce the salaries of the technical staff of DELLINGBURN electricity department has been opposed by the Scottish District Joint Board. The Council has decided to communicate with the secretary, pointing out that in the opinion of the Corporation, so far as Greenock is concerned, the basis for salaries contained in the schedules should not be that of plant capacity, but that these salaries might be based on the number of units sold.

To prevent delay in installing a system of electric lighting for TISBURY the Salisbury Electric Light & Supply Company notified the District Council that they did not propose to apply for an order to the Commissioners, and asked the Council's permission to open the streets and to erect poles and wires. The Council, however, have no authority in this connection, but will raise no objection to the work being started if application for an order is made through the proper channel.

In reference to the note on MAIDSTONE in our last issue, we are informed by the engineer and manager of the electric-supply department (Mr. E. E. Hoadley) that the loss of £3 775 referred to was the estimated loss to the Electricity Committee owing to the coal strike. This figure includes the lost revenue through the restricted output, the amount spent on extra labour for handling the so-called coal the department had to burn, and also the extra cost of the coal purchased during the strike.

The accounts of the BURNLEY tramways department for the year ended March 31 show total revenue £180 792, compared with £158 602 in the previous year, and working expenses £168 140, against £137 952. Interest required £5 729, against £6 103, and sinking fund £9 650, compared with £9 408. Rent of tramways owned by outside authorities and income tax absorbed £6 724 (£7 235) and the net result was a deficit of £9 752 (£2 096). The total revenue per car-mile was 24.45d. (20.71d.). Passengers carried were 23 407 356, compared with 24 603 461, and car-miles run 1 774 198, against 1 837 907.

Acting on the advice of its Electricity Committee, SUNDERLAND has decided to withdraw from the District Council (No. 1) North East Coast Area Electricity Supply Industry, but has agreed to adhere to the conditions of employment laid down except (a) as regards mechanical and electrical fitters, blacksmiths, and building trades employees, who will continue to be employed on terms and conditions for the time being agreed between the recognised local employers' and employees' organisations; and (b) that the terms of the Award No. 579 of the Industrial Court with reference to holidays to skilled men and their assistants shall be strictly adhered to.

LLANDUDNO Council have provisionally agreed to the offer of the North Wales Power and Traction Company to deliver at the Council's electricity works current in bulk at 1½d. per unit, with an annual minimum equal to 20 per cent. of the cost (£15 000) of the transmission line from the sub-station of the company near the Colwyn Bay Gasworks. During the year ended March 31, a loss of £1 136 was incurred in the supply of current to the electric tramway company, and the Council have decided that on the expiration of the existing arrangements on September 1 they will charge a flat rate of 3d. per unit for a further period of 12 months for all current supplied to the company.

The Queensferry T.N.T. Factory, which has just been taken over by the CHESTER Corporation for power purposes, contains three 1 500 kW turbo-generators, one 1 000 kW turbo-generator, one 90 kW 410 V d.c. generator and one 37.5 kW 100 V generator. The turbines are of the Curtis type, with a working pressure of 160 ps. sq. inch, and the alternators are three phase 440 V 50 cycle machines, running at 3 000 revs. per min. A fourth 1 500 kW set was retained for emergency purposes. At the full productive period of the factory there was a total motor horse-power of 8 618, and the highest record of units generated in one month was 2 588 991, in November, 1917.

The general application of electricity to cotton-manufacturing has formed the subject of many interesting discussions. Even now there is divided opinion on the question. Mr. Arthur Charles, managing director of Components, Ltd., of Burnley, told a BURNLEY gathering recently that electrical plant, correctly installed, was probably safer than any other power agent, and it was as economical. He pointed out that, in 1910, 998 consumers in Burnley paid for 3 249 287 units, as compared with 3 000 consumers and 7 594 107 units last year. Councillor L. Thorner, a prominent cotton manufacturer, said the application of electricity to textiles was all a question of cost. So far as he could gather, electricity for driving mills could not be supplied more cheaply than steam. Electricity would have to be produced under ½d. per unit to make it profitable for running a cotton mill; he admitted that current would ensure a better and steadier drive.

Municipal Electricity Accounts.

NEWPORT Electricity Department for the year ended March 31 last showed a net profit of £7 180. The reserve fund is now £21 377.

PORTSMOUTH electric lighting accounts for the year ending March 31 give the year's capital expenditure as £22 553, bringing the gross total to £400 767, but a sum of £272 858 has been repaid or placed to loans fund. The gross revenue for the year was £114 384, against £91 685 in the previous year. The expenditure, however, was £91 405, an increase of £22 782, leaving a net profit of £2 072, after meeting interest and sinking fund (£18 849), which has reduced last year's deficit of £3 375 to £1 303. The units generated were 5 939 810, and sold 4 885 782. The maximum demand was 3 410 kW.

The accounts of the WOLVERHAMPTON Electricity Committee for the year ended March 31 show a gross profit of £73 437. Interest, however, required £21 612 and repayment of capital £24 761, leaving a net profit of £27 064, of which £22 064 has been placed to reserve and £5 000 to relief of the Improvement rate. Total capital expenditure amounted to £637 064, against £581 366 last year, of which £244 262 has been repaid. Total net revenue £199 160 (£147 462); number of consumers connected was 4 329 (3 182); total connections 23 130 kW (21 381 kW); units generated, 21 559 351 (17 942 935); works costs were 1-115d. 0-948d., and the total costs 1-834d. (1-674d.) per unit sold.

The total income of the HAMPTSTEAD (LONDON) Borough Council electricity department for the year ended March was £149 550, including £135 193 for private lighting, power and heating supplies, and after meeting expenses (£112 996) the gross profit was £36 554. Interest required £6 487 and repayment of principal £18 314, leaving a balance of £11 753. A sum of £7 008 was expended on house services, meters and other capital items, and the surplus of £5 789 was carried forward. Of the capital borrowed (£472 747) for the undertaking £369 880 has been repaid. 6 895 985 units were sold, including 5 967 898 to private consumers. There are 2 637 public lamps and the total maximum demand was 4 250 kW. The works costs were 8-33d., the total costs 4-69d. and the average income 5-1d. per unit sold.

The accounts of the STEYNE (LONDON) Borough Council for the past year show a net profit of £9 376, but owing to heavy charges for income tax, writing off old steam plant at Whitechapel, &c., a sum of £8 417 has had to be taken from reserve. The total connections at the end of the year were equal to 1 287 314 30 W lamps, and the 592 services added during the year created a record, representing 118 410 30-W lamps. The obsolete arc lamps in the main thoroughfares have been replaced by gas-filled lamps, with very satisfactory results. The units sold for all purposes were 28 093 011, a drop of 229 464, though there was an increase of 454 837 units for private lighting. The total cost per unit sold was 1-864d. (against 1-51d.), and the income was 1-932d. (against 1-708d.). It is reported that the war period arrears of repairs to plant were almost completely during the year, so that the engineer and manager, Mr. W. C. P. Tapper, can be congratulated upon a very satisfactory record.

The total revenue of the BURY (LANCS.) electricity department for the year ended was £97 434 (1-406d. per unit sold) and the total costs were £95 015 (1-317d. per unit), leaving a net profit of £2 419 (0-035d. per unit). The number of units sold was 16 630 213 (against 15 367 885), including 8 778 015 for power and heating and 5 187 199 bulk supply. There are 1 299 consumers (increase: 81) with the equivalent of 329 439 8-c.p. lamps connected. The motors number 1 127, equal to 9 506 H.P.; the maximum load was 6 095 kW (5 875 kW) and the load factor 31-1 (29-8) per cent. The average price of fuel increased by 32-3 per cent., and the quantity used per unit sold was 0-669d. (0-481d.), the total generating cost being 1-100d. (0-896d.). A sum of £1 000 out of the net profit has been applied in relief of rates and the balance placed to reserve. The capital expended during the year on the Chamber Hall station was £36 999, making the total outlay £258 788, but the sinking fund amounts to £47 605, and £67 730 of the debt has been extinguished. A 10 000 kW turbo-alternator and a water-tube boiler of 50 000 lb. evaporative capacity are being installed.

The financial position of the BLACKBURN Corporation electricity department has been adversely affected by increased charges for fuel, &c., and by having had to pay £12 500 in 1920-21 as interest and sinking fund on the capital expended on the Whitebirk station. It is recommended that the Council obtain statutory authority to suspend the operation of the sinking fund and to pay interest out of capital until the station is in full working order. The total revenue for the year ended March 31 was £110 165 (increase £18 844) and the expenditure £91 949 (increase £21 205), leaving a gross profit of £18 217. Interest on loans required £15 490, instalments of loans repaid £3 020 and sinking fund £15 327; capital expenditure out of revenue amounted to £12 453 and the final adjustment of the munitions account £4 926, so that after taking credit for investments there was a net loss of £32 199 on the year, but if the exceptional items of expenditure are excluded the trading loss is only £2 321. The cost of fuel was £11 547 more than the previous year and the cost of repairs and maintenance was also heavy. The units sold totalled 10 561 959, an increase of 945 980, mainly for private lighting and power purposes. The total connections were 151 600 kW, and there are 5 699 consumers, an increase of 551 during the past year. Owing to shortage of plant, restrictions were imposed on new connections, and it is reported that hundreds of prospective consumers are waiting for supply. The contractors are making satisfactory progress with the Whitebirk generating station and the Council's area of supply is to be extended to Great Harwood, Rishton, &c. The total capital expended is £601 810, but the amount outstanding is only £436 574.

Electric Traction.

The Great Central Railway has begun a petrol-electric coach service between MACCLESFIELD and BOLLINGTON.

The TRAMWAY ACCIDENTS in the Metropolitan Police District in 1920 number 4 000, or one-twelfth of the total traffic accidents.

The extension of GLASGOW tramways from Netherlee terminus to Clarkston has been partially completed, and a service has been started to the temporary terminus.

The trackless trolley omnibuses of KEIGHLEY Corporation have been reconstructed, and the motors transferred from the back to the front axle. The front drive has been tried with success at Leeds.

MESSRS. THOMAS TILLING, LTD., are selling their present petrol-electric buses and are placing 150 of a new type in service. The new vehicles, which are, broadly speaking, of the "K" type, will carry 48 passengers.

The annual report of the DARWEN tramways shows that last year 4 618 219 passengers were carried; the car miles run were 242 045, and the units used 505 370, averaging 2-09 per car-mile. The average revenue per car-mile was 29-14d. and the average expenses 17-01d.

The question of the reduction in the wages of the MANCHESTER tramway men was again before the Tramway Committee on Tuesday, when a resolution was passed recommending that an early meeting of the National Joint Industrial Council for the Tramway Industry be called to consider the procedure to be adopted.

The proposal to increase the salary of Mr. E. S. RAYNER, general manager of the Hull tramways, by £100 was defeated by four votes at a recent meeting of the Hull City Council. In every department of the Corporation the wages of the rank and file are being cut down from 3s. upwards, and it was felt that this was not the time to increase the salaries of officials. Mr. Rayner's present salary is £950.

It is hoped that by the end of September the conversion of the WOLVERHAMPTON tramways from surface contact to the overhead conductor system will have been completed. The cars will then be interchangeable with all the adjoining systems. How to utilise the old Lorain track equipment will be decided when the question of completely relaying the track is dealt with, but this will be deferred until prices are lower. For the present the cables will be retained in use instead of an earth return.

In connection with the scheme for widening the road between LIVERPOOL and MANCHESTER it is intended to make the main artery to and from Liverpool along Edge Lane Drive, St. Oswald-street, and the Knotty Ash and Prescot-road. This length of road up to the city boundary (Knotty Ash tram terminus) it is proposed to widen to 120 ft.; the present tramway line is to be removed from the centre of the roadway to a special track; and a carriage way is to be constructed on each side of this tramway track for the use of heavy vehicular traffic. The object of removing the tramway lines is to make possible an express service of electric cars. The Corporation having purchased the tramway undertaking from the city boundary and leading into Prescot, want that stretch of roadway widened on similar lines. This road, however, is under the control of the County Council, who think the present needs would be sufficiently met if the Corporation take the tramways from their present position in the middle of the road and put them to one side upon a track to be provided by the Liverpool Corporation.

In his annual report, the MIDDLESEX County Surveyor refers to the difficulties in maintaining the surface of the roads in the county. It is stated that one of the principal obstacles to an improvement is the bad condition of many of the tramway tracks. Until these can be reconstructed the "haunches" cannot be dealt with in a satisfactory way. The increase in traffic has rendered waterbound macadam uneconomical and most difficult to maintain satisfactorily. Unfortunately, Middlesex has several miles of waterbound macadam "haunches" to tracks. It is general experience that such "haunches" are difficult to maintain if surfaced differently to the track, as the heavy traffic units always cause trouble at the dividing lines of the varying surfaces which offer unequal resistance to wear. A counsel of perfection would be to pave the whole of the tramway "haunches" with wood on reinforced concrete when the tracks are reconstructed, and it is hoped financial conditions may permit this to be done. In many cases, however, it is likely to be some years before the track reconstruction materialises, and in those cases it will be found advisable to substitute slag tar macadam or some bituminous material for the waterbound "haunches."

Reconstruction on the tramway line from CRICKLEWOOD to EDGWARE has begun. The work is estimated to cost £184 000, or £84 000 per mile.

Telegraph and Telephone Notes.

HULL Corporation telephone department has had a loss on the year of £13 279.

Many developments have recently been carried out in connection with the TELEPHONE SERVICE in the WEST YORKSHIRE district. In regard to the East Leeds underground scheme, 250 subscribers have already been transferred from open lines to the underground cable. On the Bradford Exchange c.b. switchboard accommodation for a further 540 subscribers has been made. The Leeds-York and Leeds-Harrogate underground cables are practically completed. Additional trunk circuits were recently brought into use on the following routes:—Leeds: Bingley, two additional circuits; Cleckheaton-Huddersfield (2); Cleckheaton-Halifax (2); Bradford-Halifax (4); Leeds-Goole (2). At the Rawdon Exchange last month work in connection with the provision of additional subscribers' equipments on the existing switchboard was completed.

Imperial and Foreign Notes.

After a nine weeks' strike for an increase of 10 per cent. on their wages, the DURBAN tramway men have returned to work on the old terms, on the understanding that there shall be no reduction in their pay before the end of the year.

The residents of TOWNSVILLE and CAIRNS, towns on the NORTH QUEENSLAND coast, are agitating for the erection of a radio-telegraph station. The towns are unprotected sea ports in the storm belt, and it is considered that a wireless station, placed in a suitable locality, would give advance information of storms, &c., for Willis Island.

In the REVISED AUSTRALIAN TARIFF higher duties have been placed on high-grade carbon and alloy steels. The new tariff is: British 20 per cent., intermediate 25 and general 30 per cent. In justifying the increase the Minister for Trade (Mr. Greene) said that Australia was perhaps richer than any other country in the rare minerals required for special alloy steels. A large foundry in Sydney had electric furnaces to produce high-grade steels, and in Western Australia another foundry was in course of erection which would employ over 100 men. An English firm, well-known for its alloy steels, was investing a large sum of money in the enterprise.

In a report on the "Economic and Financial Conditions in South Africa," Mr. W. G. Wickham, H.M. Senior Trade Commissioner, states that the value of the total imports in 1920 from the United Kingdom was £51 000 000 (excluding Government stores), which was a record figure. The imports from the U.S.A. were valued at £17 000 000 (against £11 250 000 in 1919), of which about one-third represented motor cars, cycles, &c. Of the electrical machinery and material, other than cables and wires, the U.S.A. supplied £377 000 out of £1 177 000, a much reduced proportion. Belgian and German goods were again available, but the total of the German trade was under £1 000 000.

In the scheme put forward by the International Waterways Commission for DEEPENING THE ST. LAWRENCE, and providing for the passage of ocean-going ships as far west as Chicago, Port Arthur and Duluth, power development plants are to be situated at Iroquois, Ontario, Morrisburg, Ontario, and at Lake St. Louis by which more than twice the power now developed at Niagara Falls, which produces approximately 70000 H.P. can be obtained. The most favoured plan proposes power units of 40 000 H.P., each developing about one-third of the theoretical power of the St. Lawrence, said to be about 5 000 000 H.P. The scheme would cost about £50 000 000, but it is said that the water power would pay for the whole project in a few years.

Fourteen of the principal manufacturers of insulated tubing in GERMANY have recently combined forces under the name of Verband Deutsche Isolierrohrwerke.

A reduction of 10 per cent. on the substantive wages which were paid on Jan. 1, 1921, will be introduced in the SWEDISH IRONWORKS from Sept. 12. This will affect all the workmen who have no contract.

The electrification of the MONTEVIDEO Northern tramways at an estimated cost of £500 000 has been discussed in Congress with a view to sanctioning a loan for the purpose. The annual loss at present amounts to about £40 000.

It is stated that the POLISH GOVERNMENT have made a contract with the Radio Corporation of America for the construction of a three-million-dollar high-power radio station at Warsaw, having direct connection with the Rocky Point, Long Island.

Recent statistics of the STEEL CASTINGS TRADE in the UNITED STATES show a rapid advance in the output of electric furnace steel. During the past year 155 196 tons of electric steel were cast, compared with 111 510 tons for the previous year, and 108 296 tons in 1918.

It is reported that the makers of ELECTRIC FURNACES in the U.S.A. are busy. Among recent orders are two large units for the International Nickel Company, and a Pittsburgh firm is executing this and other contracts. At Sandusky (Ohio) a large foundry is substituting large electric furnaces for its present equipment.

Tenders have recently been invited by the State Power House Directorate of URUGUAY for the supply of 10 450 metres for private installations in Montevideo. The supply comprises a three-phase, 50-cycle system, with 200 V between phases. Single-phase and three-phase meters are required, and the induction type is preferred.

The contract now held by the Electric Light & Power Company in MEXICO CITY is about to expire, and so far nothing has been arranged as to its renewal. It is proposed by the authorities of the Federal District, the "Engineer" states, to instal a rival plant in order to enter into active competition with the present British (Canadian) Company.

THE ATLANTIC, GULF & PACIFIC COMPANY, of Manila, P.I., will shortly, it is stated, have an electric furnace completed. It is the first installation of its kind in the Philippine Islands, and will be used, the "American Chamber of Commerce Journal" states, for manufacturing steel castings required for machines in the cane-sugar industry.

There was a reduction of 10 per cent. in the price of AMERICAN D.C. and POLYPHASE MOTORS last month, but fractional horse-power and synchronous motors are excepted. Some manufacturers have also made cuts in the prices of d.c. generators, transformers, motor generators, porcelain insulators, &c. Recent reports are that there is an increased demand for electric motors.

About \$1 000 000 is being expended on improvements and extensions of the TELEPHONE SYSTEM of the KIANGSU PROVINCE of CHINA.

According to information issued by the CHINESE Government surveys are being undertaken at Ch'ihfeng (Hata) in the Ichol administrative

area for the installation of a telephone service, and an electric light plant under semi-official auspices; the Kuang Hua Electric Light Company at Louhokau has been registered by the Ministry of Agriculture and Commerce, and the Sun Fan Electric Light Company has applied for registration.

Experiments in curing sweet potatoes by electricity are to be carried out at BIRMINGHAM, U.S.A., in the autumn. A temperature of from 85° to 95° is said to be necessary to take the moisture out of the vegetable when it is first dug out of the ground, in order to keep it for the spring trade, and an average temperature of 50° is required during the winter months. It is believed that the temperature can be better regulated by electricity than by any other method.

The students of the College of Engineering, UNIVERSITY OF WISCONSIN at MADISON, have recently designed and built a 60 kW electric brass-melting furnace of 200 lb. capacity, which has been installed in the chemical engineering laboratory. It is believed to be the smallest commercial furnace of this type in the United States. The actual cost is said to have been \$350, compared with a market price of \$1000 for a commercially manufactured unit.

THE SWEDISH METAL WORKERS' UNION, which comprises 70 000 men in the iron and steel and engineering industries has asked the State to take over suitable works as national undertakings, place them in the hands of the workmen, provide the necessary working capital and entrust the Board of Trade with the duty of disposing of the production. Mr. G. A. Styman, director of the Swedish Engineering Works Association has, we understand, been interviewed on the question, but nothing has apparently been settled.

Mr. H. E. Satow, H.M. Consul-General at BEYROUT, in his report for the year 1920 on the trade of Syria, states that both the Tramway Company and the Electric Light Company give cause for complaint. The former's service is inefficient, the rolling stock requires renovation, and the lines relaying. The Electric Light Company's power station is inadequate, so that the lighting both of the streets and of private houses is very poor. Schemes for obtaining electric power from streams in Lebanon are under discussion. A beginning has been made with one scheme at the Nahr Ibrahim, north of Beyroul, but little progress has so far been made.

During the year 1920, 2 598 projects were submitted to the electric-power section of the SWISS RAILWAY DEPARTMENT, 939 of which concerned transmission lines. Of the projected transmission lines, 602, states "Engineering," are to carry high-tension current and 1 307 low-tension current. The length of the new high-tension lines actually erected was 875 km. (544 miles); 582 km. in the previous year, comprising 54 km. (34 miles) of underground cable; 670 km. (416 miles) of the arterial lines were copper wires, 80 km. (50 miles) being of aluminium (against 167 km. in 1919). The machinery projects included plans for 14 new generating stations; but only one of these will contain units of more than 200 kW.

According to Reuter the ASSOCIATION OF PRODUCERS OF ELECTRIC POWER AT MADRID have protested against some of the duties in the new draft tariff on material used in the electrical industry. They point out that certain articles—for example, tubes for pressures over 25 atmospheres—cannot be obtained in Spain. One of the members of the Association has ordered 1 000 tons of these tubes in Germany at about 1 000 pesetas per ton. According to present proposals duty of 1 600 or 800 pesetas a ton, according to whether they are admitted under the first or second column of the tariff, will have to be paid. Purchasers of large parts and very high-tension apparatus will be similarly affected, the Spanish market for these goods being too small to warrant the setting up of works for their manufacture in the country.

According to figures issued by the U.S. CENSUS BUREAU the value of electrical machinery and apparatus manufactured in America in 1919 amounted to \$1 014 373 000, an increase of \$654 941 000 over the 1914 figures. Of the manufactures, motors (not including starters or controllers) amounted to \$116 898 000 (\$44 176 000); generating apparatus and parts, \$86 266 000 (\$23 233 000); insulated wire and fittings, \$84 217 000 (\$69 506 000); batteries, storage, dry, liquid, \$92 506 000 (\$23 402 000); incandescent lamps, \$59 372 000 (\$17 350 000); magneto-ignition apparatus, &c., \$47 389 000 (\$22 261 000); telephone apparatus, \$46 340 000 (\$22 816 000); telegraph apparatus, all types, \$12 816 000 (\$2 248 000); industrial and household apparatus and devices, \$54 998 000 (\$4 049 000); transformers and feeder potential regulators, \$31 691 000 (\$13 120 000); electric locomotives, \$8 161 000 (\$3 721 000).

What is stated to be one of the LARGEST HORIZONTAL WATER WHEEL DRIVEN GENERATORS ever built has been constructed for the Great Western Power Company's Great Meadow plant on the Feather River, Cal. The "Electrical World" states that it is a three-phase 60-cycle machine, rated at 22 200 kVA, 0.9 power factor, 11 000 V, 171 revs. per min. As it is intended for operating on a 165 000 V transmission line, the highest operating voltage in America, it has been designed with special reference to line-charging requirements, so that with full-load armature current the transmission line voltage will not build up to over 80 per cent. of the normal voltage. Silicon steel has been used in the construction of the armature to minimise core loss, and factory tests show that the generator has 97.25 per cent. efficiency at full load, 95 per cent. at half, and 93 per cent. at quarter load at 0.9 power factor. The rotor consists of four separate wheels, mounted on a single spider, with rim dovetailed to receive the poles. The total net weight of the machine, which was built by the General Electric Company, is 334 000 lb.

Miscellaneous.

Additional means of telephone communication are now available between NOTTINGHAM and SUTTON-IN-ASHFIELD.

Damage estimated at £600 was caused by a fire which broke out last week at the premises of Mr. G. Blackburn, electrician, Crown-street, BOLTON.

MESSRS. EAGLESTONE & SON, electricians, of the Plain, Oxford, were among those who offered prizes at the Headington Horticultural Society's annual show.

ALDERMAN H. LINSLEY, ex-Mayor of SALFORD, and chairman of the Tramways Committee since its formation in 1901, died last week at the aged of 73 years.

The Department of Overseas Trade has issued application forms to British firms for the BRITISH INDUSTRIES FAIR which will be held in London at the White City next year, from Feb. 27 to March 10.

A ballot vote is being taken of members of the ELECTRICAL TRADES UNION employed on contracting work as to their acceptance of a sliding scale of wages, to be based on the rise or fall in the cost of living.

A REDUCTION of 17½ per cent. is announced in the WAGES OF SHEFFIELD STEEL PIECE-WORKERS on open-hearth and electric steel furnaces, heavy mills and forges, and in press shops, and of 1s. 2d. per day on time workers.

H.M. Senior Trade Commissioner for Canada and Newfoundland (Capt. EDWARDS) will retire on Oct. 31 and will be succeeded by Mr. G. T. Milne, who is at present acting temporarily as Senior Commissioner in South Africa.

The increased use of ELECTRICITY IN COTTON MILLS, and the consequent lessening of fire risks, is among the factors which have enabled the Fire Insurance Offices Committee to make a substantial reduction in the premiums charged for cotton-mill insurance.

MR. W. G. WICKHAM, H.M. SENIOR TRADE COMMISSIONER IN SOUTH AFRICA, is at present in this country on an official visit and will interview at the Department of Overseas Trade from Sept. 1-16 firms who desire to obtain information as to trade possibilities in the Union of South Africa.

Cyril Bertram Maurice and Albert Walter Coward, carrying on business as wholesale factors of electrical and engineering supplies, at 139, Oxford-street, London, W.1., under the style of MAURICE & COWARD, have dissolved partnership by mutual consent as from August 6, 1921. Debts received or paid by Mr. Coward, who continues the business.

We regret to record the death of Sir SAMUEL C. DAVIDSON, K.B.E., chairman and managing director of Messrs. Davidson & Company, Ltd., of Belfast, engineers and makers of the "Sirocco" fans. Deceased was a well-known engineer and was credited with nearly 200 patents. He was knighted on the occasion of the King's recent visit to Belfast.

The current issue of the "Industrial League and Council Journal" contains an interesting account of the reception given to Mr. Ernest J. P. Benn and Mr. F. H. Elliott on their return from America, where they represented the League. The Right Hon. G. H. Roberts, M.P., presided, in the absence of Viscount Burnham, C.H., and over 200 employers and employed were present.

The General Electric Company, Ltd., Magnet House, Kingsway, W.C., seek leave to AMEND THE SPECIFICATION OF LETTERS PATENT No. 1,161/1911, granted to the Deutsche Gasglühlicht Aktiengesellschaft (Auergesellschaft), for "Improvements relating to drawn wires suitable as illuminating bodies for electric incandescent lamps and process for manufacturing same."

THE GOVERNMENT EXPORT CREDIT SCHEME has now been extended to ITALY and PORTUGAL. A great deal of work is proceeding on hydro-electric and electric traction schemes in Italy, and several other projects are being discussed, and in the Portuguese Colonies there should be demands for machinery, &c. In both cases the exchange is not favourable to business transactions at present, but the credit scheme should assist British exporters.

The Board of Trade has approved the use of ELECTRIC LIGHT SIGNALS for both day and night use on the Liverpool-Overhead Railway, and there are now 52 lamps in use along the 5 miles of double lines between the Alexandra and Herculaneum Docks. The electric signals are automatic, are seen more easily in daylight than the semaphore arm signal, and it is believed they will also prove more successful in penetrating fog. The London & South Western Railway are also experimenting with the same system.

With reference to statements which have recently been made, the FEDERATION OF BRITISH INDUSTRIES informs us that they take no part in politics whatever, and have never at any time supported or worked for Parliamentary candidates. It happens in the ordinary course of events that there are between 70 and 80 Members of Parliament who are connected with firms which are members of the Federation, but in no single instance can it be said that the Federation had any part in these being elected.

ABOUT 50 MEMBERS of the WEST OF SCOTLAND BRANCH of the ASSOCIATION of MINING ELECTRICAL ENGINEERS last week visited the works at Flemington, Motherwell, of Messrs. Anderson, Boyes & Company, Ltd., manufacturers of disc and chain coal-cutters and mining switchgear. The visitors witnessed tests carried out by Prof. D. Burns to demonstrate that a rectangular type of trailing cable plug attached to a coal cutter was capable of being used in an explosive mixture of gas and air.

We have already recorded the various steps taken to form the ENGINEERS' CLUB FOR LONDON, which is to be opened on Thursday next. It was registered on the 17th inst. as a company limited by guarantee under the title of "Engineers' Club (London), Ltd.," and the objects are to promote the interests of engineers generally and to provide a club-house. Every member is to contribute a sum not exceeding £5 if necessary. The directors are: E. Manville, E. L. Hill and P. C. Pope. The office and club premises are at 39, Coventry-street, W. 1.

The report of Dr. F. W. Alexander, Medical Officer of Health of the Borough of Poplar, on the sanitary condition and vital statistics of the Borough for 1920, contains the following particulars relating to the manufacture and supply of ELECTROLYTIC DISINFECTING FLUID by the Council's disinfecting department. The output was 39,255 galls. (compared with 33,285 in 1919) and the cost including electricity was £258 18s. 7d. (against £216 11s. 9d.). The fluid is supplied to hospitals, schools, baths and to manufacturers and trading concerns, and Dr. Alexander maintains that the process has been a success for 15 years.

The valuable copper mine at Sandwich, a few miles south of Lerwick in the SHETLANDS, which for lack of proper plant has been idle for many years, is being re-started. Modern machinery is being erected, and a gas-producing plant has been put up to obtain gas from peat, which will supply power to drive the dynamos, as the mine will be worked by electricity. The mine has been carefully surveyed and 384,000 tons of copper are in sight. It is estimated that for every 500 ft. of lateral development an additional 400,000 tons of metal may be obtained. Besides copper, there are a number of by-products.

MR. E. BRONTMAN, electrical engineer and contractor, will give a lecture and demonstration at St. Peter's Hall, Bournemouth, at 3 p.m. on Oct. 5th. Simpson Baker & Company, J. & W. B. Smith, Ltd., The Ediswan Electrical Company, Ltd., The Falkirk Iron Company, Ltd., Belling, Ltd., and Berry's, Ltd., are among the electrical manufacturers who are taking part, and the Marconi Scientific Instrument Company have lent their M15 receiver and are also arranging for a loud speaker so that a wireless concert will be given. Other firms wishing to participate are asked to communicate with Mr. Brontman, at 139, Bournemouth-road, Parkstone, Dorset.

The Board of Trade call the attention of British subjects resident in this country who have PRE-WAR DEBTS owing to them from branches outside Germany of German undertakings whose head office is in Germany, to the fact that apart from their remedy against the branch, they may be entitled to claim payment alternatively from the head office through the Enemy Debts Clearing Office. In the event of there being any doubt as to recovery of such debts from the branch British creditors will be well advised to file a claim against the Head Office with the Enemy Debts Clearing Office, Cornwall House, London, S.E.1. It is essential, however, that any such claims should be received by the Clearing Office before Sept. 30.

Catalogues, Price Lists, &c.

MESSRS. E. P. ALLAM & COMPANY have issued their August stock list of electric motors.

MESSRS. RAYNER & HEALD, LTD., have issued their stock list of squirrel-cage and slip-ring two and three-phase induction motors.

THE AUTOMATIC TELEPHONE MFG. COMPANY, LTD., announce that they have considerably reduced the prices of their "Xcel" heating and cooking appliances.

THE LIGHT PRODUCTION COMPANY, LTD., manufacturers of piston rings, have issued a circular giving the standard sizes and prices of their manufactures.

A group of leaflets which are being circulated by the OVERSEAS ENGINEERING COMPANY, LTD., 163-5, Great Portland-street, W.1., contains particulars and prices of the "Overseas" vacuum cleaner, the "National" volt and ampere meters and the "Garage" current converter for charging accumulators from alternating-current circuits. The "Garage" converter is a simple and self-contained instrument to convert alternating current to direct current and at the same time to reduce the voltage to the desired pressure.

MESSRS. W. F. DENNIS & COMPANY, 70, Queen Victoria-street, E.C. 4, have recently issued the third edition of their "Useful Tables and Data for the Assistance of Consumers of Wire." It is published in a size convenient for the vest pocket at 2s. 6d. (leather case 1s. extra), and gives the standard wire gauge compared with other wire gauges, tables of the equivalents in decimals, inches, millimetres and sectional areas, breaking strains, lengths, conductivities, resistances, comparative costs of iron, steel, copper, bronze, aluminium and wire strand, &c. The information should prove very useful to electrical engineers and contractors.

Conveyors and elevators are extensively used for the economic handling of materials, and in these days of keen competition it is desirable to see that these operate under the most economical conditions so as to reduce the running charges. In many power-elevators and conveyors friction losses are very considerable and Messrs. HYATT, LTD., 4, Thurlow-place, London, S.W.7, claim that by the use of the HYATT ROLLER BEARING the power required to operate the whole system is greatly reduced and a considerable saving in power is effected. In an illustrated pamphlet, recently issued by the company, particulars are given of the various types of bearing manufactured by them, together with notes on the selection of bearings, size and load tables, &c.

Personal and Appointments.

The late Mr. A. G. NEWINGTON, of DUNFERMLINE, electrical engineer, has left personal estate valued at £4382.

The late Mr. T. E. GATEHOUSE, editor and director of the "Electrical Review," has left estate valued at £23345.

We understand that LORD ULSWATER is to be chairman of the Royal Commission to inquire into the Government of Greater London.

Glasgow Corporation has accepted the resignation of Mr. JAMES M. FREER, manager of the Kelvin Hall, and Mr. HAMILTON MARR has been appointed interim manager.

Mr. A. H. SEABROOK has accepted a seat on the board of Messrs. Farndon's Power and General Electric Company of Stratford, and will act as its technical director.

Mr. J. ORRIDGE has been elected President of the ELECTRICAL CONTRACTORS' ASSOCIATION for the coming year, and Mr. H. MARRYAT has been re-elected hon. treasurer.

On his retirement from the position of Controller of Telegraphs at the Edinburgh G.P.O., Mr. G. DAWKES received a presentation last week from the members of the department.

Mr. F. O. J. ROOSE, electrical engineer to the Bombay Government, has been appointed member of a committee which is to draw up a comprehensive scheme for technical and industrial education in the Presidency.

SIGNOR MARCONI, who has been spending a few days at Aberdovey in connection with the wireless experiments he is making on his steam yacht "Electra," has been presented with an address by the Aberdovey Council.

For assisting to rescue the crew of the steamship "Manxman," of Montreal, which was abandoned in the North Atlantic on Dec. 18, 1919, the CANADIAN Government have awarded a silver cup to Mr. F. E. UPTON, formerly wireless operator of the steamship "British Isles," of London.

Sir PHILIP DAWSON has been adopted Conservative "Anti-Waste" candidate for West Lewisham to contest the vacancy caused by the death of Sir Edward Coates. In consenting to stand, Sir Philip reserves for himself absolute freedom on all finance questions and on such questions will not be subject to the Government Whips.

The following appointments have been made in the Faculty of Engineering at UNIVERSITY OF LONDON, University College: Mr. M. T. M. ORMSBY (previously Reader in Surveying), to be Chadwick Professor in Municipal Engineering; Mr. Bernard H. Knight, to be Assistant in Municipal Engineering; Mr. H. T. DAVIDGE, to be Senior Lecturer in Civil and Mechanical Engineering.

Mr. WILFRED EVANS, foreman of the electrical department of the Briton Ferry Chemical Works, has been appointed head of the electrical department of the State Railways of the Malay Peninsula at a commencing salary of £750 per annum, and sails for Malaya on October 1. Mr. Evans is a member of the Technical Advisory Committee of South Wales for Electricity, and chairman of the Port Talbot branch of the Electrical Trades Union.

Lieut.-Col. A. K. TASKER, T.D., from the Tyne Electrical Engineers, has been posted in the same rank to the Regimental list of the Territorial Force Reserve, and Major C. M. SHORT and Captain C. M. CAMPBELL, of the same regiment in their respective ranks, have been similarly posted to the Reserve of Officers (Territorial Force), from the 26th ult. A vacancy for a captain in the Hants (Electrical Lights Company) Forest Engineers has been filled by the promotion of Lieutenant K. N. ARNOLD, who joined the corps in 1915 and got his second star the following year.

"The Electrician" Tables.

The 1921 Edition of THE ELECTRICIAN Tables of Electricity Supply Undertakings is now available, price 10s. net. On the present occasion the Tables appear in a slightly modified though extended form. The particulars of the steam raising and generating plant of the various undertakings, which were given in pre-war days, have been restored, but owing to the limitations imposed by the old cross-page columnar style of presenting the information it was found necessary to re-set the statistics in a different style. The new method facilitates comparison of the station records, and, as it is much more legible, permits additional information being included as desired. We believe it will be found more useful to those who have to use or consult the Tables.

Advantage was also taken of the change to include some particulars of the oil-burning apparatus employed by a number of electricity undertakings during the coal crisis. In the British section of the Tables a number of additional supply undertakings are included and the whole of the entries were carefully checked. In the section devoted to the Colonial and Foreign Tables of Electricity Supply Works and Electric Railways and Tramways, particulars of several new Colonial undertakings were also added, and no effort was spared to bring the whole of the information up to date.

The Tables should prove a valuable work of reference to electrical engineers and manufacturers, supply engineers, industrial power users, &c. Copies can be obtained from Messrs. Benn Bros., Ltd., 6 & 8, Bouverie-street, Fleet-street, London, E.C.4.

Tenders Invited and Accepted.

GREAT AND LITTLE USWORTH PARISH COUNCIL invite tenders by Sept. 5 for electric street lighting extensions. Particulars from the Clerk, 2, Manor-view, New Washington.

DUBLIN Electricity Supply Committee requires tenders by September 5 for the supply of brass condenser tubes. Particulars from the City Electrical Engineer, Fleet-street, Dublin.

LONDON County Council invite tenders for the supply and erection of h.t. and l.t. switchgear for sub-stations. Specifications from the Clerk of the Council, Spring-gardens, S.W. 1, to whom tenders by Sept. 5.

WEST HAM Guardians require tenders by Sept. 8 for three months' supply of electrical fittings, engineers' oils and sundries, &c. Forms of tender from the Clerk, Union-road, Leytonstone, London, E. 11.

SOUTHAMPTON Corporation invites tenders for the supply and laying of extra high pressure three phase cable, &c. Specification and form of tender from the Borough Electrical Engineer. Tenders to the town clerk, Mr. R. R. Linthorne, by Aug. 30.

PORTSMOUTH TRAMWAYS COMMITTEE invite tenders for 12 months from Oct. 1 for asbestos goods, insulating materials, lamps, motor windings, overhead line materials, &c. Particulars from the engineer, Mr. V. G. Lirani, engineer's office, Vivash-road, Fratton, Portsmouth. Tenders by 10 a.m., Aug. 30, to the Town Clerk, at the Town Hall.

Tenders are invited by Oct. 5 for the supply of bronze wire (schedule 536) to the Postmaster-General's Dept., State of QUEENSLAND. Specifications, &c., from the office of the High Commissioner for Australia: Room E 5, Australia House, Strand, W.C. 2.

Tenders are also invited by Oct. 12 for the supply and delivery of galvanised iron and steel wire (schedule 537); and by Oct. 19 for the supply and delivery of insulated wire (schedule 538) to the Postmaster-General's Department, State of QUEENSLAND. Tender forms, &c., from the office of the High Commissioner for Australia, Room E.5, Australia House, Strand, W.C.2.

THE ELECTRICAL COMMITTEE of the CORPORATION OF BRISTOL invite tenders for the supply, delivery and erection at their Feeder-road generating station, St. Philips, Bristol, of a 1500 kW rotary converter, 6600 V, a.c., three-phase, 50 periods, to 500 V d.c. Specifications and forms of tender from Mr. H. Faraday Proctor, The Exchange, Carn-street, Bristol, to whom tenders by 10 a.m. Sept. 16.

THE RAND WATER BOARD invites tenders (by September 28) for supply and erection at the intake pumping station, Vereeniging, of two centrifugal pumps, direct-coupled to electric motors, one 10-ton travelling crane, and the supply and erection at the main pumping station site of two centrifugal pumps coupled to electric motors. Specifications of the Department of Overseas Trade, 35, Old Queen-street, S.W.1.

THE SECRETARY of the NEW ZEALAND PUBLIC WORKS TENDER BOARD (Wellington) invites tenders (by Nov. 1) for the supply and erection of new or secondhand auxiliary plant for the Rotorua electric supply as follows:—One oil engine (200 to 250 B.H.P.) and one three-phase 50 cycle alternator of 190-kW (power factor of 0.8) with exciter and switchgear. Specifications at Department of Overseas Trade.

PRETORIA (Transvaal) Municipality requires tenders by Oct 4 for coal handling plant (contract No. 6), 6600 V cables (contract No. 7), induced draught and ash-handling plant (contract No. 8), and feed pumps, steam, air, and water piping, &c. (contract No. 9), for the electric light and power department. Specifications, &c., from the General Manager, or Mr. G. M. Clark, 40-42, Meishe-buildings, Johannesburg.

THE URUGUAYAN BOARD OF STATE ELECTRICAL STATIONS require tenders for four electrical generating sets, including one 300 to 325 kW, 3-ph., 50 cycle (2000 V between phases), one 175 kW, 3-ph., 50 cycle (6600 V between phases), one 125 kW and one 100 kW, d.c., three-wire 2x230 V; and four 4-stroke Diesel engines, one for each set. Particulars from the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1. Tenders by Sept. 19.

COVENTRY Corporation invite tenders for the manufacture and erection at their new generating station of two 10000 kW three-phase turbo-alternators, with condensing plant (Contract H 1), and four water-tube boilers, with chimneys, superheaters, mechanical stokers, economisers, &c. (Contract H 2). Specifications from Mr. Geo. Tought, engineer and manager, and tenders to the Chairman, Electricity Committee, Council House, Coventry, by Sept. 1.

THE NEW ZEALAND Public Works Department are calling for fresh tenders for the supply and erection of steel pipe lines and fittings required in connection with the Mangahao power plant. While the quantities, &c., are substantially the same as those specified in the original call for tenders, some of the conditions appear to have undergone modification. The closing date for the receipt of tenders in Wellington is Nov. 1, 1921. Specifications can be inspected at the Department of Overseas Trade.

THE ADMINISTRATION of the SOUTH AFRICAN RAILWAYS AND HARBOURS invite tenders for the supply, for 12 months ending December 31, 1922, of 85560 incandescent train lighting lamps (tungsten filament) for 24 V, 8 to 10 c.p.; 8125 engine headlight lamps, 150 W, 32 V (gas-filled 1/2 W type with concentrated filament); 50472 incandescent lamps (tungsten filament); 5545 incandescent lamps (carbon filament). Tenders by noon, November 7, to the Secretary, Tender Board, South

African Railway Headquarter Offices, Johannesburg. Particulars from the Department of Overseas Trade.

The NEW ZEALAND Public Works Department invite tenders for the manufacture, supply and delivery, ex ship's slings at Auckland, of six sets of three-phase air-brake switches suitable for operation upon 50 000-V circuits in connection with the Waikato Electric Power Scheme. Tenders to the Secretary, Public Works Tender Board, Wellington, by noon on Sept. 27. Telegraphic tenders also accepted. Specifications at the Department of Overseas Trade, 35, Old Queen-street, London, S.W.1. A copy is also available for loan to firms established in the provinces.

The PUBLIC WORKS DEPARTMENT of NEW ZEALAND invite tenders for the supply of the following plant required in connection with the Mangahao electric power scheme: Section 12: three water-wheels of 6 450 B.H.P., and two water-wheels of 3 225 B.H.P., complete with governors, couplings and accessories; Section 13: three 6 000 kVA and two 3 000 kVA alternating-current generators; Section 14: two three-unit exciter sets, each consisting of one 375 B.H.P. Pelton wheel, one 250 kW direct-current generator, and one 350 H.P. asynchronous motor; Section 15: seven 4 000 kVA single-phase transformers and accessories; Section 17: insulators for 110 000 V 50-cycle transmission lines; Section 18: lightning arresters for operation on two 110 000 V three-phase transmission lines; Section 19: switchboard, switches and accessories. Tenders to the Secretary, Public Works Tenders Board, Wellington, by noon, Nov. 29. Specifications at Department of Overseas Trade.

WARRINGTON Corporation has placed an order with Bolekow, Vaughan & Company for 300 tons of tramway rails.

Mr. R. BARRON, of Blackpool, has secured the contract for wiring the new Secondary School in Poulton-road.

Educational.

During the coming term GLASGOW UNIVERSITY Court will appoint a James Watt Professor of Electrical Engineering, and a James Watt Professor of Heat Engines. Particulars from the Secretary of the University Court.

The Merchant Venturers' Technical College, BRISTOL, provides and maintains a Faculty of Engineering, the courses of which include schemes of study for students intending to become civil, mechanical, electrical or automobile engineers. We note from the prospectus that not only the usual engineering subjects are included, but also French and German book-keeping, accountancy, works administration and organisation, commercial law, and estimating and writing specifications.

At the Rotary Club luncheon at the Bull Hotel, BURNLEY, last week, Mr. A. Charles, managing director of Components, Ltd. (Burnley), read a Paper entitled "Electricity in Domestic and Commercial Use." An interesting discussion followed in which Mr. T. Taylor, from Savanna, Illinois, spoke of the very wide use to which electricity is put in American homes.

Important alterations are to be made in the tuition fees at BIRMINGHAM UNIVERSITY. With the opening of the new term on Oct. 4 the system of composition fees, payable in advance, will be extended practically throughout the University. The fee for pure science is £32, if chemistry is included, and £25 if chemistry is not taken; for engineering, £35 the first year, and £62 in subsequent years. These fees are for studies for the degree of B.Sc. For the degree of M.Sc., a uniform charge of £30 per session is proposed.

Institution Notes.

The BATH-WALLMANS are a democratic body. It is proposed to hold the usual luncheons and "informals" during the coming session, but members are being asked to ballot on various questions regarding date, time and place, so that everyone's wishes may as far as possible be met. This is very cunning of the Committee. Various new ideas for entertainment are being mooted. Altogether a go-ahead Society.

Mr. E. L. Hill, hon. secretary of the ENGINEERS' CLUB, has received a letter, in which the Prince of Wales conveys his best wishes for the success of the club.

The honorary secretary of the SOUTH MIDLAND STUDENTS' SECTION of the INSTITUTION of ELECTRICAL ENGINEERS has changed his address to c/o Messrs. General Electric Company, Ltd., Witton, Birmingham, and would be glad to hear from student members desirous of reading Papers during the forthcoming session.

At a meeting of the Privy Council held at Buckingham Palace on Wednesday, Aug. 10, the petition of the INSTITUTION of ELECTRICAL ENGINEERS for a Royal Charter of Incorporation was approved, and a Royal Charter has now been granted. The King has also intimated his willingness to become Patron of the Institution.

Mr. W. H. Patchell (president) will preside on Saturday, Oct. 8, at the postponed 21st annual dinner of the ASSOCIATION of ENGINEERS-IN-CHARGE, to be held at the Holborn Restaurant, London, at 6 p.m. The chief guest of the evening will be Engineer Vice-Admiral Sir George G. Goodwin, Engineer-in-Chief of the Fleet, and many eminent representatives of the engineering world have notified their intention to be present. A ladies' night, consisting of a dinner and dance, will be held by the Association at the Holborn Restaurant on Saturday, Nov. 12, Mr. J. E. Watkins, Chairman of the Association, presiding.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. MESSING, ELLIS & CO., Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.

CONDENSED SPECIFICATIONS.

- 137 773 KOLBNER. System for the transmission of electro-radiant energy. (27 11 16.)
- 139 515 KOLBNER. Method of and apparatus for the reception or transmission of electro-radiant energy. (30/11/19.)
- 139 169 SWAY. Storage batteries. (15/2/19.)
- 139 514 WESTINGHOUSE LAMP CO. Electron tube apparatus. (27/2/19.)
- 139 518 WESTINGHOUSE LAMP CO. Electron tube apparatus. (27/2/19. Addition to 139 514.)
- 14 452 SINGH. Condenserless Gen. Trans. power alternating current dynamic electric machines. (23/4/18.)
- 140 765 AZIENDA ELETTRICA MUNICIPALE. Electric meters for alternating currents. (26/3/20.)
- 141 682 E. J. B. Zuss. Co. of Philadelphia. FRANKFORD, Ltd. Electrolytic treatment of ores containing zinc and other metals. (4/4/19.)
- 141 690 DUBILIER CONDENSER CO., LTD. Electric condensers. (11/4/19.)
- 141 719 PORT-IEFED MANUFACTURING CO. Electric heating device for metal melting crucibles. (18/1/17.)
- 143 493 PHILADELPHIA STORAGE BATTERY CO. Storage electric batteries and separators for the elements thereof. (17/5/09.)
- 143 844 DA & DUTILH (Firm of). Electric distant control apparatus. (26/5/20.)
- 144 650 JULIUS. Apparatus for printing and issuing totalisator tickets and for electrically controlling totalisator indicators. (6/6/19.)
- 145 476 DE FOREST. Electric subterranean signalling systems. (16/6/17.)
- 145 483 LEFEVRE. Ignition magnetos for internal-combustion engines. (27/3/19.)
- 147 516 CONSTRUCTIONS ELECTRIQUES DE BELOQUE SOC. ANON. Controllers for electric motors. (18/3/19.)
- 147 594 KRUPP AKT. GES. Apparatus for starting and protecting continuous-current motors. (14/7/19.)
- 147 601 KORTING & MATTHESEN AKT.-GES. Electricity meters. (2/4/17.)
- 148 557 KORTING & MATTHESEN AKT.-GES. Oscillating watt-hour meters. (9/6/15.)
- 148 569 CONSTRUCTIONS ELECTRIQUES DE BELOQUE SOC. ANON. Process for regenerating energy in direct-current electric motors. (7/6/19.)
- 148 835 DIAMOND ELECTRIC SPECIALITIES CORPN. Electric flash-lights and the like. (2/5/18.)
- 148 570 CONSTRUCTION ELECTRIQUES DE BELOQUE SOC. ANON. Contact finger for rheostats and other similar electrical apparatus. (2/4/19.)
- 149 646 SEAGAL. Electric condenser. (14/8/19. Addition to 146 925.)
- 149 936 AUTOMATIC TELEPHONE MFG. CO., LTD. Telephone systems. (20/8/19.)
- 150 273 PICKER. Permanent magnets for dynamo-electric machines. (16/8/19.)
- 150 739 PHILLIPS AKT.-GES. Field-magnets for magneto-electric machines. (6/9/19.)
- 150 985 PHILADELPHIA STORAGE BATTERY CO. Storage electric batteries. (5/9/19.)
- 151 959 MAGNETO BELGE SOC. ANON. Lighting-magnetos for bicycles and the like. (10/2/19.)
- 156 070 MELOTE. Means for electrically driving the bowls of centrifugal separators. (26/12/19.)
- 157 238 BENDMANN. Electric arrester. (9/8/19.)
- 161 154 REED. Electric furnaces. (27/3/20.)
- 161 347 PEARL & RUDDLE. Secret contact electric switch devices for preventing the theft of motor-vehicles. (15/3/20.)
- 163 855 MURRAY, ERSKINE & ROBINSON. Radio navigational apparatus and the like. (19/3/20.)
- 163 887 ADAMSON. Electrically-operated riveting, pressing, stamping, and the like machines. (24/4/20. Addition to 120 651.)
- 163 907 MANSELL. Electric regulating switches. (12/5/20.)
- 163 925 ORNSTROM. Electric push-button switches. (19/5/20.)
- 163 934 CALLAWAY & CALLAWAY. Terminals for binding-posts for electric wires. (21/7/20.)
- 163 962 HADDAN (Negan). Means for detecting damaged ramps in train electrical control systems. (7/11/19. Divided Application on 158 669.)
- 163 963 CHAMBERLAIN & HOOKHAM, LTD., and JAMES. Electricity meters. (20/11/19. Divided Application on 162 015.)
- 164 046 BRITISH THOMSON-HOUSTON CO., LTD., CLOUGH & TAYLOR. Windings of alternating current dynamo-electric machines. (2/12/19.)
- 164 053 PECKER. Incandescent electric lamps. (16/12/19.)
- 164 060 GRAHAM. Means for the production of sound by electro-magnetically operated diaphragms. (29/12/19.)
- 164 062 BOCKER & EICHHOFF. Manufacture of galvanic elements. (30/12/19.)
- 164 065 AYOYE. Magneto starters. (26/1/20.)
- 164 085 KRIEGER & GERSCH. Electrically controlled fastenings for doors and the like. (20/2/20.)
- 164 093 TAYLOR. Electric toasters. (25/2/20.)
- 164 100 MOEHL. Construction of aerial masts for wireless telegraphy and the like. (27/2/20.)
- 164 102 ODGEN. Electrically-driven blocks, hoists and the like. (28/2/20.)
- 164 105 DITCHAM. Wireless telephony. (28/2/20.)
- 164 108 BISHOP & CHADWICK. Electric trackless or railless tramway cars and electric transport wagons. (1/3/20.)
- 164 114 FIELD & METROPOLITAN VICKERS ELECTRICAL CO., LTD. Dynamo electric machines. (1/3/20.)
- 164 142 CONNER & LITTLEMORE. Metal contacts for electrical apparatus. (5/3/20.)
- 164 147 AUTOMATIC TELEPHONE MFG. CO., LTD., CARTER & MERCEY. Automatic telephone systems. (6/3/20.)
- 164 149 B. T.-H. Co., Ltd. (G. E. Co.) Automatic feeding mechanism for use in machines for incandescent lamp bases and the like. (6/3/20.)
- 164 162 EDLEY & FLEMING. Device for use in winding armature coils. (12/3/20.)
- 164 175 GENERAL ELECTRIC CO., LTD., GOSSLING & BARTLETT. Electron discharge devices. (19/3/20.)
- 164 185 NORTON & NORTON. Electric switches. (26/3/20.)
- 164 193 ANDERSON. Electrically heated incubator. (29/3/20.)
- 164 215 JAMES & CHAMBERLAIN & HOOKHAM. Electricity meters. (1/5/20.)
- 164 217 SCOTT. Electrical contact makers for use with steering wheels of motor vehicles. (5/5/20.)
- 164 221 FULLERS UNITED ELECTRIC WORKS, LTD. & FULLER. Galvanic batteries. (13/5/20.)
- 164 225 ROSS. Electric distribution systems. (17/5/20.)
- 164 235 OLDHAM & OLDHAM. Galvanic batteries. (17/5/20.)
- 164 239 WESTERN ELECTRIC CO., LTD. (Western Electric Co., Inc.) Telephone systems. (11/6/20. Addition to 151 140.)
- 164 293 LAWSON. Electricity meters. (31/7/20. Divided application on 162 702.)
- 164 363 GRAMAM. Electric lamps and lamp systems. (25/2/19.)
- 164 370 CREED & CO., LTD. & CREED. Printing apparatus suitable for reproducing in ordinary printed characters telegraphic messages. (6/8/19.)
- 164 373 EASTERN TELEGRAPH CO., LTD., FRASER, WOOD & SMITH. Telegraphic receiving perforators. (25/8/19.)
- 164 380 ATKINS & RYLANDS BROS., LTD. Metal electrodes for use in the welding or deposition of metals. (19/7/20.)
- 164 415 WOONHAM (Naamloze Vennootschap Metaal draadlampenfabriek "Holland"). Electric lamps and the like. (3/2/20.)
- 164 421 MURRAY & TELEPHONE MANUFACTURING CO. (1920), LTD. Telephones. (5/2/20.)
- 164 425 JACKSON MELLERSH (Newland Patents, Ltd.). Dynamo-electric apparatus for generating and delivering alternating current of adjustable frequency, specially applicable for controlling and adjusting the speed of alternating current motors. (6/2/20.)

APPLICATIONS FOR PATENTS.

March 14, 1921.

- 7 937 & Co. T. H. Co. & Young. Ignition devices.
 8 011 GILL. (Deutsche Telefonwerke Ges.) Telephone systems with high-frequency oscillations.

March 15, 1921.

- 8 031 METCALF. Electric signalling or call apparatus.
 8 032 GARDINER. Dry storage batteries.
 8 033 BOSCH (R.). Akt.-Ges. Electric starting and energy generating machines for automobiles. (29/11/20, Germany.)
 8 034 ASHBE. Electro-mechanical lock.
 8 035 PARRY. Insulators for supporting conductors.
 8 036 M. L. MAGNETO SYND. & MCGOWAN. High-tension distributors for electric ignition apparatus.
 8 037 McKENZIE, HULLAN & WESTINGHOUSE POWER SIGNAL CO. Apparatus for electric motors. (9/11/20, France.)
 8 038 KRUPE (F.) Akt.-Ges. Electro-magnetic switch. (20/12/20, Germany.)
 8 103 B.T.-H. Co., Young & Warren. Magneto-electric machines.
 8 126 DORSEY. Electric water heaters.
 8 247 THURGOOD, DOUBLET & Co. Contact-breakers for magnetos.
 8 140 GILL. (Deutsche Telefonwerke Ges.) High-frequency multiplex transmission.
 8 141 GILL. (Deutsche Telefonwerke Ges.) Circuit arrangements for multiplex telegraphy and telephony.

March 16, 1921.

- 8 182 MASEY. Perpetual motion or magnetically-propelled power generator.
 8 187 BEAN & ROWLANDS. Electric torches, &c.
 8 197 GREATHAM MOTOR & ENGINEERING CO., SWEENEY & BOORD. Electric starting gear for internal combustion engines.
 8 233 REDDIE. (Soc. Pinelli & Co.) High-tension cables.
 8 235 SCHROEDER. Commutators.
 8 247 TRICHARD. Frequency multipliers for a.c. circuits. (16/3/20, France.)
 8 256 DARIMONT. Primary cells.
 8 277 ROUND. Reception of continuous-wave signals.

March 17, 1921.

- 8 320 ROBERTS. Variable ignition magneto coupling.
 8 349 ARMSTRONG SIDDELEY MOTORS, LTD., & SMITH. Gearing for starting motors and electric generators used on engines.
 8 384 EDISON SWAN ELECTRIC CO. & RAPHAEL. Fixing electric cables and wires.
 8 399 B.T.-H. Co. (Soc. d'Electricite et de Mecanique.) Electric rheostats.
 8 412 MILLER-JACKSON. (Cie. Generale d'Electricite.) Thermo-electronic relays, &c.

March 18, 1921.

- 8 434 SHAW. Electric heating apparatus.
 8 448 MUNTWYLER. Electric heating apparatus.
 8 462 BARBER. Electro-magnetic relays.
 8 467 THURGOOD. Constant speed dynamo drive.
 8 474 LYON. Electric generating sets.
 8 483 B.T.-H. Co. (G.E. Co.) Lamp-making machines.
 8 484 NOTTET. Electric heaters for liquids.
 8 491 AUSTIN. Facilitating identification of electric conductors.

March 19, 1921.

- 8 551 SIMPKIN & WHITELOCK. Reduction of starting load on pumps, &c., directly coupled to motors.
 8 577 BUFTON & MARPLES. Electric switches.
 8 596 BURNHAM & PHILLIPS. Wireless receiving apparatus.
 8 606 BARAN. (Alendort.) Electro-mechanically controlled telephone system.
 8 630 CHANDLER. Directional wireless apparatus.

March 21, 1921.

- 8 655 WALSH HARDWARE MFG. CO., FRANKS, READ & MAIRY. Earthing clip for electric conductors.
 8 656 WRIGHT. Electric bells.
 8 657 SMITHERS. Telephone call recorder.
 8 712 METROPOLITAN VICKERS ELECTRICAL CO. Governing devices for steam turbines (10/4/20, U.S.).
 8 713 MARKS. (Siemens-Schuckertwerke.) Arc welding apparatus.
 8 714 ARATE & WILLIAMS. Generating continuous electric oscillations.
 8 721 PICKER & BOUND. Supporting electrodes of thermionic devices.
 8 722 VOGEL. Electric storage of secondary cells.
 8 744 AUTOMATIC TELEPHONE MFG. CO. Telephone systems. (29/3/20, U.S.).

March 22, 1921.

- 8 758 ELLIS. (Johnson, Fare Box Co.) Retaining devices for overhead trolley collecting wheels.
 8 775 DELLA VIGNA. Electric starters for engines. (23/2/20, Italy.)
 8 780 ELLERSMAW. Electric fuse-holders.
 8 798 BRITISH ARC WELDING CO. & OGDEN. Automatic regulation of internal combustion engine driven electric generator.
 8 802 OLDENBOURG. Dispatch of electric messages.
 8 822 METROPOLITAN VICKERS ELECTRICAL CO. & JUHLIN. Radial-type commutators.
 8 823 METROPOLITAN VICKERS ELECTRICAL CO. & LANGRISH. Rheostats.
 8 832 BOUTHERST. Relays for wireless telegraphy.
 8 862 SACHSEN LICHT UND KRAFT AKT. GES. Electric machines. (22/3/20, Germany.)

March 23, 1921.

- 8 877 CRAKER & WARD. Electrically-controlled cranking device for engines.
 8 878 WHEELER. Automatic electric and time switch.
 8 883 WILLIAMS & CO. Photo-electric cells.
 8 940 & 8 944 CASE. Photo-electric cells.
 8 918 BERRYMAN & McCLOSKEY. Portable switch-board.
 8 919 SCHATTNER. Circuit-making and breaking device.
 8 921 M. L. MAGNETO SYND. & WATSON. Bobbins for magneto-electric apparatus.
 8 973 KEMPER. Electric lamp holders. (13/9/20, Germany.)
 8 974 LAWSON. Electric meters.
 8 981 B.T.-H. Co. & SUGDEN. Starting devices for motors.
 8 987 BERNARD. Auxiliary spark-gap devices. (1/1/21, France.)
 9 017 WADDE. (Hazelett Storage Battery Co.) Manufacture of storage batteries.
 9 021 WADDE. (Hazelett Storage Battery Co.) Manufacture of storage batteries.

March 24, 1921.

- 9 022 DEAN-OSGOOD. Electric heating resistance elements.
 9 087 HENDERSON & HINDSON. Portable hand-operated electric coal drilling machines.
 9 093 RYNDOLLS & FAIRBRIER. Insulators and insulating material.
 9 095 ROADCRAFT, LTD. & CAREY. Electrically-driven trolleys, tractors, &c.
 9 103 M. L. MAGNETO SYND. (Magneto-electric generators) & Watson.
 9 104 TUBES, LTD. Casings for voltmeters, ammeters, &c.
 9 125 LAWSON. Electric meters.
 9 131 & 9 132 PLANSON (nee Hildenbrandt). Carrying out electro-chemical reactions.
 9 144 B.T.-H. Co. (G.E. Co.) Electric regulating systems.
 9 176 MONKHOUSE & TATE. Holders for electric lamps.
 9 180 LEVY. Electric oscillation generator. (29/3/20, France.)
 9 182 WHITTAKER-SWINTON. Polyphase currents for wireless telegraphy, telephony, &c.
 9 183 BRITISH VACUUM TUBE RESEARCH ASSOCIATION, PHILPOT & JACKSON. Regulating vacuum in X-ray tubes, &c.
 9 191 MARKS. (Aknebolaget Kraftveindustri.) Heating material in electric furnaces.
 9 192 MINJES. Electric motors.
 9 193 AKT.-GES. BROWN, BOYER & Co. Means for suppressing upper harmonic anode currents in metal vapour rectifiers. (1/4/20, Switzerland.)

Companies' Reports, &c.

VERA CRUZ ELECTRIC LIGHT, POWER & TRACTION.

Mr. V. W. YORKE (chairman), who presided at the annual meeting of the above company in London last week, said that during the past year he had visited Mexico, and had spent two days at Vera Cruz, where he found everything very satisfactory. The tramways had recently been extended to the new sea-bathing resort at Balneario, and approximately 25,000 passengers were being carried per week. Over the whole system they had now 15 trams in daily use, but owing to the increasing traffic additional cars would have to be purchased in the near future. The Tuxpango Puebla Tramway, Light & Power Company had continued to give a satisfactory supply of power. During the few interruptions that did occur in the supply they (Vera Cruz Electric Light, Power & Traction Company) Diesel engine plant carried the load, but this plant was now very old, and a new steam turbine would shortly have to be installed.

With regard to the accounts, after providing for the debentures and corporation profits tax, there was a balance of £48 582 7s. 4d. A dividend of 5 per cent. had been paid in respect of 1920, and it was proposed to pay a further 5 per cent., which would absorb £35 000. It was proposed to place £15 000 to depreciation and reserve account (the same figure as last year), which left £21 980 15s. 11d. to be carried forward (£1 400 less than last year). The depreciation and general reserve account now stood at £75,000. Owing to increased operating costs, higher wages, and a strike of tramway employees in September, the net profits in Mexico were about 890,000 less than those for the previous year. Both sections of the company's business were, however, showing satisfactory increases: the combined net earnings for the first six months of the current year were 25 per cent. above those for the corresponding period of 1920.

The Rt. Hon. Earl Buxton, G.C.M.G., has accepted an invitation to join the board of the BRITISH THOMSON-HOUSTON COMPANY, LTD.

The OXFORD ELECTRIC COMPANY have declared a dividend at 5 per cent. per annum, less tax, on the ordinary shares for the half year.

An issue of £750 000 6 per cent. debentures, at £96 per £100 debenture, was made during the week by the COUNTY OF SOUTHLAND ELECTRIC POWER BOARD.

The BRITISH ELECTRIC TRANSFORMER COMPANY have declared an interim dividend at the rate of 6 per cent. per annum on the ordinary shares for the past half-year.

The half-year's interest on the general consolidated first mortgage 50-year 5 per cent. Gold bonds of the MEXICO TRAMWAYS COMPANY will be paid on and after Sept. 1.

An interim dividend at the rate of 5 per cent. per annum has been declared by the CLYDE VALLEY ELECTRICAL POWER COMPANY on the ordinary shares for the past half-year.

The ADELAIDE ELECTRIC SUPPLY COMPANY have declared a dividend at the rate of 6 per cent. per annum for the half year ending Aug. 31, 1921, less tax, on the cumulative preference shares.

A dividend at the rate of 8 per cent. per annum, less tax, for the half year ending August 31, has been declared by the MELBOURNE ELECTRIC SUPPLY COMPANY on the first cumulative preference shares.

The gross revenue of the PORTLAND (OREGON) RAILWAY, LIGHT & POWER COMPANY for the year 1920 was \$956 4 615. After paying \$2 101 615 interest and meeting various charges, \$711 459 remains to be carried forward.

For the half-year ended July 31 the ABERDEEN SUBURBAN TRAMWAYS COMPANY made a profit of £1 771, plus £3 808 brought in, making £5 579. After placing £1 000 to the renewal and depreciation account, making it £22 300 and providing for a dividend of 7 per cent. for the year and £100 directors' fees, £2 292 remains to be carried forward.

For the year ended June 30 the profit of BENN BROTHERS, LTD., was £24 836, plus £5 711 brought in, making £30 547, less directors' percentages £4 986, leaving £25 561. It is proposed to add £2 000 to general reserve, bringing the account up to £8 000. A dividend of 15 per cent., less tax, on the ordinary shares is recommended, leaving £8 453 to be carried forward.

The profit of the TYNESIDE TRAMWAYS AND TRAMROADS COMPANY for the half-year ended June 30 was £4 787, plus £488 brought in, making £5 275, less interest, on mortgages, loans, &c., £2 023, leaving £3 249. A dividend on the ordinary shares has been declared at the rate of 3 per cent. per annum, less tax and £500 has been placed to reserve, leaving £140 to be carried forward. Traffic receipts show an increase of £1 180.

The CITY OF LONDON ELECTRIC LIGHTING COMPANY has declared dividends, less tax, at the rate of 6 per cent. per annum on the first preference shares for the half-year ended June 30; at the rate of 8 per cent. per annum upon 10s. per share from April 25 to June 30 on the second preference shares issued in April, 1921; 1s. per share for the half-year on the ordinary shares numbered 400 001 to 1 105 950; and 2-2d. per share on the ordinary shares numbered 1 105 951 to 1 200 000.

Mr. Herbert Guadalla, who presided over the meeting of the SAO PAULO IMPROVEMENTS & FREEHOLD LAND COMPANY, LTD., last week, said that during the 14 months covered by the report considerable progress had been made in development work, construction of roads, and the provision of public utilities, such as electric light, water, &c. At the Villa America Estate the contemplated extensions to the tramways and telephone services had been delayed, owing to difficulty in obtaining materials. At Lapa, 12 kilometres of streets had been completed, and 1 320 metres of tramlines laid.

Bankruptcies, Liquidations, &c.

HUB-ON'S ELECTRICAL ENGINEERING COMPANY, LTD., has agreed upon voluntary liquidation. A first meeting of creditors will be held at the Griffin Hotel, Boar-lane, Leeds, on Monday, Aug. 29, at 11 a.m.

A first and final dividend of 1½d. in the £ in the matter of Walter Hedgecox, 121, Salop-street, Wolverhampton, electrical engineer, is payable August 29 at the Official Receiver's Office, 30, Lichfield-street, Wolverhampton.

A receiving order was granted on Aug. 16, on debtor's petition, to **THOMAS HYDE**, 180, London-road, Croydon, Surrey, electrician. First meeting, Aug. 26, 12 noon, 132, York-road, Westminster Bridge-road, S.E. 1. Public examination, Oct. 20, 11 a.m., County Court, Scarbrook-road, Croydon.

A deed of assignment for the benefit of creditors was executed on June 9 by **ARTHUR GRAY** (trading as Gray Electrical Company), of 9, Denmark-street, Charing Cross-road, London, W.C. 2. Claims should be sent on or before Sept 12 to the trustee, William A. J. Osborne, Balfour House, Finsbury-pavement, London, E.C., in order to benefit by dividend about to be declared.

New Companies.

The following list is compiled from information supplied by Messrs Jordan & Sons, Ltd., company registration agents, 116 and 117, Chancery-Lane, London, W.C. 2:—

CINEMA REQUISITES, LTD. (176 241).—Reg. Aug. 12. Electricians and engineers. Nominal capital, £500 in 500 shares of £1 each. Subscribers: J. E. D. Kendrick, 14, Poulter-street, Aintree, Liverpool; A. G. Wilson, 94, St. Donnings-vale, Liverpool.

FRANK RAWCLIFFE & COMPANY, LTD. (176 278).—Reg. Aug. 15, 8, Nun-street, Newcastle-upon-Tyne. Electrical engineers and factors. Nominal capital, £12 000 in 12 000 shares of £1 each. Directors: F. Rawcliffe, 9, Queen's-gardens, Benton; J. McGree, 9, Queen's-gardens, Benton.

MODERN ELECTRICAL SUPPLY COMPANY, LTD. (176 286).—Reg. Aug. 15. -7/8/9, Whitcross-place, Wilson-street, Finsbury-square, E.C. 2, electrical engineers. Nominal capital, £1 500 in 1 500 shares of £1 each. Directors: A. T. Whittle, "Sam Suffy," Grosvenor-road, Broadstairs (governing director and managing director); G. F. A. Stone, 14, High-street, Pinner; G. A. Davenport, 14, High-street, Pinner.

OHMS, LTD. (176 318).—Reg. Aug. 16, 41, Upper Berkeley-street, W.1. Electricians, electrical engineers and contractors. Nominal capital, £400 in 400 ordinary shares of £1 each.

TECHNICAL TRADES' SUPPLY CORPORATION, LTD. (176 293).—Reg. Aug. 15, Craven House, Kingsway, W.C. 2. Manufacturers, traders and agents in all materials used by "The Technical Trades," namely, the building and engineering trades. Nominal capital, £2 000 in 40 000 shares of 1s. each, 5 000 of the shares (to be numbered 1 to 5 000 inclusive) to be called Founders' Shares. Directors: C. W. Gray, The Cottage, Lynton-stown Avenue, New Barnet; S. Hobman, Lynton House, Hockley, Essex; A. M. Nelson, 26, Kingscliffe-gardens, Wimbledon Park, S.W.; G. P. Blades, 2, Ryde-street, St. James's, S.W.; E. W. Dickie, 91, Endlesham-road, Balham, S.W.

VICI ENGINEERING COMPANY, LTD. (176 362).—Reg. Aug. 18. Electrical engineers, &c. Nominal capital, £50 000 in 50 000 shares of £1 each. Subscribers: W. L. Williams, Schinor-villa, Rayleigh, Essex; C. S. M. Harding, 22, Fernwood-avenue, Streatham, S.W.

WREN THREE LINK PATENT SAFETY COUPLER, LTD. (176 331).—Reg. Aug. 16. Electrical engineers, &c. Nominal capital, £1 500 in 1 500 shares of £1 each. Subscribers: G. T. Little, 7, Dorncliffe-road, Fulham, W.S.6; F. W. Eve, 38, Salmon-lane, Limehouse, E.14.

Books Received.

[Copies of the undermentioned works can be had from THE ELECTRICIAN Offices at receipt of published price, plus postage.]

"Costruzioni Elettromeccaniche." By E. Morelli. Vol. I.—Generatrice a Corrente Continua. Pp. 824. Lire 70. Vol. II, Section 1.—Macchine Generatrice a Corrente Alternata. Pp. 599. Lire 60. Vol. II, Section 2.—Trasformatore-Motori-Commutatore-Gruppi Varii. Pp. 795. Lire 70. (Torino: Unione Tipografica Editrice Torinese.)

"South African Engineers' Electrical and Allied Trades Directory." Pp. x+481. 30s.

"Modern Motor Car Practice." Edited by W. H. Berry. (London: Henry Frowde and Hodder & Stoughton.) Pp. xii+582. 31s. 6d. net.

"Telefon-Haandbogen, 1921-22." (Odense: Fyens Stiftsbogtrykkeri Dreyer.) Pp. 447.

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Benn Brothers' Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"The Cabinet Maker" (Annual Colonial Issue); "K. D. Upholstery for Export"; "Exports of Furniture to the Colonies"; "Practical Window Dressing."

"The Chemical Age" (Special Colonial Annual): "Trade Openings and Possibilities in the Colonies"; "Electrometric Control in Chemical Industry," by Dr. E. K. Rideal.

"Farm and Home": "Ensilage on the Farm"; "Belated Corn Claims"; "Minister Faces the Music."

"The Fruit-Grower": "Popularising the Apple-Eating Habit"; "Shrewsbury Show"; "The Public and Prices."

"Gardening Illustrated": "Herbaceous Borders in Autumn" (illustrated); "Autumn Flowering Shrubs"; "Rose Muriel Wilson" (illustrated.)

"The Gas World": "The Price of Gas and the profits of Gas Supply"

"The Difficulties of the Gas Companies"; "What the Gas Companies have done for the Consumers."

"The Hardware Trade Journal" (48th Colonial Annual): "Midland Hardware and Colonial Trade"; "How to Mount Grinding Wheels"; "Empire Notes"; "Common Sense and Salesmanship."

Forty Years Ago.

(THE ELECTRICIAN, AUGUST 27, 1881.)

ELECTRIC LIGHT IN EDINBURGH.—We hear that Messrs. R. E. Crompton & Company are lighting Holyrood Palace, Edinburgh, with their lights.

THE NEW ATLANTIC CABLE.—On Monday evening last the telegraph steamer "Faraday" picked up the shore end of the new Atlantic cable, and, having made the necessary splice, proceeded on her outward voyage, laying the mid-ocean section.

ELECTRIC LIGHT FOR VIENNA.—It is stated that an electric light company has offered to light one of the squares of Vienna at its own expense as an experiment, and that the Municipality have accepted this offer for the street called La Graben, and the Place de la Cathédrale de St. Etienne.

SPIDERS AND THE TELEGRAPH.—In Japan the spiders spin long webs from the telegraph wires to the trees and to the earth, which, in wet weather, become good conductors and carry off the current. Men are therefore employed to keep the lines clear, which they do by brushing them with long bamboo poles.

THE POSTAL AND TELEGRAPH SERVICES.—Mr. G. Stewart MacLiver, M.P., has given notice of the following motion:—"To move, early next Session, for a Select Committee to enquire into the working and management of the Postal and Telegraph Services, with a view to ascertain whether increased facilities and lower rates cannot be afforded; and also to consider and report on the relationship of the letter-carrying and telegraph services to each other, and the best means of securing efficiency in both branches, having regard to their constantly increasing importance in their bearing on social and commercial life."

Prices of Metals, Chemicals, &c.

		Price.	TUESDAY, Aug. 23.	
			Inc.	Dec.
Copper—	Best selected..... per ton	£66 10 0	—	£3 15 0
	Electro Wirebars	£72 10 0	—	£2 10 0
	H.C. wire, basis	0s. 11½d.	—	½d.
	Sheet	0s. 10½d.	—	½d.
Phosphor Bronze Wire (Telephone)—	Phosphor-bronze			
	wire, basis	1s. 3½d.	—	½d.
Brass 60/40—	Rod, basis	0s. 8d.	—	—
	Sheet, basis	0s. 10½d.	—	—
	Wire, basis	0s. 11½d.	—	—
Pig Iron—	Cleveland Warrants .. per ton	£6 15 0	—	—
	Galvanised steel wire, basis 8 SWG ..	£25 0 0	—	—
Lead Pig—	English	£24 5 0	—	£0 10 0
	Foreign or Colonial ...	£23 2 6	—	£0 10 0
Tin—	Ingot	£152 12 6	—	£2 17 6
	Wire, basis	2s. 1½d.	—	½d.

Salammoniac.—Per cwt. 65s.-60s.

Sulphur (Flowers).—Ton £13.

" (Roll-Brimstone).—Per ton

£13.

Sulphuric Acid (Pyrites, 168°).—

Per ton, £9 17s. 6d.

Copper Sulphate.—Per ton £30.

Boric Acid (Crystals).—Per ton

£65.

Sodium Bichromate.—Per lb. 7½d.

Sodium Chlorate.—Per lb. 3½d.

Rubber.—Para fine, 1s. 0½d.; plantation 1st latex, 8½d. lb.

The metal prices are supplied by British Insulated & Holuby Cables, Ltd., and the rubber figures by W. T. Henley's Telegraph Works Co.

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Notes.

History Repeating Itself.

THE fact that, owing to the wide difference in the exchanges and to industrial conditions generally, Germany is gradually building up an export trade at our expense is not unnaturally giving grave anxiety in commercial circles. The most obvious result of this development is that Germany is able to undercut us in the world's markets, and the most obvious remedy is that we should reduce our prices so as to be able to compete on a level with them. But if we draw on our past experience we find that it is more than a little doubtful whether this is the real solution. Something very like present conditions are not altogether a new experience in the British electrical industry. Indeed, 12 or 15 years ago British electrical manufacturers were passing through just the same crisis as are other British manufacturers now. They were faced with most strenuous competition not only in the foreign, but in the home markets, and there were then, as now, not lacking those who asserted that the best policy was to meet cut with cut in the hope that present necessity would be turned to glorious gain in the future. As a matter of fact it is ancient history that such optimism was not justified.

How Germany Helps British Trade.

IT may, therefore, be argued that industrial conditions then and now differ rather in quantity than in quality, and in degree rather than in kind. Germany, with a very much lower rate of taxation per head, and a very much more inflated currency than ourselves, is regaining a place in the world's markets which she had absolutely lost, and we are apparently losing what we thought we had securely gained. The only thing for us to do, say some of the more sapient of our advisers, is to decrease our taxation, and to deflate our currency. While we admit that present conditions are most harmful to the development of British trade, and that if they continue the prospects for a revival of our commerce are not encouraging, we cannot agree that to follow Germany's financial policy is the best way out of our difficulties. Indeed we consider that to do so would

be the best way to land us in fresh difficulties. Deflation and inflation, which are as closely related as NEWTON'S action and reaction, are but temporary phases, and must the more gradually approach each other as the world's trade becomes normal. Paradoxical as it may seem in fact, Germany is employing one of the best ways of assisting British trade by adopting her present policy of living in the present and taking no thought for the future.

The Present versus the Future.

THE relative position of the two countries, in fact, reminds us of two householders with approximately the same financial resources, one of whom lives laborious and unexciting days in order to secure by insurance and investment some means to support his old age, while the other lives for the day alone and, trapping pleasure as it flies, lets old age look after itself. There is no doubt which of these two men enjoys what is known as the better time at the moment. There is equally no doubt as to which is pursuing the best financial policy for the future. Or, once again to compare British and German financial methods, we feel sure that, while at the moment we are being called upon to make almost overwhelming sacrifices, we shall much sooner than our trade rivals reach a position of industrial and financial stability.

Reduction in National Expenditure Essential.

THE opinions which we have just expressed refer to international finance, in which field our policy seems the correct one to follow. But when we come to examine British national finance we are immediately struck by the need for some drastic change in the policy which has been adopted. In home finance the watchword is *laissez faire*, and that must be changed for something better if we are not to drift into disaster. And while on the one hand we must have a policy that is concerned with liquidating the war debt, it must at the same time ensure that that war debt is not increased by peace-time expenditure. It must go further. It must ensure that our present expenditure is reduced. For only by reducing our expenditure can we hope for a reduction in the taxation which is preventing more surely than any foreign competition the proper development of the industries of the country.

A Premium on Unemployment.

WE have for so long endured an ever-mounting income tax, not to speak of such modern excrescences as the Excess Profits Duty and the Corporation Tax, that we have almost been drugged into a state when we imagine that the maintenance of taxation at its present level is among the benefits of modern civilisation. But, while it may be admitted that some taxation is a necessity, there will be few that will disagree that high taxation, and especially over high taxation, is an unmitigated evil. And not less an evil than high taxation is taxation which in its genesis prevents all enterprise and industrial development. As Sir JOHN BENN said at the annual general meeting of Benn Brothers Ltd., last week, "the present rate and manner of taxation offers a premium to bankruptcy and unemployment." This applies particularly to the Corporation Tax, which "introduces a new trade-destroying principle into taxation. It is a tax upon industry, as industry, and upon the most beneficent part of the industry, namely, joint-stock enterprise." These statements are of the most general application. BENN BROTHERS are, it is true, publishers, not engineers, but they are publishers of many different sorts of journals, and their experience therefore forms an excellent trade barometer. To quote Sir JOHN BENN again: "If the State devotes its energies to a wise economy instead of harassing business, the barometer will soon show 'set fair.'" It is in this direction, and in the movement towards a closer co-operation between employers and employed, wherein BENN BROTHERS themselves set a notable example, that the best hopes for the recovery of British industry really lie.

The Effect on Eyesight of Kinema Studio Lights

COMMENT has recently been made both in THE ELECTRICIAN and before the Illuminating Engineering Society on the alleged prejudicial effects on the eyesight of certain lamps used in kinema studios. We are therefore interested to see that a Report on this subject has now been issued by the Committee on the Causes and Prevention of Blindness, which has been working under the Ministry of Health. During the latter part of 1920 it appears complaints were received of injury to the eyes of actors in studios, this injury being ascribed to the powerful lights employed. Sir ANDERSON CRITCHETT mentions five such cases. The injuries seem to be transient and to resemble those familiar to people working with naked arcs at close quarters, e.g., for welding operations. No cases of permanent injury are recorded. From the evidence of witnesses it is deduced that the injuries arose mainly as the result of using certain powerful searchlight lamps imported from America without any form of diffusing shade. The Incorporated Association of Kinematograph Manufacturers have given their assurance that naked lights of this type will no longer be used in their studios, and experts seem agreed that, even from the photographic standpoint, their use is not desirable. Thus the lessons already appreciated in ordinary lighting problems apply also in the Kinema studio. This particular point seems a fairly obvious one that only needed authoritative evidence to indicate the right methods. There are, however, other more complex problems to be studied, and in the final paragraph of their Report the Committee express approval of the step taken by the Illuminating Engineering Society in forming a Joint Committee to carry on further investigations.

Swiss Hydro-Electric Policy.

FOR a small country with no coal or iron Switzerland has done well to develop its industrial position so successfully. There is no doubt, however, that the utilisation of the water power resources of the country which have made her independent of coal have been a large factor in this success. Prior

to the war the various waterfalls were being gradually brought into use for the generation of electrical energy for power, light and traction; but as all the coal used in Switzerland is imported either from Germany or Belgium the war necessitated greater attention being paid to the employment of hydro-electric power and the rate of development was speeded up. The result is that there are now over 6 870 power stations of which 178 have an output exceeding 500 h.p. The total aggregate output of these works is estimated at about 3.2 milliard units per year, or an equivalent of about 4 million tons of coal. It is interesting to find that in the majority of cases the large generating stations are owned by Companies, but the distribution of electricity is mainly in the hands of municipalities, cantons or inter-cantonal associations.

An Example to be Copied.

THIS distinction between the generation and the retail supply of electricity is an example which might be followed in this country, especially as this state of affairs has only been reached by a process of evolution. Like this country, the electricity works were formerly quite independent of one another, but now interlinking is being effected between all power stations and two special power transmission companies have been formed for the purpose of transmitting electrical energy from one part of the country to the other. Though the greater part of the energy is used for industrial power, lighting and domestic purposes, electro-chemical and metallurgical works are also substantial consumers. Electric heating and cooking are making rapid progress, even schools, churches and public buildings being heated electrically.

An "All-Electric" Country.

IN some spinning and weaving mills steam is produced electrically during the night and stored up for use during the day. The electric drive is now almost universal in textile mills, between 90 and 95 per cent. of the cotton spinning mills being now generated electrically, compared with 48 per cent in 1911. It is claimed that the consumption of electric current per inhabitant is greater in Switzerland than in any other country in the world, being 842 units per head per year, or 2.31 units per day. Taking the average of the charges for lighting and power this represents a cost of about 81 centimes a day. The charge for electric lighting is so low everywhere that all other forms of illumination are ruled out, and even with coal prices approaching those of pre-war days, hydro-electric energy would still, it is said, be cheaper. As substantial progress is also being made with the electrification of the Swiss railways it will not be long before we shall see every mechanical operation in the country performed electrically, no doubt to the great economic and social advantage of the inhabitants. All together a happy land from the electrical point of view.

Oil Fuel from a Critical Point of View.

THE publication of a pamphlet by the Manchester Steam Users' Association on some phases of the application of oil fuel to steam boilers is not only opportune, but is worthy of that close attention which is the due of any publication on such a subject associated with the name of Mr. C. E. STROMMEYER. As is not unnatural, considering its place of origin, there is plenty of insistence in the pamphlet on the dangers incidental to oil firing. These dangers, it appears, are not only present when oil is being used, but do not disappear for some time after the system has been abandoned. Unconsumed or partially consumed oil, for instance, may have settled in the flues, or oil leakages may have saturated the brickwork, with the result that if the dampers are closed over night, as is

customary under coal-firing conditions, vapours may accumulate in the flues and explode when the heater is re-lighted. Another danger arises when a carbonised particle of oil, which may have settled in the flues, is distributed when coal is burned. On the other hand, the experience of the Association is that for economic reasons there has been widespread disappointment owing to the inefficiency of the oil burners, and that, in spite of the higher calorific value of oil, most users have found that they were consuming the same weight of oil as of coal and obtaining less power. On the financial side, too, matters are less in favour of oil than is sometimes supposed, and the general conclusion, with which we think there will be equally general agreement, is for the moment coal still holds the field, both economically and from steam-raising standpoints. There are cases where for quite special reasons oil will probably find an increasing application. We know of certain electricity stations which are without siding accommodation where no storage ground is available, and where, as a consequence, not only is the maintenance of the coal supply difficult, but ash-handling is a not inconsiderable item in the revenue account. Under such conditions it is obviously economically sound to employ oil rather than coal, and we shall not be surprised to find that this will be done in the near future.

The Bermondsey Clause Once More.

WHILE perusing some of the Special Orders recently made by the Electricity Commissioners we came across an old friend. For the Guildford Order, which authorises the Corporation to acquire the undertaking of the Guildford Electricity Supply Company and extends the supply area to certain neighbouring rural districts, contains a modification of the clause imposed in 1902 upon Bermondsey Borough Council by a House of Lords Committee. Variations of the clause, known as the Northumberland and Winchester Clauses, have from time to time been inserted in Orders at the instance of the gas companies, but committees of both Houses have as frequently refused to allow its insertion, and since 1911 there have been only one or two cases in which it has been permitted. To the principle of the clause, viz., that electricity undertakers shall fix their charges so that the revenue shall be not less than the expenditure, there can be no objection from anyone, except on the ground that if this obligation is inserted in one Order it should be inserted in all. But it is really unnecessary, for ratepayers are now strongly opposed to any municipal venture which is likely to add to the present heavy burden of the rates. Even were they not the majority of municipal electric-supply works were profit-making concerns in pre-war days and will be so again, when things become more normal.

Scope of the Clause.

BUT in Guildford they are evidently suspicious, for by the terms of the Order, the Corporation are required on the completion of the fifth complete financial year, and on the expiration of each fifth succeeding year, to revise the prices charged for electrical energy, so that no contribution from the rates will be required during the next five years. The prices must not exceed the maximum allowed in the Order, i.e., one shilling a unit. For street lighting the rate must not exceed that charged to consumers using energy for lighting for the like hours of supply, and for any other municipal purpose the charge must not exceed that made to consumers using energy for similar purposes and for like hours of supply. Some of these provisions will be very difficult, if not impossible, to enforce; but perhaps they are not meant to be enforced, as no penalty is imposed for their infraction. In fact it all looks like a bit of window dressing.

Progress of Marconi Companies.

THE long and interesting address of Mr. G. MARCONI, at last week's meeting of Marconi's Wireless Telegraph Company, covered, as might be expected, a great deal of ground, and gave a good idea of the steady progress that is being made in wireless telegraphy and telephony. Naturally, the Company's research department is very elaborate and well-organised, and we gather that, as the result of researches and tests, carried out by and under the guidance of Mr. MARCONI, in order to get rid of the effects of atmospheric, improvements and inventions have been made to which the greatest importance is attached. It is well-known that for sometime past Mr. MARCONI has been devoting his attention to this important subject, and he claims that "the results obtained during the last few weeks by the combination of various devices and inventions are of signal importance, and that, if we have not completely mastered the troubles arising from adverse atmospheric conditions, we have gone far enough to enable me to tell you that this work is of transcendental importance and epoch-making in the conduct of wireless telegraph services." This is a very guarded statement, but it is also definitely claimed that the new arrangements not only enable communication to be carried on under conditions which previously made it impossible, but also allow of a very considerable increase in speed and improvement in accuracy. Should these claims be justified in practice, there is no doubt that a great advance will have been made in the range and utility of radio-telegraph services. For technical, as distinct from commercial, reasons, it is a pity that the Company are not more open about the results of the research work which they are carrying on.

Company's Claims against Government.

Mr. MARCONI's speech also elucidated the Company's position in regard to foreign contracts and the shrinkage of the gross profits, the claims against British Government departments and other matters. The attitude of the Treasury in regard to the claims against the Admiralty, and other departments for the infringement of the Lodge patent, and for the payment of remuneration for services rendered during the war is not a creditable one, but the Company's experience is similar to that of other engineering firms. At first, the Admiralty denied infringement, and then, after four years' negotiations over arbitration terms, the dispute was referred to the late Lord Moulton who decided in favour of the Company in August, 1920. The next step was to obtain the number of circuits used, but it took nearly a year before this information was forthcoming, and it will, we understand, be another year before the Royal Commission on Awards to Inventors will be able to deal with the actual claims of the Company. We are accustomed to dilatory methods by Government departments, especially when dealing with monetary demands, but we think that the Chairman of the Marconi Company is fully justified in complaining of the great delay, and the manner of dealing with, the claims his undertaking has put forward.

The Future of the Overseas Trade Department.

THE question of what does and what does not constitute economy in a Government Department is not made any easier to answer by the report of a Committee presided over by Mr. STANLEY HOLMES on the Department of Overseas Trade. This Department, it will be remembered, was created to assist the development of the country's trade by keeping in touch with foreign markets. That it has not been so successful as it might have been may be ascribed to its youth, and to a lack of that sense which grasps instinctively what is and what is not required. Nevertheless the trade service given by the Overseas Department has been distinctly better than what was

provided in pre-war days, and except on the score of ruthless economy it is therefore difficult to see the reason for the drastic pruning of its activities which the Committee recommend. This pruning would take the form of limiting the inquiries undertaken by the Department, and making it carry out its work on a self-supporting basis. This, of course, is all very well, but the real use of the Department has lain in the preparation and circulation of reports which could not well be done in any other way or by any other body with less aloofness from commerce than a Government Department. It may be added that the Advisory Committee of the Department, which is composed of business men, dissents from the findings of the Committee of Enquiry, though it agrees that there should be closer co-operation between the Department and the Federation of British Industries. But surely the object of both these bodies is to develop British export trade, and we cannot see that the new proposals would do much towards that end?

The Board of Trade.

DURING the war and since the armistice the Board of Trade has undergone various changes. It has lost its control of railways, tramways, electricity supply and mines, and has received other work in exchange. Nevertheless, the Committee of investigation into its operations find that the suggestion that the staff is not fully occupied has no foundation, though they think that the technical advice given by the Industries and Manufactures Department should preferably be obtained by consulting the Department of Scientific and Industrial Research. In the Power, Transport and Economic Department there is "a similar aspiration to acquire and maintain a technical knowledge relating to power and transport," on which the Board should get advice from the Ministry of Transport and other technical departments. It is certainly mystifying, to say the least of it, to find several Government Departments dealing with one industry, and if means could be found of getting rid of this overlapping it would be an advantage, and a real economy. For instance, the electrical industry is directly or indirectly brought into contact with the Electricity Commissioners, the Ministry of Transport, the Home Office, the Mines and the Power, Transport and Economic Departments of the Board of Trade, and the Ministry of Health.

The Straphanging Scandal.

THE recent mandate of the CHIEF COMMISSIONER of Police that straphanging is to cease on October 1, provides a subject for discussion when suitable topics are scarce. It is therefore not surprising that both daily Press and public are busily occupied in considering the various aspects of the question. At first sight it does not appear unreasonable to request a tramway or omnibus undertaking to provide a seat for each passenger as in pre-war days and thus enable people to travel in reasonable comfort. The transport concerns, however, point out that if the order is enforced it will mean that fares will again have to be increased, as the revenue of both tramways and omnibuses, which is scarcely adequate to meet the expenses at present, would be adversely affected. The recent drop of 5d. a gallon in the price of petrol will no doubt relieve the omnibus companies of anxiety on this point, but the tramway undertakings, especially that of the London County Council, which had to fall back upon the rates to make up last year's deficit, will be seriously affected for a time, until the revenue and expenses once more balance. For ourselves, we have little sympathy with the movement to prolong the straphanging era, though some concessions might, perhaps, be made on wet days and on special occasions. On the other hand the effort of the Municipal tramways to rife

out omnibus competition on tramway routes is not unreasonable, provided it can be proved that the tramway service is adequate and efficient. One of the first results of the return to the old policy should be large orders for new tramcars and omnibuses in order to cope with the traffic, though we should not be surprised at increases in tramway fares also, as that seems the one way of getting out of all difficulties.

The Session's Electrical Legislation.

FROM the purely electrical standpoint, the output of legislation during the past session was not up to the average, either in point of numbers or in the importance of the measures. In fact, the Parliamentary year will be remembered as much by its failures as by its achievements. To those who consider that the country is suffering from too much, rather than too little, law making, this will be a source of gratification. And though to some extent we endorse this point of view, it is a matter for regret that a more serious attempt was not made to pass the Electricity Supply (No. 2) Bill, or some modification of it, so as to round off and complete the policy outlined in the Electricity Supply Act of 1919.

SOME IMPORTANT PUBLIC ACTS.

There were only three public Acts which directly affected the electrical industry—those relating to the Safeguarding of Industries, the Railways and the Telegraphs Acts. Of these, the first is the most important, as some of its provisions are likely to have a far-reaching and we sincerely hope a beneficial effect upon the future of certain branches of electrical manufactures. In its progress through the House of Commons the clauses of the Bill were strenuously opposed by a section of the members, and though no one seemed to be fully satisfied with the scope of the measure, it was ultimately passed with the aid of a liberal application of the Closure rules. It is doubtful, therefore, if the proposals received that full and careful consideration which they deserved. But, now that the Act is on the Statute Book, we trust that it will really assist those manufacturers of electrical instruments, magnetos, arc lamp carbons, scientific glassware, chemical apparatus, &c., for whose benefit it is intended. Undoubtedly, these trades have suffered severely from foreign competition, but more especially from German dumping, in the past, so that if the Act only provides a measure of protection for these "key" industries during the next five years the departure from our present fiscal methods will have been justified.

There is, however, a large volume of opinion in this country opposed to a duty of 33½ per cent. on the import of the articles enumerated in the first part of the Act, while a good many more, recognising the need for protection, prefer the grant of a bonus or some other form of assistance to those industries which are essential to the welfare of the country. Only time and experience can, however, prove which is the right course; but we trust that those who benefit from the protection given will not be lulled into a feeling of false security, but will continue to progress with the times.

COUNTERACTING DEPRECIATED EXCHANGE.

Over and above the protection given to the key industries, a further duty of 33½ per cent. will be levied on foreign articles of any class or description which may be included in an Order to be made by the Board of Trade on the ground that they are being sold, or offered for sale, here at prices below the cost of production; or, owing to the depreciated exchange, at prices at which similar goods can be profitably manufactured in the United Kingdom. Undoubtedly, this is a wide and dangerous

power to confer upon any department of the Executive. Our experience of the incursions of Government departments into business transactions has not been a happy one, and the acts of the Board will have to be closely scrutinised.

THE RAILWAYS ACT.

The Railways Act, which became necessary on the decontrol of the railways, contains provisions relating to light railways, and, in future, these useful means of rural transport will be placed under the control of the Ministry of Transport. Their development, as well as the introduction of electric traction on the standard lines, will depend upon the progress made in the grouping and reorganisation of the existing companies, though no doubt the electrification of the standard railways will have to be considered very shortly.

THE TELEGRAPH ACT.

The Telegraph (Money) Act, which authorises the raising of £5 000 000 for the extension of the telephone system of the country, is a measure in which telephone engineers and contractors are particularly interested, for it should mean numerous contracts for telephone equipment and material for a long time to come. Among other Acts which are of indirect interest are the Coal Mines (Decontrol), the Overseas Trade (Credits and Insurance) Amendment, and the two Unemployment Insurance Acts. These present existing legislative methods at their worst, for within three months of the Royal Assent being given to the first Unemployment Insurance Act the benefits conferred by it had to be reviewed and curtailed.

DECREASE IN PROVISIONAL ORDERS.

The decrease in the number of Acts confirming Provisional Orders is mainly due to the change of procedure introduced by the Electricity Supply Act. In place of Electric Lighting Provisional Orders, Special Orders are now granted by the Electricity Commissioners, confirmed by the Minister of Transport and approved by resolutions of both Houses of Parliament. Recently seven of these Orders were so approved, and as there are several other applications under consideration, or in contemplation, there is every prospect of a busy time in the electricity supply branch of the industry for a long time ahead. A feature of the session was the large number of Bills for confirming Ministry of Health Provisional Orders for the extension of municipal boundaries. These Orders extend electricity supply and other powers to the added areas, and in this way electrical engineers are interested in their fate. Local authorities seem to have become more ambitious in recent years, and in the last session there were ten of these Bills, two or three of them being the cause of strenuous fights before Parliamentary Committees. With the exception of the Cardiff Bill they were all successfully piloted through both houses. The Cardiff extension scheme included districts in which the South Wales Electrical Power Distribution Company has rights of supply, and as the conflicting interests of the parties could not be reconciled, it became necessary to suspend the confirming Bill until next session. There were only two Scottish Provisional Orders, the Aberdeen Corporation (Electricity Works Railway) and the Airdrie and Coatbridge Tramways Trust Orders, which referred to electrical matters.

PRIVATE ACTS.

Of the private measures there were two of outstanding importance—viz., the County of London Electric Supply and the Lochaber Water Power Acts. The directors of the County of London Company are to be congratulated in securing, in the face of strenuous opposition, some useful additional powers for the erection of their projected capital station at Barking if the Electricity Commissioners sanction the scheme. When

the present uncertain position of electric supply in London is considered, coupled with the fact that the London County Council can exercise its purchase rights in the London areas in 1931; it shows that those responsible for the policy of this progressive company must have an unbounded faith in the future of electricity supply in the Metropolitan district. The company, must, however, give a bulk supply to its London areas in case the County Council exercises its purchase rights in 1931, and, if a Joint Electricity Authority be established for the London and Home Counties, the station can be purchased by the Authority within five years of its formation.

SCOTTISH HYDRO-ELECTRIC SCHEMES.

Only one of the two interesting Scottish hydro-electric schemes received legislative sanction. The Lochaber Water Power Act, which was promoted by the directors of the British Aluminium Company, confers authority for the utilisation of the water power of the Spean watershed and the flood waters of the Spey river, in order to generate electrical energy for the proposed works of the British Aluminium Company at Fort William. There was considerable opposition by riparian owners and by representatives of the fishing industry, but ultimately the scheme, which is estimated to cost £3 000 000 and will have an important effect upon the prosperity of the Highlands, was passed in a somewhat modified form. The other, and more ambitious water-power project, embodied in the Grampians Electricity Supply Bill, had to be withdrawn owing to the numerous opponents it aroused, but we understand that it is likely to be revived next year.

MISCELLANEOUS POWERS.

A number of municipal electric-supply authorities secured additional powers, which should be useful for developing their undertakings. In three cases authority was conferred to establish and maintain show-rooms for exhibiting electric lighting and domestic apparatus; in several cases power was secured to lay mains in private streets, to attach brackets to buildings, to fix a minimum charge for consumers with an independent source of supply, to discontinue supply when accounts are in arrear, and to fix a minimum charge for general supply. Though the principle of the minimum charge is now well established, and is usually included in Special Orders, it has aroused keen criticism by consumers, and we hope that as soon as settled conditions prevail once more electric supply authorities will not rigidly enforce this right.

ELECTRIC TRACTION ACTS.

The only Bill which contemplated the construction of a new tramway system—viz., that promoted by the Durham County Council—was rejected on the motion for its second reading in the House of Commons, though the Grimsby Corporation secured power to acquire the local tramways, to construct some extensions, to use the trolley-vehicle system and trailer cars, to carry parcels, &c. In seven Acts power to employ trolley vehicles is conferred, indicating a revival of interest in this method of transport, while trailer cars are sanctioned in three cases. The construction of a separate tramway track has been authorised in two instances, but there were many failures to secure the right to run motor omnibuses, and where this was allowed severe conditions were laid down as to the maintenance of the highways over which these vehicles are to run. Owing to the increased motor and charabanc traffic County Councils are up in arms against any proposals which will add to their burdens and lead to an increase in the rates. One County Council had to levy a 5s. rate last year for road maintenance, and we are not therefore surprised to learn that motor omnibus powers are being strenuously opposed everywhere.

An Electricity District in Being.

Recent Developments in Power Supply on the North-East Coast.

(Concluded from page 263.)

SUBSTATIONS.

The total number of substations supplied from the Company's system of and exceeding a capacity of 100 kW is at present approximately 400. From these supplies are given to 145 collieries, 73 engineering works, 36 shipyards, in addition to process works, railways, tramways, chemical works, laboratories, cement works,

iron works, rolling mills, steel works, &c., &c. The total transformer capacity of the system, including transmission units, is approximately 460,000 kVA.

The general arrangement for the erection of substations is that these are provided by the consumer, being built for uniformity of design and equipment to standard drawings supplied by the

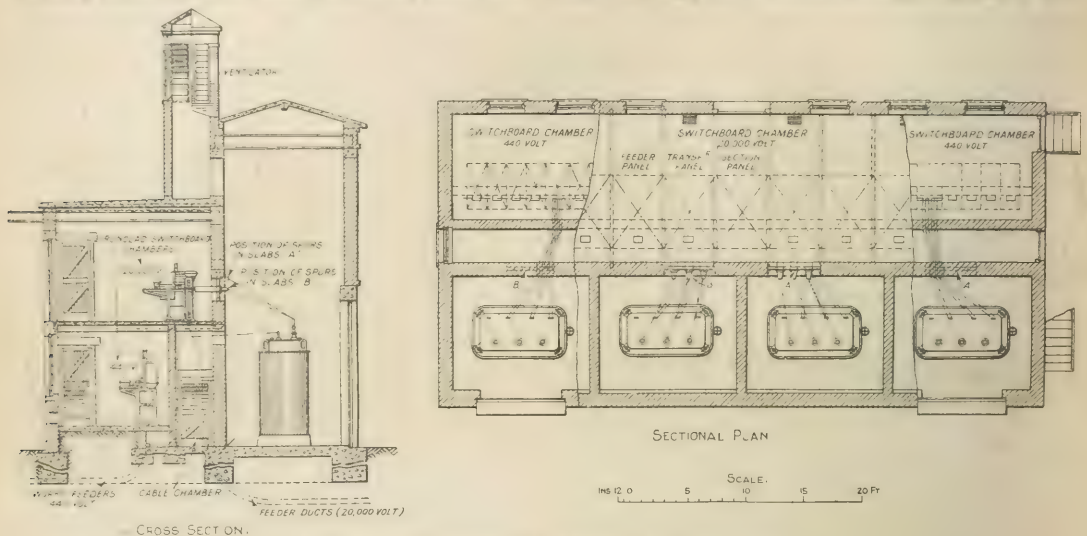


FIG. 8.—PLAN AND CROSS-SECTION OF BIRTLEY WEST SUBSTATION.

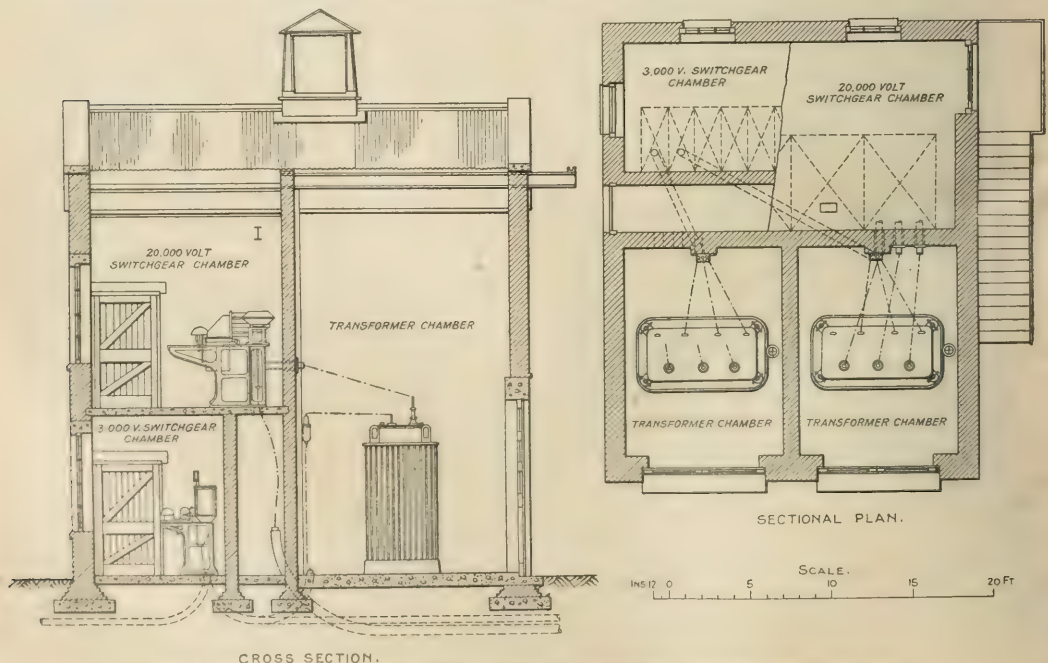


FIG. 9.—PLAN AND CROSS-SECTION SHOWING GENERAL ARRANGEMENT OF SEATON BURN SUBSTATION.

Company. They usually contain high and low-pressure switch chambers, cable chamber and transformer chamber or chambers, the latter being sufficiently lofty to allow the transformer windings to be lifted and examined inside the chamber. For this purpose a special girder is fitted and is extended through the outer wall to enable the transformer to be placed on a truck or trailer. Two views of such substations are shown. Fig. 8 shows the Birtley station which supplies a munition factory, and Fig. 9 the Seaton Burn substation which is on the premises of a large colliery. An essential point about the switchgear installed and about the design of the substations generally is the small space occupied.

THE LAY OUT OF PROTECTIVE GEAR.

It should be further noted that in each case the high-pressure transmission line is looped into the substation and advantage is taken of these loops to instal suitable protective gear. This protective gear is operated by primary batteries, which are kept in special boxes, with 50 per cent. spare. Two batteries of 12 cells are usually employed, the operating voltage being 30 V. The same

that of the Allhusen Works of the United Alkali Company Ltd., a view of which is shown in Fig. 10. This substation contains six 500 kW B.T.H. rotary converters which are used in connection with an electrolytic process.

DUNSTON SUB-STATION

One of the most important of the step-up substations for main-line transmission is that situated on the Dunston Power Station site. This substation contains two 6 000 kVA Brown Boveri and three 8 000 kVA Westinghouse water-cooled transformers, each bank consisting of three single-phase units. A view of the 20 000 V iron-clad switchgear in this substation is given in Fig. 11, and it will be noticed that the switch chamber is subdivided into two independent portions by means of a fire-proof wall and door, the latter being so arranged as to close automatically.

Several substations have recently been put into commission for suburban lighting and power distribution where heavily loaded three-wire direct-current areas have been changed over to single phase alternating current, the neutral on such systems being connected to

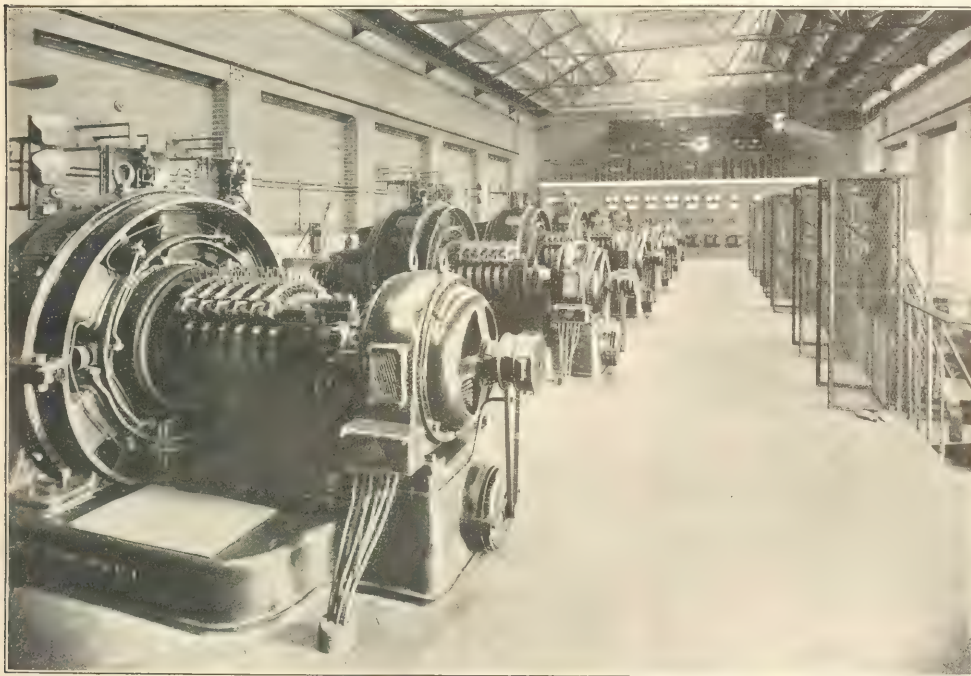


FIG. 10.—VIEW IN THE UNITED ALKALI CO.'S ALHUSEN SUB-STATION

source of power is also used for tripping the switches, but at the more important distribution points on the system the protective gear and switches are operated by means of small secondary batteries equipped with electrolytic or mercury arc rectifiers for charging purposes.

In the city and large town areas where, as already mentioned, supply is given on the three-wire continuous-current system, the buildings that were previously used as generating stations for these areas are now used as substations. An example of this is the substation at Gateshead, where supply at 6 000 V is transformed to 20 000 V for main-line transmission, to 440 V for supply to local works, to 550 V direct current for the local tramways and, finally, to 480 V direct current for three-wire lighting and distribution. The direct-current plant consists of Bruce-Peebles "La Cour" converters and Brown-Boveri and G.E.C. motor-generators of a total capacity of 3 200 kW.

A similar substation supplies power and lighting to the Middlesbrough Corporation by means of Westinghouse rotary converters, which transform the 11 000 V 40 cycle current to 460 V direct current. An example of a direct-current substation is

a middle point on the transformer low-tension winding. A view of one such substation, showing an outdoor-type transformer, is given in Fig. 12.

In addition to these, substations have been provided in connection with the supply to the North-Eastern Railway. Those on the Tynemouth passenger lines are equipped with the usual transforming gear and with two or more 1 200 kW rotary converters which transform the alternating current into direct current at 600 V, at which pressure it is supplied to the third rail, while those which supply the Shildon-Newport line used for heavy mineral traffic are equipped with rotary converters of 400 and 600 kW capacity—two machines in series—which give direct-current supply to overhead lines at 1 500 V.

THE CONTROL OF THE SYSTEM.

It is obvious that on any interlinked system the most careful control must be kept over switching operations in order not only to maintain the supply and give a satisfactory pressure distribution throughout, but that repairs may be carried out with the maximum of safety to those concerned, while certain power stations or parts of the system must not be allowed to become under- or over-

loaded at the expense of the others. We have already referred to the systems of protection which are employed, but, in addition, a very interesting form of personal control has been devised and is operating successfully.



FIG. 11.—VIEW OF DUNSTON SUBSTATION STEP-UP SWITCHGEAR.

This system of control is worthy of study by all engineers who are proposing to operate an interlinked system in the near future. The whole of the Newcastle Company's network is virtually controlled by an engineer termed the control engineer from the control-room or nerve centre at Carville station, with the exception that a deputy controller at Middlesbrough carries out the detailed work necessary in that part of the area. Owing to the growth of the area, arrangements are now being made to subdivide the control into three main districts, one north of the Tyne, one south of the Tyne and the third at Middlesbrough. The whole of this very large system will be under the control of the chief controller at Carville with two assistant controllers at the same place for dealing with the north and south of the Tyne districts, while the Middlesbrough area will be supervised by a sub-controller as at present.

Centralised control of this kind is obviously only possible with the assistance of a very extensive telephone system, which allows the controller to be constantly informed of the condition of the whole of the mains, feeders, and substations, while by means of a large wall diagram, which is illustrated in Fig. 13, the actual position of every important switch is shown together with details of men working, faults, &c. Our illustration shows the existing diagram, but in future this will be modified with the rearrangement we have just mentioned, though the general methods of working the control will continue to be the same. On the diagram cables carrying different pressures are represented in different colours and at each tapping or terminal is fixed a hook on which can be hung a disc bearing a distinctive colour or mark. These discs give by their colour a visual indication of the condition of the transmission network at that point, and so show the engineer exactly what switches are open and closed, while, as no switch movement can be made on the high-pressure cable system without the knowledge and permission of the control engineer, safety is assured. This engineer is also responsible for organising the switching arrangements in advance so that the necessary repairs and maintenance can be carried out without undue trouble or dislocation.

The main feeders going out of Carville are also remotely controlled from this room, on the same lines as those which we have already described, in connection with the Dunston station where the feeders are operated from a special switch-room. An illustrated diagram

placed near this board shows what machines are running at all power stations, while the power instruments indicate exactly what power is being transmitted at various parts of the system. These include voltmeters indicating the pressure at the extreme ends of the northern and southern areas as well as at other important centres and wattmeters showing the exact loads at the principal power stations. The switching arrangements on the North-Eastern Railway electrified lines are also directed from the control-rooms and similar diagrams to those which we have just mentioned show the arrangements on the traction system, and on the special 3 000 V lighting network which supplies this railway through four substations with its necessary electrical requirements for lighting stations, signal boxes, goods yards and other places.

CONTROL ORGANISATION.

The general distribution of duties between the chief control engineer and the assistant control engineers is that the chief supervises the distribution, telling the various generating stations what machines are to be run and how the power demand generally is to be met. In other words, he says what each station is to generate and how it is to generate it. The assistant control engineers are concerned with the detailed switching arrangements in the way that we have described and generally deal with any minor problems as they arise in connection with switch movements.

For the purpose of this control and also for general maintenance the area supplied by the Company is divided into a number of districts, each of which is in charge of a District Engineer and contain from 10 to 20 sub-stations. With the sole exception of switches controlling machines put on or taken off load under normal working routine the operation of high pressure switches is carried out to the instructions of the control engineers. Any servant of the Company or a selected representative of a consumer may open or close high pressure switches on being directly instructed by the control engineer, but only specially authorised persons may isolate, earth or certify as safe to be worked upon conductors which are normally alive at high pressure. These persons receive their

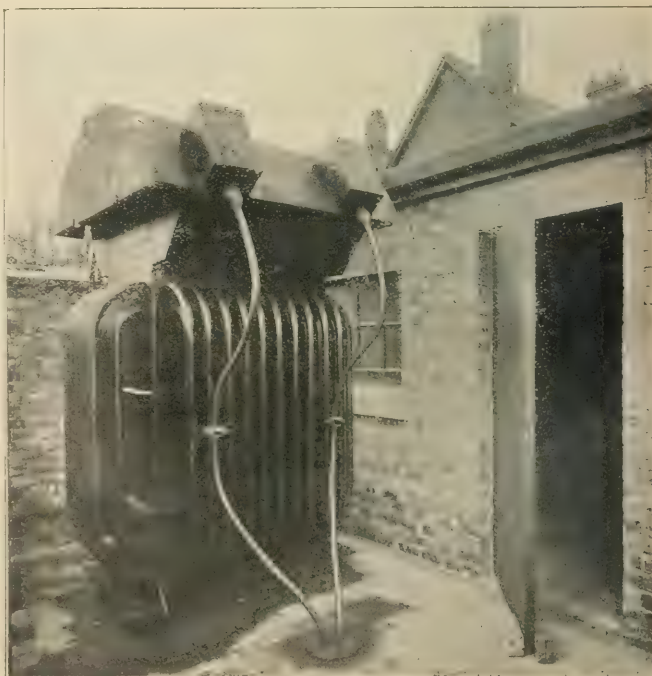
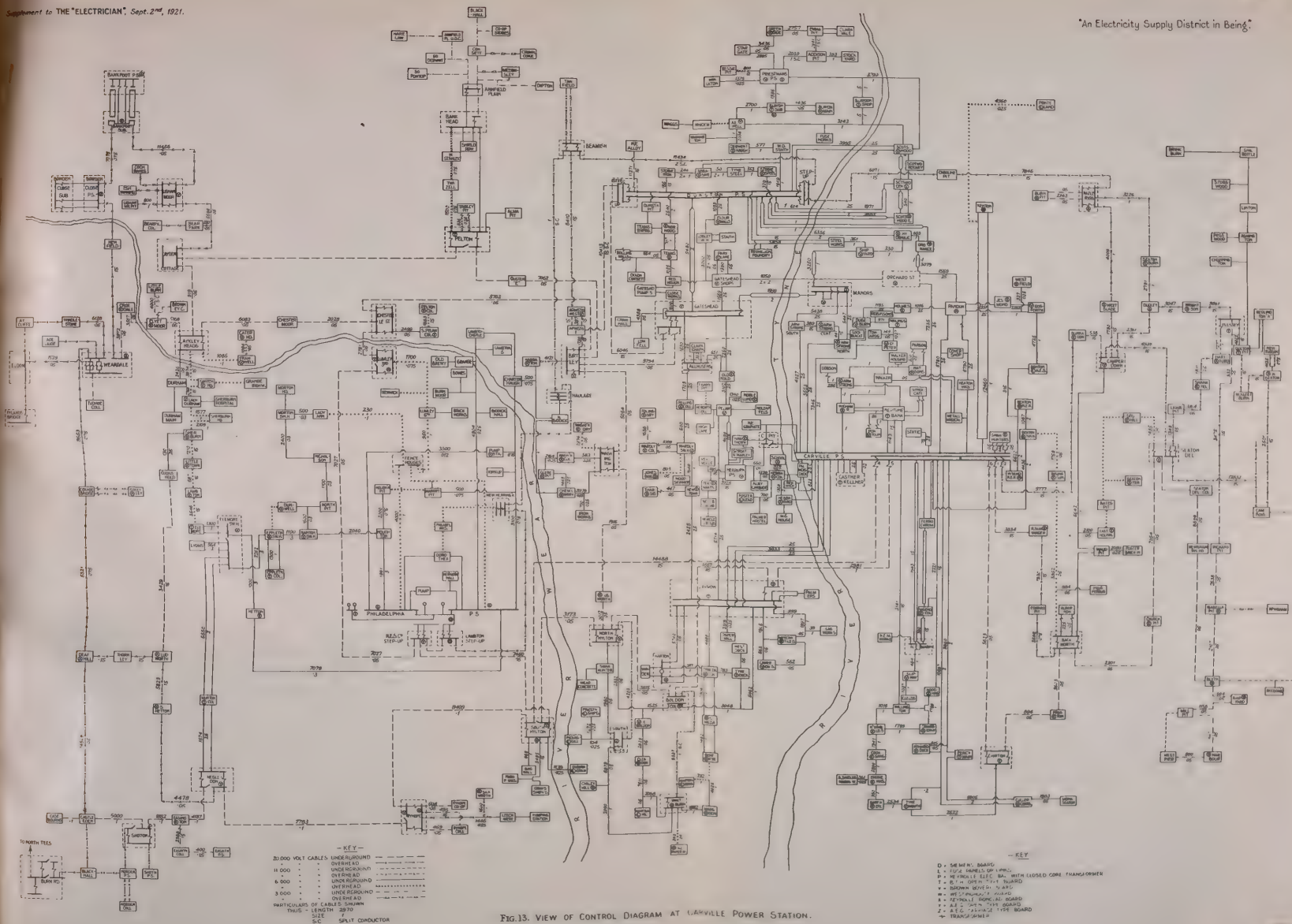


FIG. 12.—WESTFIELD SUBSTATION SHOWING OUTDOOR TRANSFORMER.

authority in writing and consist of shift engineers in power stations, district engineers and staff officials of the Company. Special keys are supplied to such persons which enable them to enter chambers where high pressure apparatus is exposed and nobody is allowed

An Electricity Supply District in Being.



access to such chambers unless accompanied by an authorised person. Another protection against accident to persons working on apparatus normally alive at high pressure is a "permit-to-work" card, a copy of which is shown in Fig. 16. This card, which states definitely the apparatus on which work may be carried out with safety, must be issued by an authorised person before any such work is begun and must be actually in the possession, during the whole period work is in progress, of the person in charge of the work to which the card relates. The card is only issued to competent persons, such as foremen. Until this card is duly cancelled by an authorised person, the apparatus for which it was issued must not be made alive.

DOMESTIC SUPPLY.

Though the Newcastle Company is mainly concerned with supply of electrical energy to coal mines, ironworks, and other large consumers of a similar character, it does not for that reason neglect the possibilities of the domestic load, including under this heading the heating of offices and the supply of current for cooking purposes in restaurants and other similar institutions. This load is as a matter of fact growing most satisfactorily and has been well cultivated by the excellent propaganda of personal contact, by advertising in the local cinematograph theatres, and by campaigns with all sorts of apparatus as a basis.

A SUCCESSFUL SHOWROOM.

Touch is kept with the consumer by a showroom in one of the principal streets of Newcastle, and so successful has this been that it has largely outgrown its accommodation. Unfortunately, at the moment larger premises are not obtainable. The company has always followed the very wise policy of working in with the local contractors and encouraging both them and the builders to give close attention to electrical apparatus and to trumpet its advantages whenever that can be done.

At the showroom on the occasion of our visit a large amount of domestic electrical apparatus was on view, and we were informed that only apparatus that is known to be sound is kept in stock or sold, while special attention is paid to the acquirement of electrical apparatus that is suitable for local conditions. In the case of heating apparatus the company insist from experience on the

equally particular about the design and manufacture of cooking apparatus. A careful record of all faults and failings on the apparatus used is kept, and the manufacturers concerned are communicated with, we hope with beneficial results, and at any rate to the increase of their experience. A great deal of work is also being done with small apparatus, such as toasters and irons, and these, we are glad to learn, are generally found to be very satisfactory in both design and operation. Especially is the hiring of irons found to be a very profitable source of revenue, some of these apparatus having been



FIG. 14.—BED ROOM IN ONE OF THE HOUSES, SHOWING ELECTRIC HEATER.

in use for as long as 15 years. In fact, it may be said without exaggeration that almost every consumer in the Newcastle area has an electric iron.

THE BILLINGHAM HOUSING SCHEME.

At the present time no description of the Newcastle Company's system would be complete without some reference to the Billingham Housing Scheme. This scheme has already been described in THE ELECTRICIAN, and it is, therefore, sufficient to say here that for the accommodation of their employees at the new North Tees power station the company have erected a number of houses at Billingham village. From an architectural point of view they present a pleasing appearance and have been planned economically so as to afford the greatest amount of comfort and the least amount of work to their occupiers, both very desirable features. The electric village itself has been tastefully laid out. The boundary and division fences are formed of thorn and privet hedges, and the planting of mountain ash, birch, and similar trees in the grass margin of the roads will give an additional attractiveness and at the same time will bring the estate into keeping with its rural surroundings. On the occasion of our visit the tenants of the houses, which were already occupied, had also got to work on their own account and were engaged in turning the primeval soil with its overlay of discarded building material into tasteful gardens, so that the ultimate result will undoubtedly be most pleasing.

Turning to the buildings themselves electricity is installed throughout each house for lighting, heating and cooking. A coal fire fixed in the principal room and fitted with a boiler provides the necessary domestic hot water supply. The only other fireplace in the house is fitted in the bedroom immediately above the principal living room, though a plug allows one of the portable electric fires to be used in both these rooms if desired. The scullery behind the sitting room is fitted with a large sink with hot and cold water laid on and here the electric cooker is also installed. Adjoining the scullery is the bathroom also with hot and cold water, and an electrically-heated clothes boiler. This boiler is of 16 gallons capacity and is loaded



FIG. 15.—EXTERIOR OF HOUSES BEING BUILT AT BILLINGHAM, STOCKTON-ON-TEES, BY THE NEWCASTLE-ON-TYNE ELECTRIC SUPPLY CO., LTD.

paramount necessity of every unit being liberally designed for its work. The company's staff incidentally come in useful in trying out electrical apparatus, and so determining its fitness or otherwise for domestic work, while the experiment has also been made of installing certain apparatus, for instance, washing machines, on consumer's premises, charging for the current consumed only and receiving reports as to their operation. The company are

convenient for usual problems to read the values of force from the curves in Figs. 3 and 4.

If I is the effective alternating current in amperes, the force given by the formulae or curves is the average force, or the steady push, exerted by the current. If I is the peak value of current in amperes as read from an oscillograph, the force given is the maximum momentary force. Under steady conditions, the momentary force rises to double the average value every half cycle. This large momentary value of force must be used in many problems, for it is capable of overcoming initial friction or of cracking a latch which holds a switch closed.

EXAMPLES.

The derivation of the above formulae was given in a Paper by the author entitled "Calculation of Magnetic Force on Disconnecting Switches," at the annual convention of the American Institute of Electrical Engineers, June, 1920. The author had previously published in 1917* a solution along the same lines, but less complete.

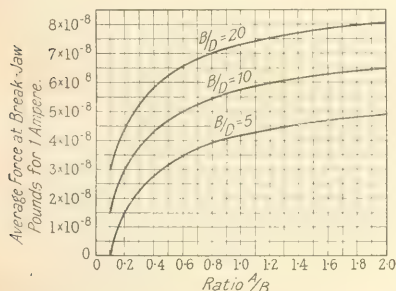


FIG. 3.—REPUSSION IN DISCONNECTING SWITCHES.

The following example will illustrate the application of the formulae and curves: Find the magnetic force due to a current of 60 000 A, effective, tending to open a front-connected switch in which $A=4$ in., $B=20$ in., width of blade $=2C=1.5$ in., and width of jaw $=D=2r=1$ in. There is no return circuit behind the switch.

By formula (1), since A is less than B , the average force at the break-jaw is

$$\frac{36 \times 10^8}{4.45 \times 10^7} [2.769 - 0.667 - 0.100 - 0.006 + 0.002] = 162 \text{ lb.,}$$

average force.

The maximum momentary force at the peak of the current wave is 324 lb.

Using the curves of Fig. 3, $\frac{A}{B}=0.2$, and $\frac{B}{D}=20$, and, therefore, the average force at the break-jaw is

$$36 \times 10^8 \times 4.5 \times 10^{-8} = 162 \text{ lb., average force.}$$

CRITICISMS OF OTHER SOLUTIONS.

Two other solutions of this general problem have appeared in the technical Press. In THE ELECTRICIAN of Dec. 3 and Dec. 10, 1920, Mr. L. B. W. Jolley published a formula obtained by differentiating an expression for the inductance of a rectangle. The principle of calculating the magnetic force from the differential of the inductance is fundamentally correct and is sometimes very useful. The author has used this principle in obtaining a formula for the magnetic force between air-cored reactance coils with parallel axes.† The principle, however, can be used only when there is a suitable formula for inductance. Probably the nearest inductance formula

published is the one chosen by Mr. Jolley, namely, the formula for inductance of a rectangle. A rectangle fits the case of a rear-connected disconnecting switch (Fig. 2) to a rough approximation, but it does not apply at all to the case of a front-connected disconnecting switch (Fig. 1). This fact destroys most of the usefulness of Mr. Jolley's solution. For instance, he states that the magnetic force may be considerably reduced by decreasing the blade length from 12 in. to 8 in. His solution does not show him the more important fact that the force can be greatly reduced by changing from a rear-connected switch to a front-connected switch, without lowering the voltage rating of the switch which decreasing the blade length would do.

An incorrect solution of this problem was published by J. Loebenstein in 1917, and is discussed at some length in Mr. Jolley's Paper. Mr. Loebenstein made the serious error of assuming that the mechanical force exerted on a short element of current-carrying conductor by a second element acts along the straight line joining the two elements. As a consequence, the results of his solution are about one quarter as large as they should be.

The error in Mr. Loebenstein's calculation was ascribed by Mr. Jolley to the assumption of "action at a distance," and it seems plainly to be inferred in Mr. Jolley's Paper that a formula for the force exerted by one short element on another cannot be correctly written out. Such, however, is surely not the case.

Sir J. J. Thomson* gives what he calls "Amperé's formula" for the magnetic field due to a short current element as

$$\frac{i_1 ds_1 \sin \theta}{r^2} \dots \dots \dots (3)$$

This gives at once the force on the second element ds_2 , equal to

$$\frac{i_1 i_2 ds_1 ds_2 \sin \theta}{PQ^2} \dots \dots \dots (4)$$

This force, as is well known, acts perpendicularly to ds_2 .

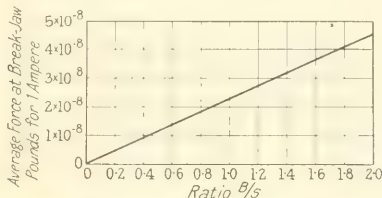


FIG. 4.—REPUSSION DUE TO RETURN CIRCUIT.

Now it may be possible to use the expression "action at a distance" in connection with (4), but nevertheless formulae (3) and (4) are correct. Formula (4) gives exactly the same values of magnetic force as the energy, or differential of inductance, method, as the author has found, to give one example, in calculating a formula for the force between two rectangular conductors as distinguished from two round wires. Formula (3) is the basis of calculating many standard inductance formulae.

Electrical Engineering at the B.A.

Among the Papers of electrical interest to be read before Section G of the BRITISH ASSOCIATION at the forthcoming Edinburgh meeting are the following: "The Linking Up of the Smaller Water Powers of Scotland," by Prof. F. G. Baily; "Tides as a Source of Power, with Some Reference to the Severn Scheme," by Prof. F. C. Lea; "Some Notes on the Electricity Supply Station of the Corporation of Edinburgh for Supply of the City and the Lothians," by Mr. S. B. Donkin; "Two New Negative Resistance Devices for Use in Wireless Telegraphy," by Mr. John Scott-Taggart; "Long Distance Transmission of Electrical Energy, with Special Reference to Tidal Power," by Dr. T. F. Wall; and "Large Electric Units—New Constructive Features," by Dr. S. S. Smith.

* "Elements of the Mathematical Theory of Electricity and Magnetism," by J. J. Thomson, Fourth Edition, Art. 211, page 356.

* "The Force of Repulsion in Disconnecting Switches," by H. B. Dwight, "The Electrical Review," (N.Y.) Oct. 20, 1917, page 684.

† "Some New Formulas for Reactance Coils," by H. B. Dwight, Proceedings A.I.E.E., September, 1919, page 1045, and Transactions A.I.E.E., 1919, page 1681.

Large Induction Regulator Installation.*

By RAYMOND BAILEY.

By far the largest induction regulators ever built have been installed by the Philadelphia Electric Company in order to permit the operation of the 66 000 V transmission lines from the Chester generating plant at maximum load under all conditions. The regulators, rated at 1 750 kVA, are of rugged construction and are installed in the outdoor substation at the Philadelphia end of the lines. A chart has been worked out for the purpose of giving the proper regulator setting for different conditions of load. This is described in detail to show how the maximum loading of the lines is effected.

Fig. 1 is a single-line diagram showing the tie lines in which the regulators are connected and layouts of the outdoor substations connected thereto. The Schuylkill and Chester generating stations, in Philadelphia and Chester respectively, are connected by these two

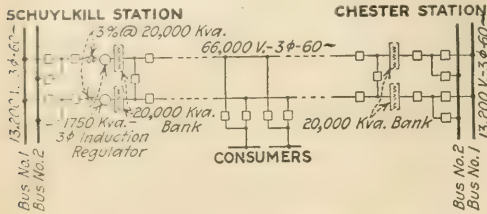


FIG. 1. LAY-OUT OF THE TWO 66 000 V LINES.

lines and are about 14 miles apart. The generating-station bus voltage—13 600—is stepped up in the outdoor substation for transmission at 66 000 V, three-phase, 60 cycles, over lines of approximately 20 000 kVA rating each.

MEETING AN INCREASING DEMAND.

In order to supply the rapidly increasing demand for power in the Philadelphia district it was found advisable to make use of available generating capacity in Chester, which necessitated loading the two 66 000 V tie lines to the maximum. The rate at which the power demand throughout the system of the Philadelphia Electric Company has grown is indicated by Fig. 2, which shows the yearly peaks in kilowatts since 1904. It was decided that it would be necessary to increase the kVA rating of the two tie lines and to install voltage-regulating equipment so that the generating-station bus voltages would not differ greatly even when the lines were carrying full rated kVA at system power factor (approximately 85 per cent.).

No trouble was experienced in increasing the rating of each 66 000 V line from 15 000 kVA to 20 000 kVA, as there was sufficient copper in each line to carry the increased current. The 13 200 V to 66 000 V transformer banks were rated at 15 000 kVA, with a temperature rise of 40° C., but are good for 55° C. rise and 10 per cent. overvoltage, at which rating they have the desired capacity. The capacity of the 13 600 V cables from the generating stations to the outdoor substations was increased by pulling in an additional 1 000 000 circ. mil. cable for each phase.

The matter of voltage regulation was not so quickly disposed of, owing mainly to the fact that, as these lines were to act as part of the additional generating capacity, it was decided to connect no equipment to them except that of the greatest reliability and sturdiness of construction.

The power demands of the consumers' substations tapped to the 66 000 V lines (Fig. 1) are such that one line is usually supplying from 10 000 kVA to 15 000 kVA more to these consumers than the other line. The vector diagram (Fig. 3) shows the impedance drop in each line under certain loading conditions to be such that one line supplies 15 000 kVA to the consumers and the other line transmits its full rated kVA all the way through to Philadelphia.

Fig. 3 shows clearly that in order to load these lines to the best advantage it is necessary to use a voltage-regulating device which will permit a variation of the phase relations of its voltage and the line voltage. E_b and E_c are the regulator voltages referred to. Both are synchronous booster (equipped with a frame-shifting device) and the polyphase induction regulator fulfill the requirements.

ADVANTAGES OF THE SYNCHRONOUS BOOSTER.

The synchronous booster, equipped with a frame-shifting device, is more flexible than the polyphase induction regulator in that its

voltage may be varied both in magnitude and phase relation. The polyphase induction regulator was selected for this service, however, because it is superior to the synchronous booster in so far as simplicity, ruggedness and ability to resist short-circuit stresses are concerned, and on account of its adaptability to outdoor installation and its lower cost as compared with the synchronous booster.

A detailed analysis of the induction regulator problem was made, using a circle diagram as shown in Fig. 4 in order to determine just what percentage of "boost" would best meet the operating conditions. This circle diagram is arranged with scales to read total kVA, kW, reactive kVA, power factor, total amperes, reactive amperes and kW line loss of the untapped line for certain assumed loading conditions of the line that is carrying the consumers' substations. In order to make sure that the regulators selected for these lines would operate on the worst conditions possible, it was assumed in the analysis that one line carried all of the load tapped off along the line.

EXPLANATION OF THE CIRCLE DIAGRAM.

The circle diagram may be more readily understood by first referring to Fig. 3. Consider the following conditions: E_c , the Chester bus voltage, 14 000; load from Chester to the tapped line, 20 000 kVA at 0.85 power factor; load to consumers, 15 000 kVA at 0.90 power factor (referred to consumers' voltage). The impedance drop from Chester to consumer in the tapped line is IZ_b ; the impedance drop from consumer to Philadelphia is IZ_c . If Schuylkill station is carrying 13 800 V at the bus, the regulator in this line will be placed in such a position that its voltage will be represented by the vector E_b . If the regulator in the second line is placed in a position corresponding to the vector E_c and the governors of the turbines are adjusted so as to maintain the phase relation shown on the diagram for the generating-station bus voltages, then the current through this line will be of such a magnitude and phase relation as to give an impedance drop X .

The scales given on the circle diagram are based on the fact that the magnitude of the impedance drop in the untapped line can be used as the measure of the kVA transmitted over the line and that the phase relation between the impedance drop in the line and the generating-station bus voltage has a definite relation to the power factor of the line. Therefore a scale that will read the length of

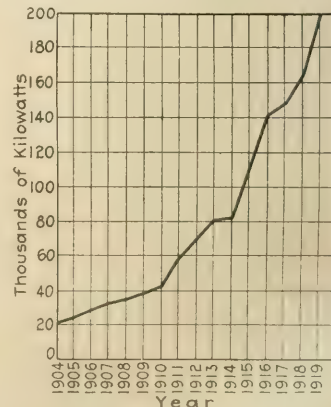


FIG. 2. YEARLY PEAKS OF THE PHILADELPHIA SYSTEM.

the impedance drop vector in any position can be marked to read the total kVA transmitted over the untapped line. At unity power factor this vector—i.e., the vector of impedance drop over the untapped line—will read the kW transmitted as well as the kVA. The position of this line at unity power factor is given by $I_a Z_b$ (O-D) (Fig. 3). As the current lags from its position at unity power factor the impedance drop vector will move from its position at unity power factor through the same number of degrees. Therefore the projection of this line on O-D will be proportional to the projection of the line current on the line voltage and therefore proportional to the kW transmitted over the line. A scale can now be placed on the line O-D, which will read kW transmitted over the untapped line. At zero power factor the current will have swung through an

* Abstract of an article in the "Electrical World."

angle of 90 deg. and the impedance drop through an equal angle to the position *O-G*. The arc *D-F-G* may now be drawn and divided so that it will read per cent. power factor, 100 per cent. being at the intersection of the arc and the line *O-D* and 0 per cent. being at the intersection of the arc and the line *O-G*. By similar reasoning the power component of the current can be read from a scale on the line *O-D* and the projection of the impedance drop on it, and the reactive current and kVA by a scale on the axis *O-G* and the projection of the impedance drop on it.

LINE LOSSES.

The kW line loss scale is placed above the scale giving the total current and is based upon the fact that the watt loss in the line is equal to a constant times the square of the line current ($3 \times I^2 R$). The kW line loss includes the resistance loss in the transformers, but does not include the transformer core loss.

The circle diagram is made up much the same as Fig. 3, except that several of the vectors are omitted and the necessary scales with the subdivisions are added.

APPLICATION OF THE DIAGRAM.

In order to use this diagram to determine what loading conditions can be obtained on the untapped line with a certain assumed load on the tapped line, it is necessary to compute the impedance drop in the tapped line for the loading conditions assumed. This impedance drop is laid off on the diagram and the point obtained to work from. In this case point 3 will be taken. Reference to the table (Fig. 4) will show that point 3 has been figured for 20 000 kVA at 0.85 per cent. power factor out of the Chester station and 15 000 kVA into the consumers' substation at 0.90 power factor. The position of the regulator in the tapped line is now determined by the Schuylkill station-bus voltage. Assuming 13 900 V, the regulator voltage will be E_b . With the end of this vector (regulator vector in tapped line) as a centre a circle may be described and the conditions of loading which may be obtained in the untapped line are read at points on this circle. For example, consider the point where the circle intersects the 20 000 kVA arc. The position of the regulator on the untapped line is then E_g . The loading conditions are 20 000 kVA, 17 900 kW, 0.89 power factor; reactive kVA, 9 000; power component of current, 740 A; reactive component of current, 375 A; line loss, 700 kW. As another example assume that it is desired to have Chester supply kVA to the untapped line at system power factor, 0.85. Note the point at which the regulator circle intersects the 0.85 power-factor line. The regulator voltage will then meet this point. Reading the loading condition, we have 17 500 kVA, 0.85 power factor, 14 900 kW; reactive kVA, 9 300; power component of current, 620 A; reactive component, 385 A; total current, 725 A; line loss, 530 kW.

It should be noted that all kVA and kW values, power factor, &c., are given with respect to the Chester generating-station bus voltage.

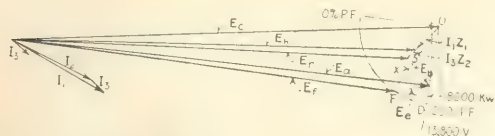


FIG. 3.—VOLTAGE RELATIONS ON THE TWO TRANSMISSION LINES.

E_c —Chester bus bar voltage. E_b —Consumers' voltage. E_g —Voltage at regulator (tapped line). E_r —Schuylkill bus voltage. E_d —Regulator voltage (untapped line). E_f —Regulator voltage (untapped line). E_e —Voltage at regulator (untapped line). E_h —Current in untapped line at unity power factor. E_i —Impedance, Chester to consumer (tapped line). E_j —Impedance, consumer to Philadelphia (tapped line). E_k —Impedance (untapped line). E_l —Current, Chester to consumer (tapped line). E_m —Current taken by consumer. E_n —Current, consumer to Philadelphia (tapped line). E_o —Drop in untapped line for regulator position shown.

If the Chester station is assumed to be operating at any bus voltage other than 14 000, proportional correction must be made in the readings taken.

CONSTRUCTION OF THE REGULATOR.

It was found that the desired loading conditions could be obtained by means of 1 750 kVA, 9 per cent. polyphase regulators, and two such regulators were accordingly purchased from the Westinghouse Electric & Manufacturing Company.

That the manufacturer's engineering organisation has made every effort to build a regulator of the most rugged construction is evident from photographs of one of these regulators shown in the original article, where the author illustrates the complete regulator before being placed in its boiler-plate tank, and when assembled in the tank. This photograph shows the pipe connection for the water-cooling coils and the breather. The

weight of each regulator filled with oil is 56 000 lb. (25 000 kg.). Standard generator construction is used throughout, and the windings are braced to withstand short-circuit currents as great as fifteen times rated full-load current. The cable connections to the regulators are arranged so that it is possible to disconnect them from the lines by loosening several clamped joints, swinging the cables over to other terminals and reclamping.

It was shown in another part of this Paper that in order to load these lines as desired it is necessary to know the phase relations of the regulator voltages relative to each other and to the line voltages. This was taken care of by providing each regulator with a position indicator, which consists of a 360-deg. power factor indicator remodelled for this service. Two of the potential coils of this instrument are connected to the line-potential transformers, and the third is connected through a potential transformer to the terminals of one of the secondary windings of the regulator. The position indicators, together with the instruments for the two transmission

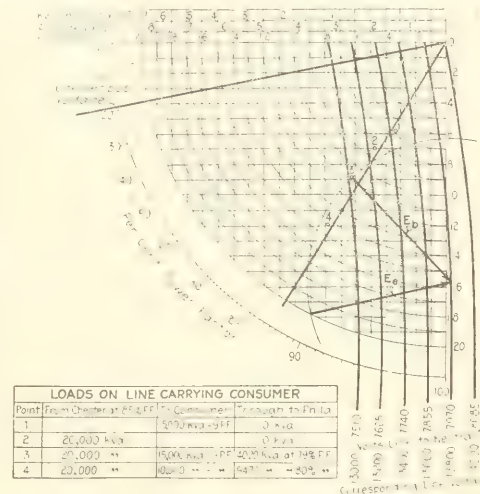


FIG. 4.—CIRCLE DIAGRAM FROM WHICH THE PERFORMANCE CHARACTERISTICS AND THE TWO TRANSMISSION LINES WERE OBTAINED.

lines, are installed so as to be in full view of the station operator when standing in front of the panel on which the regulator operating motor control is placed.

Operating experience gained since the regulator installation has been completed shows that it is possible to obtain the desired loading conditions on these lines and at the same time maintain equal generating-station bus voltages.

New Electrolytic Lightning Arrester.

Mounting the transfer-switch and gap-structure on the tank top is one of the main features of the 1 000 to 7 500 V type A lightning arresters recently placed upon the market by the WESTINGHOUSE ELECTRIC & INTERNATIONAL COMPANY, East Pittsburgh, Pa., U.S.A. This arrester is self-contained and of the most modern design. Transfer switch, horn gaps, charging resistance and short-circuiting device are all located on the tank top. The tank and tray structure is the same as that of previous models, the only difference in construction being the elimination of the wall-mounting form of transfer switch and gap structure.

The transfer switch is of the sliding-rod type, consisting of a rod with sections of conducting and insulating materials, operating through five self-aligning contacts, supported by the cover. Three middle contacts are insulated from the tank cover by porcelain pillar-insulators, but the end contacts are connected directly to the tank top through their metal supports and form a part of the ground circuit. A ball handle with guard provides an easy method of operating the switch.

The horn gap, charging resistance and short-circuiting device are mounted on insulating bases located between barriers and on the tank top. Short-circuiting metal strips are carried by insulated supports attached to a shaft. The shaft or rod is operated by means of a cone or handle against a spring which normally holds the short-circuiting device in the open position.

Manufacturing Modern Switchgear.

In last week's *ELECTRICIAN* we gave some details of switchgear manufactured by the well-known firm of GEO. ELLISON, of Birmingham, laying special stress on the care which had been expended both in the design and the construction of this apparatus. Now, when design and construction are good, it follows almost as an axiom that the organisation and administration of the works in which such equipment is made are also arranged on the most modern lines, or if they are not that an almost impassable embargo is placed on commercial success. We recently had an opportunity of finding this theory confirmed in practice when we visited the Wellhead Lane Works of George Ellison at Perry Barr, Birmingham, and of seeing the various operations which had to be performed carried

evidence by itself we can easily, and with effect, call the accompanying photographs to witness in confirmation.

THE WORKS LAYOUT.

To go into more detail the works consist essentially of one long building substantially built of brick and lighted naturally through saw-toothed roofing and artificially by means of Benjamin workshop fittings. At one end of this building is a sort of annex containing the receiving dock and the substation from which the power for driving the works and testing and for lighting is supplied. Adjacent in a separate building is the boiler for the treating apparatus and the garage for the works delivery vans.



VIEWS IN GEORGE ELLISON'S WORKS AT PERRY BARR, BIRMINGHAM.

1. Part of the Assembling Benches.
3. View of Test Room.

2. The Tool Room.
4. Finished and Partly Finished Gear Stock to Fill Urgent Orders.

out in their proper order as a preliminary to putting this modern type of switchgear on the market.

A PICTORIAL WITNESS.

As a matter of fact so much has been written and so much has been talked about the way engineering works should be designed to economise labour, to obtain a proper flow of material, to save tools and to safeguard the health of the workers, and so much of what has been written and spoken is now accepted as axiomatic, except in the most retrograde circles, that it would be tedious to describe in detail exactly how modern manufacturing principles are applied at the Wellhead Works. It will, in fact, be sufficient to say that all those questions that we have mentioned above are efficiently solved, and if our written word is not taken as good enough

AN EASY FLOW OF MATERIAL.

The main building in turn is divided longitudinally throughout its length. One portion is not further sub-divided, and this comprises the main machine shops, assembly benches and test beds. Here the wide variety of Ellison products, of which we recently gave some details, are made and assembled and pass to a similar bay to that we have just mentioned, but at the other end of the building, where they are packed and dispatched from a special dock. This dock is equipped with a recessed loading platform, so that several carts can be backed in and loaded simultaneously over the back and sides, while a ramp makes the handling of smaller packages an easy matter. This dock is, it is perhaps needless to add, roofed in and connected with the road through a spacious courtyard,

so that congestion is not to be feared. At this end of the works is another separate building and courtyard which contains the pattern shop. It may be added that George Ellison do not make their own castings, but have a satisfactory arrangement with local foundries which has resulted in the production of a high-class product suitable for employment in the equally high-class switch-gear turned out by the firm.

The remainder of the main building is divided off into machine shop bays, tool room and stores, and a very complete check of outgoing and incoming material is, of course, made. An interesting feature is the storing of small articles in specially designed boxes which can be clamped in any desired position to a number of steel uprights fixed in the floor. These boxes when reversed can be used as trays and in this form are, as a matter of fact, employed as carriers for such material as metal rods, mica sheets, &c.

This part of the building for the present also houses the office accommodation, but this is shortly to be transferred to a special building now nearing completion, where the research work so necessary in a progressive business will also be carried on.

THE WELFARE SECTION.

Mention must also be made of the welfare section of the works. This, besides clubs of various sorts all controlled by an ex-sergeant-major, comprises an excellent canteen, whose only blemish is the absence of electric cooking in its economy. Here meals are served on work days and somewhat more social exercises are held at other times. A very generous insurance scheme is another of Mr. Ellison's methods of ensuring that contentment among his work-people which is so essential to good production. His policy, indeed, is to obtain good workers, pay them well and insist on good work. It is a policy which has been amply justified in its results.

Electric Furnaces for Non-ferrous Alloys.*

By H. W. GILLET.

The most important characteristic of brass, from the point of view of electric melting, is the volatility of the zinc. If heat is supplied at a more rapid rate than it can be conducted away through the melt, overheating of the surface layer ensues, and the loss of zinc becomes prohibitive. Hence, electric furnaces of the usual arc type employed for steel are not applicable to brass which is high in zinc. The ordinary horizontal ring induction furnace is not applicable, owing to the high electrical conductivity of the alloy and consequent trouble through the "pinch" effect.

In selecting a furnace for service in non-ferrous melting, three things have to be considered—namely, the characteristics of the alloy, the characteristics of the furnace and the nature of the work.

In the original Paper, details are given of the furnaces used in this class of work in the United States. Table I. is a summary of some of the information there given.

Table I.

Make.	Total capacity per heat tons.	Total kW.	Number of furnaces.	Number of users.
Ajax-Wyatt	45	4,625	93	25
Detroit Rocking	53	15,900	57	28
Baily	48	6,890	74	51
Booth	13	5,345	40	35
Other furnaces	31	9,580	52	30
Total in use	193	42,350	318	169
Ajax-Wyatt, planned for prompt installation	(35)	(4,200)	(70)	Duplicates 25
Total, including Ajax-Wyatts planned	228	46,550	388	Sep. users. 144

Another table is also given showing the general applicability of the various furnaces.

COPPER AND SILVER MELTING.

The difficulties are not so marked in the case of copper and silver. In the case of brass the stationary indirect arc is unsatisfactory if the brass contains as much as about 20 per cent. of zinc, the direct arc being unsuitable with a much lower percentage. When we pass

to a yellow brass containing 30 and 40 per cent., the standard steel furnace types are quite unsuitable. Other methods must therefore be adopted. Three general methods have been followed: (a) Using a low rate of power input; (b) using a high rate of power input, and stirring by moving the furnace; and (c) heating from within the metal itself, with inherent stirring.

A low rate of power input means low efficiency and low production. When the heat is mainly indirectly transmitted from the source to the charge by reflection from the roof in order to distribute it more evenly, problems of refractories are made rather difficult. Various furnace builders attack the problem with furnaces of this general type in different ways.

SOME ELECTRIC BRASS FURNACES.

Bennett builds his furnace like a regular three-phase direct arc furnace, but keeps the voltage down so that he gets contact resistance rather than true arcs, and by keeping down the rate of power input he allows time for equalisation of temperature and avoidance of local superheating. By generating the heat close to the charge he avoids much of the thermal loss found with other low-powered types. The largest electric brass furnace in use is of this type, though it has not been introduced into the industry beyond the plant of the inventor.

Baily uses a large, relatively low temperature source of heat, a single-phase granular resistor, and still further distributes the heat by reflecting the bulk of it from the roof. A very low rate of power input is used, partly on account of the limitations due to the resistor troughs, and a furnace results which is slow, giving low production, sluggish, with a high heat storage, and of low thermal efficiency, especially when not run continuously. However, the furnace is simple, and easy to operate and has for this reason had a large measure of success.

The General Electric Company's furnace applies heat in much the same manner as the Baily, but uses the smothered-arc or contact resistance principle. It can employ a higher rate of power input, gaining somewhat in thermal efficiency, but increasing the difficulties with the refractories due to the higher temperature of the heat source. Three-phase power can be used instead of single-phase. Considering the time it has been on the market, it has found relatively little use.

The Rennerfelt "electric reverberatory" is just like the General Electric furnace in its source of heat, but locates this in the middle of the furnace instead of round the sides, and consequently wastes less energy in heating the furnace walls instead of the charge. One small furnace of this type has shown promising results. If structural difficulties do not become too great in man-size furnaces, it should find considerable application.

THE INDIRECT ARC FURNACE.

The next method of avoiding the specific difficulties found with alloys high in zinc is to use an indirect arc furnace, with a high rate of power input to get thermal efficiency, and to move the furnace so as to stir the metal and avoid superheating the surface. This was done long ago by Stassano in the early days of electric steel, but such furnaces were not then applied to brass. The principal furnaces using this method are the Detroit rocking furnace (operating under license from the Bureau of Mines), and the Booth rotating furnace, the former being installed almost wholly in the one-ton size, and the latter almost wholly in 500 lb. (225 kg.) or even smaller sizes. These furnaces give good efficiency, even on an eight-hour day, and have been adopted by the industry with remarkable rapidity. They are capable (especially the Detroit, which can be mechanically charged from overhead) of rapid operation and high production.

The Stassano furnace has been somewhat modified by the Volta Manufacturing Company, renamed the "Volta," and applied to brass.

ADVANTAGES OF THE AJAX-WYATT FURNACE.

Coming to the third method we have Hering's work on the pinch effect, and furnaces based thereon. The Hering furnace was tried out on brass on a considerable scale, but is no longer in use. The Ajax-Wyatt vertical-ring induction furnace, with its internal heating in the metal itself, its automatic circulation, and its compact form, has shown astonishing thermal efficiency, and has been adopted very widely by those brass rolling-mill industries which can readily melt 24 hours a day, and need not often change a furnace from one alloy to another—conditions vital to the successful operation of this furnace. Since these conditions are seldom found in the foundry, as differentiated from the rolling mill, this furnace has had little foundry use. It is in general not applicable to alloys of high electrical conductivity, i.e., those high in copper.

The last type that deserves mention is the Ajax-Northrup, the ingenious high-frequency eddy-current furnace which Dr. E. F.

* Abstract of a Paper read before the American Electro-chemical Society.

Northrup has already described. This is in commercial use on silver, platinum, &c., and besides the commercial installations some 25 furnaces are being used in laboratories on account of their extreme flexibility.

The furnace itself is highly successful for its special applications, and may be expected to find large commercial use if and when the generation of the necessary high-frequency current is so developed and cheapened that man-sized Ajax-Northrup furnaces are practical.

When the electric furnace replaces a crucible furnace, it effects a large saving, but it must be remembered that depreciation and obsolescence charges must be taken into account and these, when expressed per ton, are minimised by operation that gives maximum production (that is, steady operation). The electric brass furnace occupies a position of greater relative importance in the brass industry, and it has reached this position in a much shorter time.

THE ELECTRIC MELTING OF ALUMINIUM.

The electric melting of aluminium has not progressed as far as that of brass and bronze. The large latent heat fusion of aluminium makes it require a good deal of energy for melting, and, therefore, production is slower on aluminium than on bronze. On the usual aluminium alloys the electric furnace does not show any particular saving in metal.

It may be said that electric melting is thoroughly established for brass, well-established for bronze, frequently used for nickel-chromium and similar alloys, and used to an increasing extent for silver and for precious metals, is but little used for aluminium, and is not usual for lower melting alloys. The fundamental requirement for good performance of an electric furnace on non-ferrous alloys is that the furnace be fitted for its job. Experience has shown that an electric furnace, metallurgically suited to its job, once installed, generally stays in service, even though the melting cost sheets may show no saving. That is, the advantages of ease of control, cleanliness, and less trying working conditions for the furnace tender, which can hardly be expressed in terms of dollars and cents., are as real reasons for the adoption and use of electric furnaces as the more obvious reason that it generally costs less per unit to melt in the electric furnace.

Electrification of the Ebbw Vale Works and Collieries.*

By WALTER DIXON.

At present the properties either owned or under the control of the Ebbw Vale Steel, Iron & Coal Company, Ltd., extend almost continuously over an area of 15 miles north and south and 4 miles east and west. The works are to-day amongst the largest of their kind in the country. With the completion of the schemes now in progress, they will provide for an annual output of coal, 5 500 000 tons; coke, 575 000 tons; pig, 450 000 tons; while the allied industries embrace the manufacture of steel rails and sleepers, galvanised steel sheets, weldless steel tubes and couplings, coke-oven and blast-furnace by-products, iron and steel castings and engineering work.

There is an ever-increasing demand for power. At present 45 million units are generated per annum, which will probably be increased soon to 60 millions. The capacity of the generating steam plant installed is 22 000 kW, which exceeds the combined outputs of the four principal Corporation installations of Cardiff, Newport, Swansea and Llanelly.

The electrical plant installed includes: Generating plant having a combined output of 22 000 kW; over 50 transformers, having a combined output of 31 000 kVA; over 500 motors, having a combined output of 30 000 h.p.; converters, having a combined output of 2 500 kW.

POWER STATIONS.

The principal power station at Victoria is equipped with four turbo-alternators, two of 2 000 kW and two of 5 000 kW. A third 5 000 kW set is in process of completion. Steam alone is used for power generation, the gas-fired boilers being in close proximity with the generating station, and connected with the main battery of boilers which supplies the blast-furnace equipment. At present some coal is used, but with the completion of the present scheme there will be a margin of 10 000 h.p. to 14 000 h.p. available for electrical generating purposes, after the steam requirements of the blast furnaces have been met. The station generates at 2 000 to 2 200 V alternating current, three-phase at 50 ω . Turbines are arranged

for a steam pressure of 175 lb., with superheat. Condensing plant is arranged on the "Tinsley" system, the plants being driven both electrically and by steam.

Direct current is generated at 250 to 275 V from the original four high-speed engine sets, each of about 200 h.p., and one mixed pressure turbine 600 h.p. generating plant. The station also contains motor generators for supplying direct current in bulk to the Ebbw Vale Urban District Council. The supply is supplemented to the steelworks area by motor and rotary converters, totalling 2 500 kW.

Other power stations are situated at Six-Bells Colliery, where two 1 500 kW mixed pressure turbo-alternators, 3 000 V, 50 ω , feeding a line through South Griffin to the Upper Deep Collieries, are installed; at Prince of Wales Colliery, Abercarn, where there are three steam turbo-alternators, with a combined capacity of 3 500 kW, 2 000 V, 50 ω ; and at Cwmsychan Colliery, where there are two combined engine-driven sets, 25 ω .

DISTRIBUTION.

The installation roughly divides itself into two distributing systems, covering the iron and steel works, northern sections, and the southern district concerned with collieries. Direct current is taken to the steelworks from Victoria, and is transmitted on overhead cables to a distribution house in the steelworks. The alternating current is taken from the switchboard in the generating station to the main substation, and distributed to the northern area at 2 200 V on a ring main system with balanced protective gear. From various substations current is delivered at full and also at 500 to 550 V for general purposes. A supply is also being arranged for Trevil Quarries, transmission being at 6 000 V. Other subsidiary developments are described.

A split-conductor ring main, with transmission at 20 000 V, is projected to a number of collieries. Certain collieries are also supplied at 3 000 V.

TRANSMISSION.

The transmission lines are mainly erected on the overhead system, though in places it has been necessary to adopt underground cable. For the steelworks, "H" poles of the ordinary type have chiefly been employed. For dealing with the collieries in the Southern Section, the lines embraced within the ring are fixed on poles, and are of a type suitable for dealing with the voltage concerned, viz., 20 000.

Throughout the steelworks electrical power is used for many purposes, including Sheet Mills, Dolomite Plant, Steelworks, Upper-Mills, Ebbw Vale Blast Furnaces, Spring and Wagon Shops, Tube Works, Coke-Ovens, Victoria Colliery By-Product Plant, Gas-Cleaning Plant, Engineering Shops and Foundry, Victoria Blast-Furnaces. At the collieries electrical power is also employed, for pumps to the extent of 3 200 h.p.; winders to the extent of 2 000 h.p.; ventilating fans to the extent of 1 300 h.p.; air compressors to the extent of 4 400 h.p. Most of the collieries are arranged with their own substations.

Rough-cleaning of Blast-furnace Gas at Skinningrove by Lodge Process.*

By A. HUTCHINSON and E. BURY.

If a process could be found whereby gas could be cleaned for combustion processes without loss of the heat contained in the blast-furnace gas, a valuable fuel asset would be secured towards making the iron, steel and by-product coking plants self-contained. Other palpable advantages include (1) greater thermal efficiency at the stoves, boilers, &c., by preventing heavy deposits in flues, checkers, and regenerators; (2) more profitable use of capital in obviating the laying off of plant for cleaning; (3) reduction in labour employed for cleaning stoves, boilers and checkers; (4) preservation of the fire-brick construction from attack by alkalis contained in the blast-furnace dust; (5) saving in gaseous fuel consumed owing to the greater thermal efficiency of the blast-furnace gas.

The main difficulty has been that rough cleaning processes did not economise the sensible heat in the blast-furnace gas. In water washing processes, not only the heat was lost, but further fuel had even to be expended in pumping the water required for the dust removal. In filter cleaners employing filtering media of combustible textile fabric, the gas had likewise to be cooled to prevent damage to the filters and then reheated beyond its dew-point to

* Abstract of a Paper read before the Iron and Steel Institute.

* Abstract of a Paper read before the Iron and Steel Institute.

prevent deposition of slime upon the filters. Cleaner fans had also to be employed for forcing the gas through the plant, involving a further expenditure of power in fuel.

During the war two new considerations were:—

1. The use of electrostatic methods in America for the precipitation of chemical and metallurgical fume, and in Great Britain for the precipitation of sulphuric acid fume at H.M. explosive factories.

2. The national shortage of potash, which during 1916 had been proved to be present in the blast-furnace dust at Skinningrove in considerable quantities.

The possibility of cleaning dusty gases by electrostatic discharges had been raised by Sir Oliver Lodge as far back as 1882. At Skinningrove the plant designed for these trials was at work early in 1917, and consisted of two nests of vertical pipes in series. In the centre of each pipe was suspended a vertical rod on which horizontal discs were placed at intervals of 6 in. The electric discharge at 40 000 V was passed to the vertical rod, and thence through the discs to the inner surface of the pipe. The gas was passed between the periphery of the discs and the surface of the pipe, thus coming under the influence of the discharge, the dust deposit taking place upon the pipe surface.

The quantity of gas passed through this apparatus was varied from 40 000 to 80 000 cubic ft. per hour. The cleaned gas contained from 0.2 to 0.5 grm. per cubic metre according to the rate of flow, the dust content in the dirty gas being 4.0 to 5.0 grm. per cubic metre. After three months it was decided to erect a plant for the treatment of the entire make of blast-furnace gas—i.e., from 3 000 to 3 500 tons of pig iron per week.

In the original Paper the authors then enter upon a detailed description of the plant and processes involved.

The plant has only been at work for approximately four months, but experience has so far proved the following points with regard to electrostatic rough gas cleaning at Skinningrove:—

(a) That with 80 to 85 per cent. of the electrostatic plant at work the dust in the gas has been reduced from 5 to 6 grms. per cubic metre in the dirty gas to 0.8 to 1.1 grm. in the cleaned gas—i.e., to the standard of Continental practice for stove and boiler use.

(b) That this result has been attained with a total fuel consumption corresponding with only 50 kW

(c) That no power is necessary for pumping water or for moving gas through the system.

(d) That the cleaning has been effected by a comparatively small loss of the original sensible heat. The raw gas enters the cleaning chambers at 220°C. to 250°C., and the cleaned gas leaves at 200°C. to 220°C.

(e) Less gas is being used at the stoves and boilers. It is too early to state the total saving accurately, but the surplus gas available has increased.

(f) The recovery of 48 to 50 tons dust per week containing 27 per cent. KCl.

Reviews.

Messgerate und Schaltungen für Wechselstromleistungsmessungen. By W. Skirl. (Berlin: J. Springer.) Pp. 278. 26 M

This book is intended as a reference book for engineers who have to measure alternating pressures, currents and powers, and is not a book on the theory of electrical measurements or instruments. We are told that the book is the result of a series of technical instructions prepared by the author for use with Siemens & Halske instruments; while the information given is of general application, the constructional details described in the first half of the book refer exclusively to this firm's types, many of which are well known to (and liked by) English engineers. The errors of instruments are succinctly given at the outset; then comes a description of portable laboratory and test-house precision instruments of the electro-dynamometer type with air damping and various compensations. In the laboratory patterns the moving coil is inside the fixed coil, whereas in the more compact test-house patterns the reverse is the case. This is followed by a section on portable workshop instruments. Instead of the rotary-field system, the recent iron-core dynamometer type is preferred for measuring power, while the moving-iron principle is advocated for measuring pressure and current. The construction and use of precision instrument transformers are discussed in detail.

The second half of the book is devoted to connexions and methods. Precision meters of the laboratory pattern are used for direct measurements, but indirect methods (i.e., with transformers) are used with other patterns, in which the instrument current is limited to 5 A. For measuring single-phase power, direct, indirect and semi-indirect methods are described. An example of each is worked out and it is shown how to correct for the energy consumed in the instruments. Similarly the various methods are described and the connections given for measuring three-phase power by the one-, two- or three-wattmeter method or by the three-phase wattmeter method. The last section deals with the calibration of alternating-current instruments; while in an appendix there is a very useful description of the moving-coil instruments—the one-ohm instrument being referred to as the classic and the 10-ohm as the modern precision instrument for continuous current.

We have heartily enjoyed reading this book, and can confidently recommend it to all who have to make alternating-current measurements. The worst fault about the book—at least, of our copy—is its bad binding, which is unpardonable in a reference book and rather surprising with one of Springer's publications.

S. PARKER SMITH.

Direct-current Motor and Generator Troubles. By T. S. Gandy and E. C. Schacht. (London: Hill Publishing Company.) Pp. ix. + 274. 15s. net.

Much attention is now being paid by writers to this subject. Starting with the preface, we are told that the theories of why a motor or generator will run have been completely given in numerous excellent textbooks; but many in the electrical world are greatly interested in why a motor or generator will not run, and it is to supply information on this topic that the present book has been written. Then follows an introductory note by Steinmetz. After explaining in a very elementary way the types of motors and generators and their uses, information is given on the application of motors, along with a schedule of the particulars to be supplied to the manufacturer when a motor or generator is ordered. In the chapter on erection and assembly the reader learns how to make the foundations, how to sling the several parts, how to space the brushes, &c. Then come sections on the starting and operation of motors and generators, commutator grinding, bearing lubrication, parallel operation, &c. Direct-current switchboards, with instructions for installing and operating, conclude the opening chapters.

"Troubles and their Remedies" is the title of the main section, extending over 100 pages. Starting with commutation, brush position and brush potential curves are first dealt with in a practical fashion. Some useful remarks are then made on wrong choice of brushes, unequal spacing, chattering, glowing, vibration, high mica and on most of the other brush and commutation evils. Armature and field troubles, motor and generator troubles, shaft and bearing troubles and noise bring this excellent chapter to an end. The book closes with a chapter on tests and repairs and a lot of useful data. There is no doubt that those engaged in testing and seeing after electrical machines will find this a very useful reference book—doubtless some sources of trouble have been omitted, but so many are given that the enquirer will almost certainly get some help by consulting one part or another. The book is illustrated and finished in the well-known style of the McGraw-Hill publications.

S. PARKER SMITH.

A Second Course in Mathematics for Technical Students. By P. J. HALL and A. H. STUART. (London: University Tutorial Press, Ltd.) Pp. vii + 363. 6s. net.

This book is intended for students in the second and third years of their mathematical course in evening technical schools. The first section of the book is mainly analytical, and includes the elements of the differential and integral calculus. The second section is mainly geometrical. The object of the authors is to accustom students to those analytical processes which they will find useful in their practical work and to initiate them into the many ingenious graphical methods used by engineers. For example, the explanation of the principle

of the slide-rule follows at once from the chapter on the practical theory of logarithms.

Mathematical functions are illustrated and explained by means of graphs. In finding areas and volumes stress is laid on Simpson's rule, but in the writer's opinion it would be better to use Wedde's rule. The importance of velocity-time and force-space curves is duly emphasised. The chapter on graphs in three dimensions should prove useful.

The explanations are sometimes too condensed. For example, when explaining potential and kinetic energy the reader is asked to consider a "body whose weight is W lb." No definition is given of the pound. He is then told that if we call W/g mass and represent it by M , we have

$$\text{Kinetic energy (in foot lb.)} = \frac{1}{2} M v^2.$$

A warning should be given that this definition of mass is not generally accepted. According to this definition M is not measured in pounds. If it were, $\frac{1}{2} M v^2$ would be given in foot-pounds.

This book will prove more useful for teaching in class than for the private student. An able teacher will be able to pick out and amplify those portions of the book suitable for a particular type of student. A. R.

"Freezor" Fan Manufacture.

There are few branches of the electrical industry in which more rapid strides have been made in recent years than that concerned with the manufacture of ventilating fans; and a very prominent position in this comparatively modern development is occupied by the well-known "Freezor" Fans of the GENERAL ELECTRIC COMPANY. In the early part of 1912 the "Freezor" Fan Works were erected at Witton, near Birmingham, and from that time many thousands of fans for offices, hotels, ships, railway trains and countless other situations, have been manufactured.

A special study has been made by the company of the various types required in modern practice, and designs suitable for desk, bracket or ceiling use are available. In many cases the same fan can be adopted for any two or all three of these purposes. Again, particular attention has been given to the oscillating fan which possesses very obvious advantages. The needs of the foreign market have been kept well to the fore, and the "Koolah" three-blade fan with a 54 in. blade has attained a wide popularity in India and other hot countries. But it is the processes of manufacture with which we have chiefly to deal.



FIG. 1. ONE OF THE MACHINE BAYS IN THE "FREEZOR" FAN WORKS.

STANDARDISED METHODS OF PRODUCTION.

Naturally the production of large quantities of the various types of fans enables wide use to be made of standardisation, and the small number of jigs and templates employed tends to avoid complication, with its consequent increase of working costs. Being a modern works it is almost superfluous to state that the various bays are so arranged that the work can progress from one stage to another in appropriate sequence and with a minimum of transport. Naturally, very light

and high-class castings are required for these small machines, so that special attention has to be devoted to them in the foundry. The castings are arranged in sets in the castings section of the stores, and issued in this manner to the machine shop. This comprises two 220 ft. bays equipped with machine tools of most modern design, many of which are automatic. A view down one of these bays is given in Fig. 1.

The machined castings are again issued in sets to the enamelling shops, so that the stores are in a position to arrange the finished parts in sets without undue confusion or dislocation of other work



FIG. 2.—GENERAL VIEW OF THE WINDING SHOP.

in the earlier stages of development. Finally a regular flow of complete sets of parts for each type of motor is maintained to the assembly benches. This, of course, makes for economy in output, and avoids any confusion.

At the same time that the rough castings are issued to the machine shop sheets of dynamo steel are forwarded to the press shop. The armature, rotor and stator stampings produced in this shop are then re-issued to the core assembly benches for building up on spindles or into shells. When finished these parts are transported to the winding shop which in the meantime has been engaged on the windings of the armature, field and stator coils which can now be assembled on the cores. Fig. 2 shows a view of the winding shop, which provides employment for some 250 women and girls. In their work they are assisted by much winding machinery, many special machines having been designed on scientific principles to deal with the peculiar requirements of this highly specialised class of work, it is perhaps needless to add, with highly satisfactory results.

PLATING AND ENAMELLING PROCESSES.

It will be convenient to digress at this stage so as to give some account of the various plating and enamelling processes employed, for it is highly essential that each fan should possess a thoroughly high-class finish. It is possible to supply fans of a colour to harmonise with any surroundings; white and nickel-plated fittings add considerably to their appearance. Before any finishing process can be applied, the surfaces of the various parts must, of course, be thoroughly cleaned and prepared. This preliminary operation is carried out by means of suitable emery and buffing wheels, and dressing machines. The enamelling shop is particularly well equipped, part of the available space being devoted entirely to white enamelling, which is largely in favour in tropical countries. The liquid enamel is sprayed on by compressed air, special protected compartments being reserved for this process. The various enamelled parts are then placed in suitable racks, fitting into carriages which can very easily be guided into ovens.

The plating and dipping section is equipped with a series of vats, with the necessary switchgear for controlling the current passing through the liquid. The current is supplied from motor generator sets. A view of one of the rooms devoted to this work is shown in Fig. 3.

BLADE AND GUARD MANUFACTURE.

The blades and guards are all made at Witton, every blade being produced from solid brass, not sheet iron brassed over. The vanes are all carefully dished to give a definite curvature, as determined by experiments, so that the maximum air delivery is given with minimum air friction loss. They are riveted to a stout spider

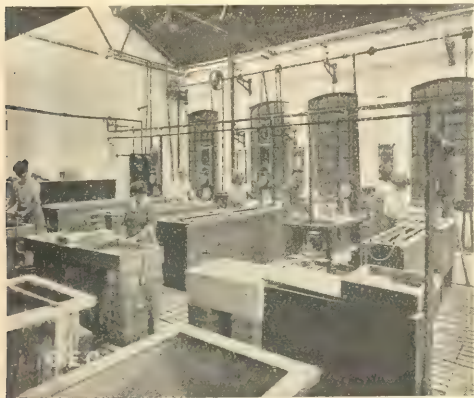


FIG. 3. PLATING AND DIPPING SECTION.

this construction guaranteeing a rigid structure capable of withstanding any requisite air resistance without warping or creaking. In this way it has been possible to obtain very high air deliveries without increasing the noise emitted by the blade.

Not the least important part of a desk fan is the guard. The type of guard supplied with "Freezor" fans has been designed in such a way to ensure absolute rigidity and freedom from noise due to eddies. As with the blade, solid brass is used throughout, so that any of the following finishes can be supplied: (1) Bright brass finish; (2) nickel plate finish, light or heavy; (3) oxidised copper; (4) oxidised silver; (5) silver plated; and (6) gold plated.



FIG. 4. BLADES READY FOR ASSEMBLING.

The various parts which have just been described, together with the completely wound armatures and stators and other accessories, are carefully inspected and tested before finally being dispatched to the assembly benches. An illustration of the part of the work in which this particular operation is carried on is shown in Fig. 4. From here the fans are passed on for the final testing.

Not a single motor even down to an ordinary $9\frac{1}{2}$ in. desk fan or 1.50 H.P. motor, is allowed to pass into dispatch until its test cer-

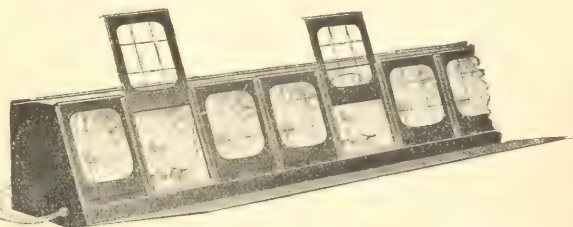
tificate has been appended certifying that the complete machine has passed between the limits fixed for watts consumption and volumetric or mechanical efficiency. Included in the final test is a long period of full-load running. This vigorous test together with an extensive inspection of the integral parts at each stage in the process of manufacture must obviously guarantee a thoroughly high-class and satisfactory article. Finally, each fan has the blades dismantled and is packed for dispatch.

Progress in Stage Lighting.

Though great advances have taken place during the last decade in stage construction, scenery, and methods of production, in the matter of artificial illumination conditions are practically the same as they were a generation ago; but the system of lighting recently developed by the BRITISH THOMSON-HOUSTON COMPANY represents a development that may almost be termed revolutionary. It will not be denied that lighting is an enormously influential factor in the production of modern stage plays, and every producer realises that his play may be made or marred by light. As a rule he knows exactly what he wants in the way of lighting effects, but until recently he was not able to get the necessary apparatus for there has not hitherto been available any standard range of lighting appliances capable of providing the various effects required. The lighting equipment of the average London theatre consists usually of metal troughs, painted white, and equipped with ordinary metal filament lamps. In order to obtain colour effects, some or all of the lamps would be dipped in lacquer. It is hardly necessary to point out the defects of this system, but the new B.T.-H. system of stage lighting is both more effective and adaptable than the traditional method.

DETAILS OF THE NEW EQUIPMENT

Briefly described, the new equipment is a combination of three elements—the X-ray mirror reflector, the Mazda gasfilled lamp and a metal framework to hold colour gelatine slides. The required number of units, each consisting of a lamp, reflector, and colour slide, are assembled in a specially-designed metal trough. The equipment is supplied in four



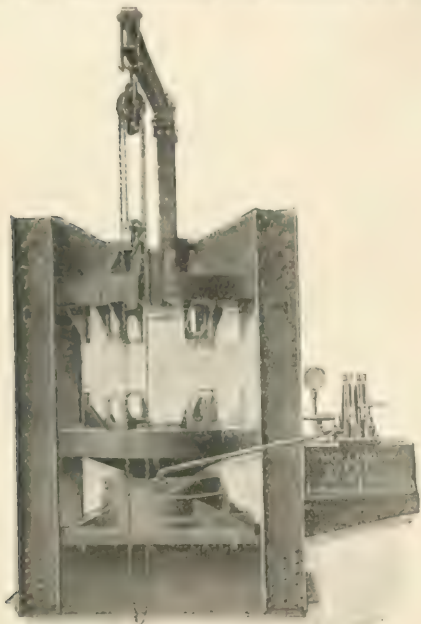
different patterns—viz., concentrating battens, distributing battens, floats and proscenium strips. The concentrating battens are intended for the intense illumination of particular sections of the stage. They are equipped with "Jupiter" X-ray reflectors and with either 100 or 200 W Mazda gasfilled lamps. Using 100 W lamps, this form of batten gives a downward illumination of 1,000 c.p. per lamp, so that a batten containing thirty 100 W lamps would project a light of 30,000 c.p. on to the stage. For the general illumination of the stage, distributing battens, equipped with "Scoop" X-ray reflectors and 100 or 60 W Mazda gasfilled lamps are recommended. Special "E.60" X-ray reflectors and 60 W gasfilled lamps are used in the float and proscenium strip. It is obvious that the efficiency of the B.T.-H. equipment is vastly higher than that of the apparatus ordinarily used. By using Mazda gasfilled lamps instead of vacuum lamps a considerable economy in current consumption is achieved. The X-ray mirror reflector reflects a much greater proportion of the light than the painted troughs hitherto employed. In many cases the installation of the new equipment may be expected to bring about increases in overall efficiency up to 200 per cent. Another advantage is that a smaller number of larger lamps can be used thereby reducing the cost of replacement and maintenance. As it is not necessary for the lamps themselves to be coloured there will be an economy in handling and consequent breakage to which lamps are commonly exposed.

COLOR EFFECTS.

In the B.T.-H. system colour effects are obtained by the use of gelatine slides. Over the mouth of each reflector is fitted a sliding frame, into which the gelatine is slipped, and it is quite a simple thing to change the colours as desired. With a fair supply of gelatine slides of various tints, a producer can get any colour effect desired, and can change from one effect to another in a few seconds by the substitution of one set of slides for another. The new system gives colour effects which have hitherto been thought impossible. The system has already been installed in two of the leading London theatres, and the equipment for several other theatres is being made. Further information on the subject may be obtained from the Illuminating Engineers' Department of the British Thomson-Houston Company. We understand that the company is busy with the manufacture of other stage-lighting appliances which are likely to cause a considerable stir in the theatrical world. The illustration shows a B.T.-H. X-ray distributing batten.

A Modern Tyre Press.

A new design of tyre press has just been introduced on the market by Messrs. Mather & Platt, Ltd., of Birmingham. The special feature of this equipment, which is constructed in such a way as to have no gears or other parts that are fixed to or removed from the frame or other similar wheels without taking the wheels off the press, is the fact that the frame consists of solid steel riveted together, while the cylinder is of cast-iron. The cast-iron frame has 18 in. x 18 in. dimensions with a length of 18 in. The frame and base are 4 ft. 6 in. high and are placed 2 ft. 6 in. apart, being mounted on four legs. The 14 ft. 6 in. has a 12 in. hole in the middle of the frame, while the base has an open slot to adjust the table. A pressure of 1,000 or 2,000 tons is obtained on the table. The press is of the double ram type, the large ram being used for raising the press quickly and the small ram for giving high pressure. The construction is of Messrs. Mather & Platt's well-known design, and is of the type of those which, it is claimed, give a frame reinforced with maximum strength. A



View of the new Mather & Platt Tyre Press. Mather & Platt, Ltd., Birmingham.

view of the new Mather & Platt Tyre Press, which enables the wheel and axle to be carried right into the centre of the press table. The design of the machine is of the type of those which, it is claimed, give a frame reinforced with maximum strength.

Rectifiers for a French Railway.

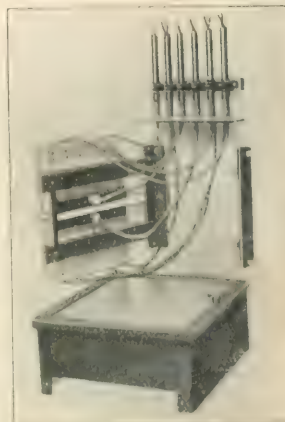
The French Government has recently ordered for a railway rectifier, which will be used for the purpose of converting the alternating current into direct current for the purpose of driving the electric locomotives. The rectifier is to be of the type known as the "Mather & Platt" type, and is to be of the type known as the "Mather & Platt" type.

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The "Priory" Distribution Board.

A further step towards simplification in electrical wiring work has been made by the PRIORY ELECTRICAL ENGINEERING COMPANY, Bath Street, Birmingham, in their new distribution board which we illustrate herewith. The process commences by fixing two angle irons to the wall and hanging the frame supporting the fuse units to one of them as is clearly shown in the illustration. The service cables and distributors are then connected and the frame is swung back and held in place by means of screws which fit into two pillars cast on the other piece of angle iron. The sheet steel case shown in the recumbent position in the illustration is then slipped over, being fastened by screws into the sides of the angle-iron supports. The board illustrated is arranged for six ways—with two fuses per way. The cables are led into the box through an insulated separator, an asbestos fillet being fitted between the upper and lower row of fuses. The service cables are connected to a small bus-bar to which one terminal of each fuse is clamped by a screw. The construction of the board is, we are pleased to note, very substantial and all parts are easily connected up and assembled. It may be pointed out that the board complies in every detail with Home Office regulations and is quite fireproof.

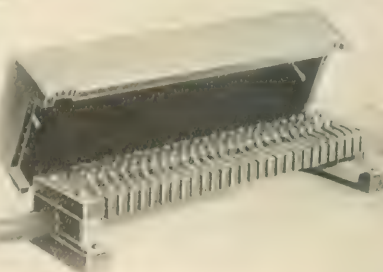


THE "PRIORY" DISTRIBUTION BOARD SHOWING METHOD OF FITTING.

A New Telephone Junction Box.

The accompanying illustration shows a new telephone junction box, which has recently been placed on the market by DICTOGRAPH TELEPHONES, LTD. For many years this box has, we understand, been successfully used in their dictophone telephone installations by some of the largest engineering concerns in the country, and it is equally useful for other apparatus which require multi-core cable, such as annunciators, and large systems of bell indicators for hotels.

The chief feature of the box is, that all the connections are soldered. Each lug, which is made of heavy tinned wire, will take three conductors and each junction box will take three or four main cables. There is ample room behind the base of the junction box to lace and form the cables, and when fixed to the wall, the cables are entirely hidden, only the soldered ends and colour code being visible from end to end.



DICTOGRAPH TELEPHONE JUNCTION BOX.

The box is completely enclosed in a hardwood cover, which can be supplied in a variety of finishes to match the furniture in the room. Not the least interesting feature of the box is its price, which is one-third that of the usual box. This should ensure its appeal to a wide circle.

Adjustable Pendants.

The accompanying illustrations are examples in two positions of the "Adjustalite" pendants which have been placed on the market by the RHODES FITTING COMPANY, LTD., of 224, Upper Thames-street, London. The standard range of adjustment is from 1 in. to 18 in., but the fitting can be made in special sizes to order and in accordance with period designs. The fitting is very light and the



THE "ADJUSTALITE" PENDANT (a) RAISED, (b) EXTENDED.

adjustment is secured by sliding the pendant holders over tubular guides. It is wired complete with lampholders and is also supplied in a number of finishes, including polished or antique brass, oxidised copper and oxidised silver. The same company are making a table standard for offices or libraries which has the useful feature of containing no adjusting screws and, while it has a firm grip and adjustment, can be operated with one hand.

"M. & C. Machine Mining."

Apart from their other activities, MESSRS. MAYOR & COLESON are already well known amongst our readers as the publishers of an exceedingly bright and well-got-up house magazine. They have now added both to their responsibilities and their publications by the issue of "M. & C. Machine Mining," a monthly journal which is designed to promote the adoption of mechanical conditions in the mining of coal—a very excellent object. As is pointed out in the opening editorial, on the achievement of the task of economic production of coal depends the livelihood of the whole of the population of this country, and the planning of the workings to permit of effective use of labour-saving appliances is one of the problems of efficient management. A vital factor in the increase of output and the reduction of costs must, therefore, be a great extension of the employment of machinery, but additional machinery will be of little avail unless measures are taken to ensure the full output that can be derived from its systematic application. Details of the various coal cutters made by the firm are given, the descriptions including features not only of their design and construction, but of their operation.

The Victorian Minister for Education has been asked by the Footscray (Victoria) Technical School Authorities to convene a conference of employers and representatives of employees to discuss the subject of APPRENTICESHIP. Proposals to be discussed are that boys, prior to apprenticeship, should be trained for not less than three years in a technical school, that at least one-half day a week should be allowed for apprentices to attend technical schools in their employers' time, and that a central committee for apprentices should confer with leading employers and employees interested in education, and draw up courses of work and determine the number of boys required in the State in each year, and see that the required number were prepared.

C.A.V. Service System.

A motor car is all right until it goes wrong, and that is all a great many drivers know about it. The same may be said about the battery lighting systems which are often fitted to these vehicles. These incidental troubles which always occur at the most awkward moments are quite irrespective of the make of the car or of the battery lighting system, and it therefore behoves motor-car manufacturers and those who make battery lighting equipments to take steps to see that the inconvenience caused by these breakdowns should be reduced to a minimum. We are glad to see that MESSRS. C. A. VANDERVELL & COMPANY have realised this by instituting an interesting service system in connection with their motor-car battery lighting equipment business. MESSRS. Vandervell's experience shows that in a majority of cases trouble with the electric system of a car can be traced to the batteries and they have therefore made arrangements with the Willard Storage Battery Company to render service to motorists throughout the British Empire, except in Canada, which is already dealt with by the Willard Company. With every car equipped with C.A.V. electric batteries there is supplied a card which entitles the owner to have his batteries periodically inspected and kept in order for 90 days, free of charge, at a C.A.V. service station. At every station too there is a man who has been through a period of training at the C.A.V. factory, and every C.A.V. service station is capable of dealing with any trouble from which a battery can possibly suffer, and even replacements, if necessary, can be made without reference to the factory. In the past many battery troubles have arisen because the owner had no conveniently available means of getting his batteries attended to by a capable expert, but under the new C.A.V. system this will no longer be the case.

A Paper-Testing Device.

An instrument, known as the Elmdorf paper tester, which measures the tearing strength of all kinds of paper and used in America for measuring the strength of insulating paper, is (according to the "Electrical Review" of Chicago) being placed upon the market by the THWING INSTRUMENT COMPANY, of Philadelphia.

The strength of paper is commonly judged by tearing it with the hands, and the Elmdorf tester does the same thing, but measures the average force required to tear a considerable length of the paper. The illustrations show how the instrument operates. A strip of heavy paper, or several strips of lighter paper, are first cut to a standard width on a simple paper-cutter with a gauge. The swinging sector of the instrument is lifted 70 deg. and rests against the spring stop; the samples are dropped into the two jaws and clamped fast by the set screws. The right-hand jaw is part of the fixed support and corresponds to the thumb and finger of the right hand; the left hand jaw, corresponding to the left-hand thumb and finger, is on the moving sector. With the specimen in position the knife handle is depressed, cutting a slit in the specimen which determines an exact length left to be torn. The friction pointer is set against a fixed stop and the spring stop released, allowing the sector to descend by gravity and tear the paper. Owing to the resistance offered by the paper the sector will not swing to 70 deg. on the opposite side, but to a position depending only on the strength of the paper and the length of the tear. This position is shown on the

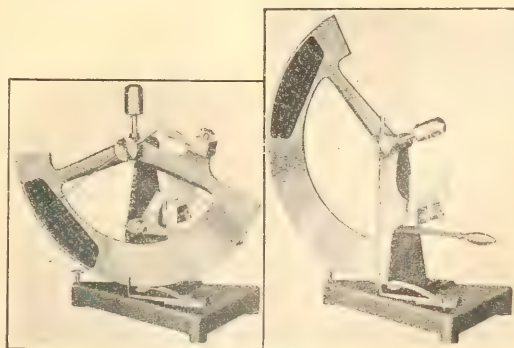


FIG. 1.—ELMDORF PAPER TESTER WITH SPECIMEN IN POSITION READY TO BE TORN.

FIG. 2.—TESTER SHOWING TORN SPECIMEN WITH POINTER INDICATING FORCE.

dial by the pointer. By resetting the sector and pointer and moving the specimen an inch to the left the test may be repeated in a few seconds. Papers of uniform strength will give repeated indications agreeing very closely.

Obituary.

Mr. Peter Cooper Hewitt.

We regret to record the death of Mr. PETER COOPER HEWITT, which occurred at the American Hospital, Neuilly (Paris), on the 25th ult., from pneumonia, following an operation for intestinal trouble. Mr. Hewitt, who was 69 years of age, was a son of A. S. Hewitt, a former Mayor of New York and a member of Congress. He was educated at the Stevens Institute of Technology and at Columbia University. In spite of the fact that he inherited a very large fortune from both his parents, he devoted himself to scientific research and succeeded in acquiring an international reputation.

Although Mr. Cooper Hewitt is perhaps best known in Europe in connection with the development of the application of mercury vapour apparatus—viz., the Cooper Hewitt lamp and the mercury arc rectifier for the conversion of alternating to direct current, for the manufacture and sale of which he founded, in collaboration with Mr. Geo. Westinghouse, the Cooper Hewitt Electric Company of New York and the Hewitt Electric Company of London—he was also a contributor to scientific discovery in a diversity of fields, from wireless telegraphy and telephony to a special process for the electrical welding of steel. In 1903 the degree of Honorary D.Sc. was conferred on him by Columbia University. He was a director of several mining, railway and electrical companies, and he was also associated with philanthropic institutions, and with many organisations for the encouragement of art. Mr. Hewitt was a member of various American learned societies and clubs, including the Society of Naval Architects and Marine Engineers, and the Inventors' Guild.

"X-Ray Scoopette" Fittings.

The latest enterprise of the BRITISH THOMSON-HOUSTON COMPANY is illustrated herewith and described below. In a happy blend of science and slang, it has been called the "X-ray Scoopette"



FIG. 1.

fitting, and has been designed to meet the demand for a neat and effective lighting unit suitable for use in show cases and windows that cannot be lighted from the top. This fitting, of which we illustrate an example (see Fig. 1), consists of a Scoopette X-ray reflector; in other words, a diminutive edition of the firm's standard window lighting X-ray reflector, a polished nickel or Florentine bronze casing and a bayonet lamp-holder. Any size of Mazda Navy bulb lamp may be used in the fitting, and these lamps, besides being more efficient and durable,

are, it is claimed, very neat in appearance. The combination is, in fact, suitable and efficient for lighting jewellery, hosiery and other windows where close dressing is an invariable rule, and for the illumination of show cases, small counters, pictures and music stands. Fig. 2



FIG. 2.

illustrates a type of bracket which has been designed to facilitate the fixing of the fitting to a wooden beading or windows. Other brackets allow a similar fixing to a steel bar or a glass shelf to be easily effected.

Benn Brothers Annual Meeting.

The annual meeting of the shareholders of Benn Brothers, Ltd. (proprietors of THE ELECTRICIAN and numerous other trade and technical journals), was held on Friday, August 26, at 8, Boulevard-street, E.C.

THE CHAIRMAN'S SPEECH.

In moving the adoption of the report and balance sheet the chairman (Sir John Benn) said:—

Our accounts, presented herewith, faithfully summarise the gratifying figures for the past year. They cannot, however, give any adequate idea of the great amount of loyal and painstaking labour involved in producing the numerous publications owned by the Company. They make clear that to secure anything like pre-war profits a largely increased turnover is now indispensable. This year, as the net result of their considerable investment, the shareholders receive a sum of £11 307. To secure this, no less than £180 000 has passed, in one way or another, to wage-earners, and approximately £20 000 to the National Treasury. Reductions of wages are in the air, and it may be perhaps assumed that this £180 000 will grow less. I do not think so. It is true that this large item represents the highest wage standard extant in our industry, but in my judgment any wage reduction will really result in a total increase of this labour item. Since the Armistice all publishing business has been greatly handicapped by the extravagant cost of materials and production. Once these costs again approximate to the normal we shall be encouraged largely to extend our operations and so largely to increase our contribution to the total wages fund. There is, indeed, no limit to the expansion of our activities once reason is restored in the cost of paper and printing. Our aim has been not only to keep up our modest dividend, but to sell our journals and advertising space at, approximately, pre-war rates. The enterprise which tries to save itself by putting up prices in peril, as some current public examples show. It is true that we are doing a business of, roughly, a quarter of a million a year, and our dividend is much the same as when we did half that turnover. But this broadening of our base is, I am sure, all to the good.

Thanks to an accomplished and indefatigable staff, so largely in partnership with us, we are, despite the devastating war period, in a position never excelled in our history. Nowadays the business man is so oppressed by the daily inquisition of an assertive bureaucracy that he has neither the time nor the inclination to consider the general outlook. The present rate and manner of taxation offers a premium to bankruptcy and unemployment. As an example there is this recent Corporation Tax. It introduces a new trade-destroying principle into taxation. It is a tax upon industry as industry, and that upon the most beneficent part of industry, namely, joint-stock enterprise.

A BAROMETER OF BRITISH INDUSTRY.

Our publishing undertaking may claim to be a barometer of British industry. As adding to this world knowledge I refer, with no little pleasure, to the visit to America paid by our Managing Director. America is a country which has set an example to the world in her quick recovery from war-time measures. Our Managing Director's careful and authoritative reports on commercial conditions there have proved and continue to prove of inestimable value to us. America, of course, has her own methods, and I am not convinced that they are always necessarily applicable to our own problems, but one clear point seems to have been revealed by every American business man with whom Mr. Benn came in contact, and that was that no such recovery could have been made if American commerce had been handicapped as British commerce is handicapped by State interference and taxation on our scale.

If the State devotes its energies to a wise economy instead of harassing business in this and like manner the barometer will soon show "set fair." The trade of this country has passed through a period which may be described as little short of revolution, and yet its framework remains intact. Industrial master men, whether in the counting house or the workshop, are growing to understand and trust each other, and higher production is in sight. Such a wise pull-together policy will mean vast and growing prosperity for this nation of shop-keepers. The statesmanlike attitude of the great majority of trade-union bodies towards the re-adjustment of values now taking place gives the firmest assurance of determination to maintain our British reputation as the leaders of the industrial world.

BUREAUCRACY MUST GO.

It is not to labour but in another direction that we have to look for the greatest obstacle to activity and progress which now bars the industrial path. The bureaucracy must be swept out of the way. It is not so much a question of anti-waste as anti-humbug. The waste is bad enough, but the humbug is far worse. Every business man can give numerous instances of openings for trade and employment of which he can make no use because he does not know and cannot discover what are the regulations that stand in his way. There is a good deal of talk of the safeguarding of industries. English commerce has for centuries provided all the safeguard that the nation has enjoyed, and does not now require to be safeguarded at its own expense by the eighty Government Departments which never have and never will and never can do anything to facilitate that progress and expansion upon which the well being of every one of us depends.

The public, when it thinks of trade and industry, is apt to forget that the bulk of our business is not transacted by the big and successful concerns who monopolise the commercial reports in the newspapers,

but by the 20 000 house furnishers, the 24 000 ironmongers, the 40 000 fruit-growers, and the hundreds of thousands of small tradesmen out of whom will come the big concerns of the next generation. A large proportion of the time of all these people is still occupied in answering the questions of functionaries who were appointed to win the war and remain to lose the peace. The time has come to adopt a new slogan, not anti-waste, for that is merely negative, but a more comprehensive motto, which will include this desirable purpose and build upon it. "Back to business" should be our watchword, and if we adopt it and act upon it now, the world is at our feet. We have every reason to join the optimists.

The report (showing a profit of £24 836 and providing for a dividend of 15 per cent. for the year) was adopted, and Mr. F. H. Elliott and Mr. C. E. Hughes were re-elected directors.

Visit of Mr. Forbes Mackay to England.

MR. H. R. FORBES MACKAY, General Manager of the Electricity Department, has been instructed by the City Council of Sydney, N.S.W., to visit Great Britain and America for the purpose of making himself acquainted with the latest developments in electricity supply systems. Mr. Mackay expects to arrive in London about the middle of October. He will make his headquarters at the office of Messrs. Preece, Cardew & Rider, 8, Queen Anne's Gate. As is well known, the Sydney undertaking is a very large one. The capital expenditure is already nearly £4 500 000, and the annual revenue approximately £1 000 000. There are more than 50 000 consumers and a total connected load of over 130 000 kW. The observed greatest demand is about 40 000 kW. In the 12 months ending May 31, 1921, there were 12 041 new consumers connected. Mr. Mackay has reported to the Sydney Council that the next main generating unit installed, which it is proposed should be of about 16 000 kW, will fill up the whole of the space available on the site of the existing power house, and that, therefore, by about 1925 a new power house should be in operation. It is largely in connection with the design of this proposed new power house that Mr. Mackay is making his visit to Great Britain and America. He is specially interested in: (a) The economy and effectiveness under different conditions of pulverised coal as fuel; (b) the automatic protection of high-tension cables; (c) modern designs of high-tension switchgear; (d) the latest developments in different types of automatic stokers; (e) steam turbines, particularly the maximum rating up to which a 3 000 revs. per min. machine can be carried with safety; (f) the use of extra-high-steam pressures in boilers; and (g) methods of disposing of ash and clinker where coal is burned in large quantities.

We have no doubt that a very warm welcome will be given to Mr. Mackay.

Iceland's Water Power.

The new electricity works at Reykjavik in ICELAND have just been opened, and in spite of the cost of the works (nearly kr.3 000 000), it has been found possible to supply the town with electricity more cheaply than hitherto at 75 öre per kWh. The works contain two dynamos, one developing 1 000 h.p. and the other 500 h.p., which are driven by the comparatively small stream of the Ellidæra, a few kilometres outside the town of Reykjavik. The works at Reykjavik represent, Reuter's Copenhagen correspondent states, but a fraction of the power which could be obtained from the great Icelandic falls. Two water-power companies exist in the island at present, one Danish-Icelandic, the other Norwegian-Icelandic, and together it is estimated they control streams capable of producing millions of horse-power. The problem at present is to find use for the immense power which could so easily be produced.

The "Terra-Grip" Continuity Clip.

The Simplex "Terra-Grip" Continuity System, of which we have just received particulars, has been introduced to provide a cheap means of effecting permanent electrical conductivity in light gauge unscrewed installations. To do this each outlet of every fitting is equipped with a drilled and tapped boss for housing a special cup-shaped steel screw. After the conduit is erected this screw is driven home so that its cupped nose expands and makes a good earthing contact with the conduit. At the same time the screw is automatically locked in position, so that it does not loosen under vibration.

The device, which should prove exceedingly useful, is marketed by SIMPLEX CONDUCITS, LTD.

The Postmaster-General calls attention to the fact that the POSTAGE ON LETTERS for all foreign countries, except the United States and Tangier, is 3d. for the first ounce and 1½d. for each succeeding ounce. The postage to all British possessions, to H.M. troops and ships on foreign stations and to the United States and Tangier, the letter rate is 2d. for the first and 1½d. for each additional ounce.

N.S.W. Hydro-Electric Works.

The report of Mr. Wm. Corin, chief engineer of the NEW SOUTH WALES DEPARTMENT OF PUBLIC WORKS ELECTRICAL ENGINEERING BRANCH for the year ended June 30, 1920, states that the volume of work dealt with greatly increased, owing to the passing of the Hydro-Electric Development Act and the Local Government Act, as the former resulted in the preparation of plans for the Barren Jack and Nymboida power stations, and the latter caused a great number of municipal proposals to be referred to Mr. Corin. The investigation of the water-power of the State was continued, and further surveys are to be made. The final scheme for the Snowy River power undertaking shows that 24 000 kW can be obtained for a capital outlay of £2 000 000 and an annual expenditure of about £150 000. The data collected indicates that the Clarence river project will provide 80 000 h.p. If the Kiewa power, in Victoria, were developed and connected with the Hume power in N.S.W. less conservation would be required, and the matter should be decided upon after conference with the Victorian Electricity Commissioners. In Mr. Corin's opinion the importance of utilising the power resources of the State cannot be over-estimated, as the Government has had to refuse an application for power to the extent of 5 000 h.p. for the manufacture of aluminium, and there are continual inquiries for power from parties interested in electrothermic and electrolytic manufactures. In regard to the Barren Jack scheme, which the Government has definitely decided to carry out, there is within a radius of less than 100 miles an immediate demand for some 9 million units per annum, with a maximum demand of about 2 000 kW, while within easy transmission distance there is a demand of 15 million units and a maximum demand of 4 250 kW. Tenders have been invited for the plant for the Nymboida scheme, designed to meet a load of 500 kW and a demand of about one million units per annum at the outset, as well as the much larger undertaking in the Clarence river, of which it will form the first instalment.

It is stated that there is urgent need of legislation to prevent the State experiencing disadvantages which have resulted in other countries where supply from unrelated sources has been allowed to go on unregulated, to correct which has necessitated the expenditure of large sums of money. Particulars are given of various municipal electric supply schemes, the steps taken by the department in regard to these, and also of the works carried out at Port Kembla, and on the Port Kembla, Cordeaux Dam and Avon Dam transmission and telephone lines, and the electrical inspection of mines, &c.

Hydro-Electric Power in Sweden.

In a report received by the Department of Overseas Trade from Mr. H. Kershaw, Commercial Secretary to H.M. Legation at Stockholm, a general outline is given of the work being carried out by the Swedish Waterfall Board in regard to the State provision of electricity generated by water power.

The present power station at Trollhattan, Mr. Kershaw states, consists of eight turbines of 12 500 h.p. each and five of 13 200 h.p. each, or an aggregate of 166 000 h.p., but allowing for the variation of the load the maximum capacity may be put at about 105 000 kW. The total energy delivered from this station in 1920 amounted to 431 500 kWh. The height of the fall at the works is 30 metres, and the volume of water varies from 300 to 900 cubic metres per second, the average fall for the past two years being 500 cubic metres per second. There are 12 sub-stations equipped to transform down from 50 000 V to 20 000 and 10 000 for country purposes mostly, and down to 6 000 or 3 000 for use in cities. Gothenburg, for example, takes energy at 6 000 V. The farthest transforming station is situated at Skofde, a distance of about 100 kilometres (62 miles). The total value of the station, including the water, is about Kr. 58 500 000. The income derived from the supply of electric energy in 1919 was Kr. 5 398 000. Most of the cables are of copper, but a few 10 000 V cables are of aluminium. In the course of the next few years it is hoped to link up the Trollhattan, Alfkärlaby and Motala hydro-electric works more closely. In course of time a second station, equal in size to the present one, will probably be built at Trollhattan.

Work on the construction of the electric generating station and damming operations at Motala were begun in October, 1918, and it is expected that they will be completed in April, 1922. The estimated cost of the undertaking, with two turbines working and foundations ready for the installation of three other turbines, is Kr. 12 000 000. Arrangements are being made to operate eventually five turbines, each of 6 000 h.p. which will be direct-coupled to the dynamos. Three-phase current will be generated at 6 000 V. (50 periods) which will be transformed up to 70 000 V for long-distance transmission.

Lake Wetteren, which has an area of 2 000 sq. kilometres, is very irregular and is considerably broken up in its descent to Lake Boron. Very extensive embankments are being constructed, and a lake will eventually be formed just above the electric power house. The water will then be level with Lake Wetteren and there will be a fall of 15 metres (compared with 30 metres at Trollhattan and 50 metres at Forjus) of water to the turbines. The average supply of water for one turbine will be 40 cubic metres a second. When in operation this new power station will serve as an auxiliary station to Alfkärlaby. In order to expedite operations work is being conducted in two shifts of eight hours each per day.

Electricity Supply.

The charge for electricity at BATA has been increased by 1d. per unit. A scheme is being developed to utilise water power for providing electric lighting for COOKHAM.

CLACKSON'S SEA Urban Council has applied for sanction to a loan of £2 000 for electricity purposes.

Sanction has been obtained by HASTINGS Corporation to a loan in order to extend the generating station.

At STRICHEN, Aberdeenshire, a company has been formed, with a capital of £3 500 to light the village with electricity.

WREXHAM Town Council have approached the North Wales Power Company regarding terms for the supply of electricity in bulk.

DORCHESTER Corporation has applied to the Electricity Commissioners for permission to generate and supply electricity within the town.

Subject to the approval of the Electricity Commissioners SALE Urban Council has agreed to take a bulk supply from Manchester Corporation.

An inquiry is to be held in November into the application of SILVERSTON Urban Council for permission to undertake an electricity supply scheme.

PETERBOROUGH Electricity Committee has made application to extend the area for the supply of electricity to districts outside the present boundary.

OSWESTRY General Purposes Committee has recommended the Town Council to purchase the undertaking of the Electric Light & Power Company.

The CHESTER Rural District Council has authorised its Electricity Committee to confer with the Chester Corporation Electrical Engineer on the question of the formation of a joint distributing authority.

Sanction has been granted HASLINGDEN Corporation to borrow £10 000 for electricity purposes, to be made up as follows:—Main service £7 000, repayable in 25 years; district stations, £3 000, repayable in 20 years.

SOUTHPORT Corporation has decided to apply to the Electricity Commissioners for a licence to supply electricity to the part of Kew district which is within the jurisdiction of the West Lancashire Rural District Council.

The generating plant at MILE END Workhouse is to be scrapped and the buildings to be supplied with electricity from the Borough Council's mains. Various alterations and additions will necessitate, it is stated, an initial outlay of about £3 000.

ASHINGTON Property Owners' and Ratepayers' Association has decided to ask the Ministry of Health to hold a public inquiry before sanctioning the proposed agreement between the Urban District Council and an electric supply concern for the lighting of the district.

The return to the pre-war scale of lighting the streets of ROCHEDALE was discussed at a recent meeting of the Gas and Electricity Committee, but as this would mean an addition of 4d. to the rates the matter is to be referred to the General Purposes Committee, who would have to meet the cost.

KEITH Town Council have appointed Mr. M'Ewan, consulting engineer of Glasgow, to make full inquiries into the possibilities of an electric scheme for Keith, submit a report and get the opinion of the electors on the question. Bailie Cay and Councillors Cooper and Mathieson have been made members of the Electricity Committee.

Would-be users of electricity at IRSWICH are complaining of the absurdity of the proposal of the Town Council to open a showroom in the centre of the town with a view to popularising the use of electricity for domestic purposes, when prospective users are informed by the powers that be that "they regret they are unable to supply the current owing to the cost of laying the necessary mains."

Owing to the greatly increased revenue during the last 12 months SOUTHSHIELDS Electricity Committee announce a reduction on the present tariff charges from 8½ to 7½ per cent. The undertaking, after meeting all running and standing charges, shows a credit balance of £16 438. To this is to be added £424 realised from the sale of scrap material, and about £100 profit obtained from the sale of electrical appliances, making a total of £16 958.

MATLOCK Council last week considered the report of Messrs. Grime & Frith, consulting engineers, of Manchester, on the suggestion by Mr. D. P. Reason, that electricity for the district could be secured from turbines placed in the river Derwent at Collingwood stream, which lies at the Matlock end of the Dale. It has been ascertained that the colour works in Matlock Dale could take the whole flow of the river Derwent at its present level. The figures of the scheme are not to be published yet.

The KEIGHLEY Extension Electric Lighting Order, which has been held up since 1915, came into operation this week. Under the Order the Corporation is given power to supply electricity for light and power to Oakworth, Oxenhope, Steeton, Eastburn, Sutton, and Morton Banks, &c. The Corporation is completing the laying of an overhead high tension cable to give a supply to the large stone quarries at Eastburn, and to augment the supply on the trackless car route to Sutton. This extension will, of course, serve to supply the districts through which the cable passes now that the Order has become operative.

In a communication to the Newport (Mon.) Development Association the Ministry of Transport state that while it is impossible to say that the

SEVERN BARBAGE SCHEME will not be proceeded with at some future date, when financial conditions are more favourable, there is no prospect of the scheme being carried out for some time to come. For the same reason the technical Commission of Inquiry recommended by the Water Power Resources Committee will not be established at present. In the meantime the Ministry in conjunction with other Government Departments, propose to collect such information and data concerning the Severn as may become available.

An agreement has been arranged between the SOUTHPORT Gas and Electricity Committees, whereby the Gas Committee is to take over the whole of the tractors, plant, overhead equipment, &c., belonging to the Electricity Committee, and used in connection with the haulage of coal, and pay to the Electricity Committee the sum of £1 350; the Electricity Committee is to supply the Gas Committee with electrical current for working the said plant at the rate of not more than 1½d. per unit; the Gas Committee is to haul all coal for the Electricity Committee at the price of 3d. per ton to include tolls, weighbridge charges, &c. For every reduction of ½d. per unit in the charge of electricity for the purpose, the price for haulage is to be reduced by ½d. per ton.

The income for the year of the HEREFORD Corporation electricity undertaking was £21 074 10s., as compared with £16 688 19s. 1d. for the previous year. The expenditure (exclusive of interest, loan, repayments, and income tax on interest) amounted to £17 323 against £12 653 for 1920. The loan charges for the year were £4 242 (£8 341). The balance to the credit of the revenue account, at March, 1921, was £1 509 (£2 078). The Electricity Rural Supply Scheme account represents only a portion of the year's working. The first consumer on the rural supply was connected on July 27th, 1920. At March 25th, 1921, there were 49 consumers.

At a recent meeting of HITCHIN Urban Council formal application was made by the Electric Supply Corporation, Ltd., for the consent of the Council to the Corporation taking a bulk supply from Letchworth, and for their support in the proposed application to the Ministry of Transport for a Special Order transferring the Hitchin undertaking to themselves and providing for such maximum rates as the Ministry of Transport might determine. It was pointed out that if the Council would not agree to the supply being obtained from Letchworth additional plant must be installed at Hitchin and in that case they could not hope to supply power so cheaply as if they had the Letchworth supply. The Council agreed to consider the proposals in committee at the close of the ordinary business.

The SOUTHPORT Electricity Committee has decided that the Council be informed that the alterations which have recently taken place at the Crowlands Electric Power Station will enable the Electricity Committee to generate sufficient electricity to work the whole of the Corporation tramways in the borough. They also recommend that the power for tramway purposes should be metered at agreed points by a series of three metres. Subject to any future revision of charges by the Corporation to private consumers, the Tramways Committee would at present be debited, in respect of the power generated and used for tramway purposes, at the rate of 3d. per unit, up to 100 000 units a year; 1½d. per unit for additional units up to 300 000 units a year; 1½d. for additional units up to 500 000 a year; and 1½d. for additional units beyond 500 000 a year.

Speaking at the ROTHERHAM Rotary Club with reference to the proposal to set up 16 areas of electric supply in the country, with capital stations at each, Mr. E. Cross, borough electrical engineer, said that he was of opinion that it would not be a profitable thing for the country to have generating stations remote from the load in order to be near rivers. Without cheap coal we could not obtain cheap electrical power. At the present time Rotherham Corporation undertaking held the record for the lowest cost of generation throughout the country. Since the station was opened in 1891, the undertaking had provided £28 000 in relief of rates. He thought that if we could return to anything like pre-war conditions Rotherham would contribute in one year for relief of rates more than it had done in the last 21 years. The amount of units sold per inhabitant in Rotherham was the second highest for any town in the world, the only one higher being in the United States of America.

Mr. J. E. Macewan, engineer, Glasgow, recently submitted a second report to the Council with reference to the proposed electrical supply for the burgh of CRIEFF. Since his former report a syndicate has applied for power to distribute electricity in bulk in the Highlands to certain areas, of which Perthshire, including Crieff, is one. This scheme has been temporarily dropped, but with the possibility of its revival in the near future. The outlook from the point of view of the burgh of CRIEFF has, therefore, been entirely altered, and Mr. Macewan is of opinion that it is not advisable at present to proceed with the water-power scheme. He considers that the Town Council would be well advised to commence an electrical supply by means of Diesel oil engines, situated within the burgh boundaries, and restrict their area of supply to these boundaries. The engineer's estimate of cost for building, machinery and preliminary expenses in connection with the specially Order are £15 650; standing charges, £2 223 per annum; running expenses, &c., £1 656, making total annual expenditure £3 879. The estimated revenue from lighting and power supply, as based on a recent canvass of the town, is put at £4 275.

Electric Traction.

A MOTOR VEHICLE CHARGING STATION is to be provided by LEXTON Urban Council at an estimated cost of £2 700.

THE MANCHESTER AND SALFORD TRAMWAYMEN have resolved to withdraw their labour on the 10th inst. unless all workers are by then members of the Trade Union.

ALD. W. H. BARRETT has been elected chairman of the SALFORD Tramways Committee in succession to the late Ald. Linsley, and Councillor Hind becomes deputy chairman.

LLANDUDNO Council are considering the question of adopting the trackless trolley system of electric cars on the drive round Great Orme's Head. The complete circuit is about six miles.

THE recent abolition of the penny fares on the BRIGHTON Corporation tramways has resulted, it is stated, in further depressed traffic, and the minimum charge of 2d. has produced no extra revenue.

WE understand that by October the LONDON GENERAL OMNIBUS COMPANY will have in service 268 of the "S" type 'buses, which seat 54 passengers, and 1 042 of the "K" type, seating 46 passengers.

THE Minister of Transport has extended by one year from Aug. 18, the period limited by the NORTHAMPTON CORPORATION ACT, 1911, for the construction of tramways and for the acquisition of lands.

THE Government has requested the South Wales Railway Commissioners to provide £120 000 on its estimates for the next financial year towards the cost of the work of electrifying the tramways at NEWCASTLE.

THE fifth INTERNATIONAL COMMERCIAL MOTOR EXHIBITION will take place at Olympia from October 14 to 22 inclusive. There will be exhibits of petrol, steam and electric vehicles for passenger and goods transport and for general utility purposes.

IN order to meet expenditure in connection with tramway extensions, motor omnibuses, &c., GLASGOW Tramways Committee have put forward a proposal to the Town Council to increase the borrowing powers of the department to the extent of £600 000.

IN connection with the opening of the football season the UNDERGROUND RAILWAYS are arranging for increased services on all their lines serving the big football grounds. There will also be a considerable strengthening of the bus routes and tram routes for taking the public to and from the matches.

A TRAMCAR BELONGING TO THE LONDON UNITED TRAMWAYS, LTD., going in the direction of Kew last week left the metals at the junction of Goldhawk-road and Shepherd's Bush Green. Travelling across the road it mounted the pavement, but was brought up by the railings round the Green. The passengers were badly shaken, and a few were slightly injured.

IMPROVEMENTS and repairs are being carried out on the tramway system of the PAISLEY District Company at a cost of £40 000. At Paisley Cross a wider and more gradual curve is being laid down, and at Potterhill and Glasgow-road repairs to the permanent way are being made. Glasgow-road route is operated by the Glasgow Corporation Tramways Committee.

SANCTION has been received by the Ministry of Transport to increase the maximum TRAMWAY FARES AT LEEDS from 1d. to 1½d. per mile. A good deal of opposition has been shown to the proposed increase, and it is hoped that it may be possible to avoid a further advance, the figures for July showing a considerable reduction in the loss as against previous months.

GLASGOW Tramways Department have adopted celluloid tokens, instead of paper coupons, which entitle the traveller to a penny fare for three-farthings.

THE question of reverting to the ½d. fare on the Glasgow tramways was considered by the Sub-Committee on Tramway Finance last week, and is shortly to come before the Tramways Committee. The ½d. fare system was begun on July 1, 1894, and until December, 1911, the average length permitted by the fare was slightly over half a mile. The length of the ½d. stage was then practically doubled, and until May, 1920, the average distance given for the fare was about a mile and a sixth. On June 1, 1920, the ½d. fare was discontinued and the ½d. one inaugurated.

A somewhat serious tramcar accident occurred at GATESHEAD last week. A car from Bensham was climbing West-street hill when a charabanc cut across in front, and colliding with the front platform, carried away the controls. As a result, the tramcar ran backwards and collided with a Low Fell car which was following it. The rear platform of the runaway was driven into the on-coming car, and the conductor was badly crushed. A good deal of glass was broken, a number of passengers were cut, and others complained of shocks. An elderly tramcar inspector named Mindo, who saw the accident, although not on either of the cars, received such a shock that he died shortly afterwards.

THE Ministry of Transport has appointed a SMALL COMMITTEE to investigate the potentialities of LIGHT SIGNALS, to examine them under trial, and recommend any devices which they may think desirable, and to form conclusions with regard to economies, &c. The Committee consists of Major C. H. W. Edmonds, of the Mechanical Engineers' Department of the Ministry (chairman); Mr. W. J. Thorrowgood (L. & S.W. Railway), representing the railway companies; Capt. B. H. Peter (Westinghouse Brake & Saxby Signal Company), Mr. J. C. Allen (representing the National Union of Railwaymen), and Mr. H. J. Oxlade (representing the Associated Society of Locomotive Engineers and Firemen); with Mr. P. Tait (of the Ministry) as secretary. The Committee held a preliminary meeting on the 15th ult., and on the 29th ult. they visited Liverpool for the purpose of inspecting the installation in use on the Liverpool Overhead Railway, and referred to in our last issue.

Personal and Appointments.

MR. H. J. HOGGAN has been appointed electrical engineer to St. George's (N.S.W.) County Council.

MR. H. W. PUTTICK has resigned his position under the Calcutta Electric Supply Corporation, Ltd., and will shortly be returning to England.

MR. C. H. DOLLING, formerly on the staff of the Rochdale Borough Engineer, has been appointed tramway permanent way engineer to the Halifax Corporation.

MR. ARTHUR BROWN, city engineer of Nottingham, who has retired after 34 years' service, was responsible for the original track-work of the Nottingham Corporation tramways.

SIR C. H. BEDFORD has been appointed Honorary Adviser to the Secretary of State for the Colonies on questions relating to power and industrial alcohol in the Colonies and Protectorates.

Prof. G. W. O. HOWE, assistant professor of electrical engineering at the Imperial College of Science and Technology, City and Guilds (Engineering) College, has been appointed superintendent of the electrical department at the National Physical Laboratory.

MR. F. B. SHENSTONE, works manager of the Government tramway workshops, Randwick, N.S.W., has been appointed general manager of Parkinson (Australia), Ltd., which firm is associated with F. & A. Parkinson, Ltd., and is erecting works at Drummoyne, Sydney, for the manufacture of a.c. motors.

MR. H. NORTH, of the Engineer-in-Chief's Office of the General Post Office, has retired after over 40 years service with the Post Office. We understand that Mr. North will still represent the Falmstock Electric Company of New York, Ferodo, Ltd., &c., and will continue his experiments in wireless telegraphy at his rooms in High Holborn.

ON retiring from his position as assistant manager of the contract department of the British Thomson-Houston Company, Ltd., in order to join the editorial staff of the "Electrical Review," Mr. E. A. GATEHOUSE, son of the late Mr. T. E. Gatehouse, was entertained at dinner by the staff and presented with some handsome Georgian silver plate.

Obituary.

THE death is announced of Mr. JOHN HENRY DEWHURST, chairman of the board of Dewhurst's Engineering Company, Ltd., electrical and mechanical engineers of Sheffield.

THE death has occurred at Helsby of Mr. J. SWIFT, chief of the Stores Department of the British Insulated & Helsby Cable Company. Mr. Swift had been in the firm's employment for 33 years.

THE death is announced of Councillor C. VERNON PUGH, J.P., founder of the Whitworth Cycle Company and chairman of Rudge-Whitworth and other companies. Mr. Pugh, who was 52 years of age, had been a member of the Coventry City Council since 1906, and was until recently chairman of the Coventry Tramways Committee and of the Higher Education Sub-Committee. He was also for some years a Governor of Birmingham University and Chairman of the Governors of the Bablake School, Coventry.

Educational.

THE Board of Education has approved of the purchase of apparatus and equipment for the electrical department at BURNLEY Municipal College, at a cost of £915. 8s.

THE UNIVERSITY OF LIVERPOOL will benefit considerably under the will of the late Mr. James Wilcock Alsop, a former alderman of Liverpool and Pro-Chancellor of the University. The value of the estate is £70 40s., and after sundry legacies and annuities and a life interest to Mrs. Alsop, the ultimate residue is given to the University of Liverpool.

THE London County Council has now drawn up regulations for the "ARCHIBALD DAWNAY" SCHOLARSHIPS IN CIVIL ENGINEERING. One scholarship will be awarded each year to candidates between 16 and 18 years of age, who have passed, or are exempt from, the matriculation examination of the University of London. The scholarships will be tenable for two, or in some cases three, years at the Battersea Polytechnic, or the Finsbury Technical College. The maintenance grant will be £110 a year from which the scholar must pay his tuition fees, &c. The first award will be made early in the Autumn term, and application forms, to be obtained from the Education Officer, New County Hall, S.E. 1, must be returned before the 24th inst.

Telegraph and Telephone Notes.

IN April next an automatic telephone will be put into operation at the Central Telephone Bureau in BRUSSELS. Subsequently all the other offices will be provided with the automatic system.

THE new telephone exchange at SCARBOROUGH, which is claimed to be one of the most up-to-date in the country was opened last week. The capacity of the new switchboard is for 2 000 subscribers.

IT is reported that the GREAT NORTHERN TELEGRAPH COMPANY and the SOVIET authorities have concluded an agreement under which the Company will resume the transmission of messages to Russia. One of the conditions is that the Company shall install in Russia an apparatus capable of transmitting 110 words per minute.

Imperial Notes.

BATHURST (N.S.W.) Council has received an offer of a loan of £50 000 by the N.S.W. Fire Underwriters' Association for the equipment of electric supply works for the city.

SYDNEY (N.S.W.) Council has notified that it cannot at present undertake to supply electricity throughout the whole of North Sydney nor give a supply to Hornsby Shire Council.

The ST. GEORGE (N.S.W.) County Council has secured a loan of £100 000 at 5 per cent. for an electric supply scheme. The current will be supplied from the Railway Commissioners' Illawarra power house.

The PORTLAND (N.S.W.) Electric Lighting & Power Company has been formed, and has offered to supply current to the Blaxland Shire Council, for distribution in PORTLAND, at 3d. per unit, the company paying for the cost of installation.

The proposal to establish TELEPHONE COMMUNICATION BETWEEN MADRAS AND OOTACAMUND is postponed until next year as the Government of India have not sanctioned all the indents for materials made by the Director-General of Telegraphs.

The SUTLEJ (India) HYDRO-ELECTRIC PROJECT is estimated to cost 75 crores (£5 000 000), and when extended so as to use the full discharge of the river the cost will reach 95 crores (£6 333 333). It is proposed to supply power to all towns between Delhi and Lyallpur.

Mr. G. H. Lofts, manager in Hobart for the Tasmanian State Hydro-Electric Department, has invented a BUZZER which gives warning if IRONS AND OTHER DOMESTIC APPARATUS are left in circuit when not in use. It is stated to be operated with one-fiftieth of the energy required by a lamp indicator.

The "Australian Industrial and Mining Standard" reports that the VICTORIAN ELECTRICITY COMMISSION is making satisfactory progress with the lay-out of the important MORWELL brown coal scheme. The temporary electric power plant is running smoothly, and is proving very useful for development work.

Messrs. F. A. McCarthy & Company, consulting engineers, have submitted a revised estimate amounting to £72 700 for a power house and sub-station for the proposed TOOWOOMBA (QUEENSLAND) TRAMWAYS SCHEME. The City Council has asked the Government to instruct an expert to go on with the matter.

Every house in the city of HAMILTON, ONTARIO, is to be equipped with electricity for heating and cooking. Apart from the initial wiring expense, which will be about £50, it is estimated that electricity sufficient for cooking for a good-size family and heating and lighting a six-room house will cost about 14s. a month.

In April of last year the Hoskins' Iron and Steel Company offered to supply electrical energy to LITHGOW (N.S.W.) Council for two years at 1½d. per unit. It has been agreed that such supply shall commence on Nov. 1 next, and the Railway Commissioners have promised to give the supply required after Nov. 1, 1923.

The "Indian Importer" states that a plan is being considered for the erection of plant on the west coast of India to produce about 2 500 tons of ALUMINIUM per annum. By means of a reservoir to collect rain water, and the water from a stream, it is expected that sufficient power will be obtained to generate 20 000 kW of electrical energy for operating the works.

A medal is offered by the Accident Prevention Committee of the CANADIAN ELECTRICAL ASSOCIATION to any person who saves by artificial respiration the life of another, who has received an electric shock. The first lot of medals will be struck from copper taken from the first high-pressure transmission line in the British Empire, installed 30 years ago.

Mr. J. H. Butters, chief engineer and manager of the TASMANIAN STATE HYDRO-ELECTRIC DEPT., who has returned to Hobart after his tour of Europe and America, states that he feels confident that, with the cessation of industrial strife, England will have nothing to fear from her competitors. He purchased in England two motor generator sets for Waddamana and two transformers for 88 000 V. for Bridgewater.

A municipal electric generating plant was put into operation recently at DALBY (Queensland), and is giving satisfaction. The expenditure on the scheme was £11 000, and the plant includes a 95 h.p. Kynoch gas engine direct coupled to a 50 kW E.C.C. generator, a 300 Ah, 244-cell battery, and a 150 h.p. Cambridge wood-fuel gas producer. The charges are 1s. 6d. per unit for lighting, and 6d. for power.

Mr. A. G. M. Michell recently investigated the power resources of the Hopkins Falls, and the possibilities of utilising them for the generation of electrical energy for WARRAMBOOL (N.S.W.). At a recent meeting of the Council Mr. G. B. Lincolne expressed the opinion that, for a capital expenditure of £10 000, plant could be installed which would enable the electricity required to be generated at the water-supply pumping station.

Reports have been received by Sydney (N.S.W.) Council from Messrs. Atkinson & Harper, of the Government Mining Department, on the possibilities of 28 coal mine properties offered to the Council. The city electrical engineer, Mr. Forbes Mackay does not think any of these properties suitable, and he, with the Lord Mayor and Town Clerk, has been authorised to enter into private negotiations for the acquisition of a developed coal mine.

The New South Wales Railway Department has informed Lithgow (N.S.W.) Council that the Department proposes to establish a LARGE POWER STATION IN THE WEST PART OF NEW SOUTH WALES, when funds

are available. When the station is equipped the Commissioners state that arrangements may be made for the supply of "any quantity" of electricity. It is stated that the station will draw coal supplies from the State coal mine at Lithgow.

According to the "British Australasian," strong recommendations are to be made how the electrification works area known as "YALLOURN BROWN COAL AREA," and not "Morwell," as at present. It is considered against the best interests of the new field to be continually known as Morwell, when the two localities are 7 miles apart. The Commissioners have christened the area Yallourn, and the new postal address is also of that name.

A power-house is to be erected for the Normal School and Institute of Technology, CALGARY, CANADA, and it is proposed to install a steam-driven generating plant. The boilers have been already purchased, but specifications for the remainder of the plant are not yet prepared. British firms interested should communicate with the Provincial Architect, Department of Public Works, Alberta.

The Victorian Electricity Commissioners have issued new rules with regard to the LICENSING OF WIREMEN. The licences are graded as A, B and C. The holder of a C. licence may only work under the supervision of an A. or a B. man, and a B. man may only work under the supervision of an A. man, and there are various requirements as to examinations, exemption from examinations, and the length of the experience which applicants must have had.

The Australian Commonwealth Parliament has decided to proceed at once with the construction of an additional trunk telephone line from MELBOURNE to SYDNEY, a distance of 580 miles. The estimated cost was £37 000, but as the price of copper has since fallen it is thought probable that the estimated cost may be considerably reduced. Copper wire of 200 lb. to the mile is to be used, and it is proposed to superimpose a duplex telegraph service on the line.

When the electric plant now being constructed by the Ontario Government is completed it is stated that at least 10 000 farms will be supplied with light and power. The Government already owns and works 13 distinct systems scattered over the province and distributes 365 000 h.p. of electric energy derived from water. Another 110 000 h.p. will soon be provided by the Queenston-Chippewa plant on the Niagara River which will have an ultimate capacity of 525 000 h.p.

At the recent annual general meeting of the Melbourne Division of the INSTITUTION OF ENGINEERS, AUSTRALIA, the committee for the year was constituted as follows: Mr. A. C. Mackenzie (chairman), Sir John Monash, Messrs. J. B. Burnell, H. E. Coane, A. L. Hargrave, H. R. Harper, G. G. Jobbins, R. Lawson, A. Maling, W. J. Newbigin, H. Clement Newton, W. W. Robertson and B. A. Smith. Mr. F. W. Fisher is hon. secretary, and Mr. W. C. N. Hurford hon. treasurer.

SUPPORTING HOME INDUSTRIES seems to be an expensive matter IN AUSTRALIA. The Federal Public Works Commission, reporting in favour of the erection of a new telegraph line between Perth and Eucla, states that before the war copper wire cost the current price of copper plus £17 per ton to cover manufacture and freight. A plant had now been established at Port Kembla (N.S.W.) for the manufacture of copper wire, but it cost the Department £57 10s. a ton more than the quoted price of copper.

At the recent annual meeting in Sydney of the ENGLISH ELECTRICAL COMPANY OF AUSTRALIA, LTD. (formerly the Standard Waygood-Herules, Ltd.), the chairman, Mr. Stewart, said 10 per cent. had been more than earned, but commitments were heavy, and they must provide capital to complete and equip the new workshops, which would cost £190 000, or 25 per cent. more than was estimated a year ago. The payment of a dividend would be postponed until they got the consent of the A.Ordinary shareholders. Assuming that the Board could arrange with their London associates they had under consideration the raising of some £50 000 or £60 000 additional capital by the issue of new shares.

Dr. William MacDonald, the well-known authority on agriculture, has recently returned to Cape Town from a visit to Italy. He is greatly impressed with the development of the electrical railway enterprise in North Italy on the three-phase system, and says that such a system of electric traction would revolutionise the farming industry in SOUTH AFRICA. The Engineer-in-Chief of the Italian State Electric Railways has sent a letter to General Smuts (by Dr. MacDonald) inviting the Union Government to send electrical engineers to Italy to study the installations of electrical traction on the three-phase system. The Union Government recently determined to adopt the direct-current system, but it is possible, the "Glasgow Herald" correspondent states, that the acceptance of tenders may be delayed pending further inquiries.

Apparently Australia is ambitious of becoming independent of outside sources in the supply of all electrical plant and apparatus. Already a number of works have been established in Victoria, New South Wales and elsewhere, but these are mainly engaged in the manufacture of electric fittings, accessories, small motors, batteries, instruments, &c. In view, however, of the Morwell brown-coal scheme and projected hydro-electric developments there is a desire to establish works for the manufacture of large electric generators and other electrical equipment. THE COMMONWEALTH GENERAL ELECTRIC, LTD., hitherto a comparatively small concern, has made arrangements for the erection of large works at SPOTSWOOD, near MELBOURNE. The management claim that no electrical problem is too small for the company to handle, and none too big, and that it will manufacture every conceivable class of electrical appliance, from the smallest switch to the largest turbo-generator.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Messum, Ellis & Co., Chartered Patent Agents, 7c and 7d, Chancery-lane, London, W.C.

- 164 427 RIST. Colligation apparatus for internal-combustion engines. (6/2/20.)
 164 431 P. Manufacturing apparatus for electric accumulators. (10/2/20.)
 164 432 P. Manufacturing apparatus for electric accumulators. (1/2/20.)
 164 433 POUCHAIN. Manufacturing apparatus for electric accumulators. (10/2/20.)
 164 434 POUCHAIN. Negative plate for electric accumulators and the manufacture thereof. (10/2/20.)
 164 437 GARRETT & SONS, LTD., & SIMPSON. Safety-controlling gear for electrically-propelled vehicles. (27/2/20.)
 164 451 BROTHERS & TUCKER & CO., LTD. Interlocking device for electric switches. (3/3/20.)
 164 464 SMITH, DINE & STOKES. Method of and means for electric control of tipping-gear upon vehicles. (4/3/20.)
 164 472 VERITY. Electric radiator. (5/3/20.)
 164 490 HALL. Electric circuit-breakers and the like. (8/3/20.)
 164 507 PREMIER ELECTRIC WELDING CO., LTD. & PATERSON. Electrodes for electric welding. (22/3/20.)
 164 510 WATTS & MAJOR. Electric signalling apparatus. (12/3/20.) (Addition to 132 618.)
 164 526 BOLTON. Construction of electric resistances. (16/3/20.)
 164 536 DAMEY. Electric cable. (18/3/20.)
 164 543 JOSEPH & COBOLD. Electrically-heated soldering-irons. (22/3/20.)
 164 559 B.T.H. Co. (G.E. Co.) Protective devices for electric circuits and apparatus. (3/1/1920.)
 164 565 CASH & CORNING. Electric switches, sockets and the like. (6/4/20.)
 164 571 CROFT & ORRIN. TELEGRAPH INSTRUMENTS SYNDICATE, LTD. Telegraph systems. (1/4/20.)
 164 589 BOOTH. Electric lamp holders. (30/4/20.)
 164 590 HAROLD. Electric light bulbs. (4/5/20.)
 164 592 TAMARIN. Vacuum cleaner electric cord take-up. (5/5/20.)
 164 670 DAIMLER CO., LTD., & BERKMAN. Electric lighting systems for motor vehicles. (20/11/1920.)
 164 678 METROPOLITAN-VICKERS ELECTRICAL CO. Electrical motor starting systems. (3/6/20.)
 164 681 CUDNEY. Electric blasting and like fuses. (30/12/20.)
 164 685 POUCHAIN. Negative electrode for electric accumulators. (10/2/20; divided application on 164 431.)
 164 689 TAYLOR. Means for improving the current-carrying capacity of existing three-phase alternating-current cable systems. (23/9/19 divided application on 23 324 19 and 23 352 19; cognate application, 11 403 21.)
 Consists in means for improving the current-carrying capacity of existing three-phase alternating-current cable systems without straining the margin of insulation of the cables, wherein a current of the same frequency as that of the cable system is superposed on the existing system, and is characterised by the distribution of the terminal polarities of the superposed current upon the separate cables through the intermediary of the neutral points of the transformers feeding the said cables.
 164 779 BRITISH THOMSON-HOUSTON CO., LTD., & WHITAKER. Dynamo electric machines. (18/12/19.)
 164 782 BULLMORE. Electric lamps. (23/12/19.)
 164 784 SCOTT & BENTLEY. Electrically-operated cranes, hoists and the like. (9/1/20.)
 164 790 MURRAY & TELEPHONE MANUFACTURING (1920), LTD. Telephones. (3/2/20.)
 164 794 CHASTREE. Electric switches. (9/2/20.)
 164 799 WATERHOUSE. Electric switches. (12/2/20.)
 164 822 MARPLES. Electrical liquid heaters. (3/12/20.)
 164 827 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.) Electric switches. (11/3/20.)
 164 831 STERLING TELEPHONE & ELECTRIC CO., LTD., BELL & DAVEY. Electrical signalling systems. (12/3/20. Addition to 106 706.)
 164 837 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.) Electric ship propulsion systems. (22/3/20.)
 164 849 BRITISH THOMSON-HOUSTON CO., LTD., & YOUNG. Magneto electric machines. (16/3/20.)
 164 851 HAYTER. Ignition devices for internal combustion engines. (16/3/20.)
 164 880 VALENTINE. Electric distributor for internal combustion engines. (24/3/20.)
 164 884 FREDRIKSEN. Electric fluid heating apparatus. (25/3/20.)
 164 885 TERRY. Electric heaters. (25/3/20.)
 164 893 RUNBAKEN. Commutators or electric current distributors of electric ignition systems. (27/3/20.)
 164 900 MATHIEU. Thermionic relays or amplifiers. (1/4/20.)
 The filament of the valve or of the first valve where there are more than one valve is connected to a point in the inductance of the loop aerial or in an inductance in parallel with or coupled to the loop aerial. The filament is also preferably earthed directly or through a condenser.
 164 903 JURLIN & METROPOLITAN-VICKERS ELECTRICAL CO., LTD. Dynamo electric machines. (1/4/20.)
 164 911 CRUICK. Terminal connections for flexible electrical cables. (13/4/20.)
 164 916 ROWCLIFFE & CAMBRIDGE & PAUL INSTRUMENT CO., LTD. Thermo-electric measurement of temperatures. (15/4/20.)
 164 924 IORANT ELECTRIC CO. (Cutler Hammer Manufacturing Co.) Electric discharge apparatus and systems. (22/4/20.)
 164 927 ROBINSON & CROWTHER. Electro-magnetic wave receiving and transmitting systems. (23/4/20.)
 A receiving or transmitting system is adapted with two directional coils or aerials arranged at an angle to one another and made to rotate together, and a receiver or amplifier circuit or a transmitting circuit is alternately coupled to the directional coil or aerial circuits by means of a rotatable or the like coupling.
 164 946 RYLAND & FERGUSON. Means for bonding metallic tubing in electrical wiring installations. (12/5/20.)
 164 965 LEE. Electric cables. (19/6/20.)
 164 977 JACKSON. Method and means for detecting the presence in or absence from bodies of non-magnetic material of certain component bodies of magnetic material. (8/7/20.)
 164 998 GATTI. Electro-magnetic device for withdrawing metal splinters from the eye. (3/7/20.)
 165 001 GARDNER. Electric miners' lamps. (30/8/20. Divided application on 159 665.)
 165 072 REYNOLDS & CO., LTD. (Leson - Mirrey). Time limit relays, circuit-breakers or the like. 9/2/20. (Divided application on 163 420.)
 165 115 TAGART. Relay and radio receiving systems and the like. (18/8/19.) (Cognate. Applications, 3252/20 and 34315/20. Patent of Addition not granted.)
 Relates to receiving relay or detector systems employing an electric discharge device in which the current is carried by electrons or ions, in which two or more means of controlling the main current are provided, and each of the elements used to obtain control is associated with an input circuit, the nature of its main current being dependent on the modulating potential or currents applied to the control elements particularly for use in radio systems and the like.
 165 116 THOMPSON (Compagnie Generale de Telegraphie et de Telephonie). Telephone systems.
 165 117 VICTORIA FALLS & TRANSVAL POWER CO., LTD., and PRICE. Electric oil switches. (9/9/19.)
 165 133 FERRANTI, WALL & FERRANTI, LTD. Electricity meters and the like. (17/1/20.)
 165 137 FERRADI. Magnetic means for producing, modifying, and transmitting mechanical movements at variable speeds. (21/1/20.)
 165 143 WHITE. Bonding-clips for electric-wiring systems. (18/2/20.)
 165 150 CLARK & CLARK'S NEO-ELECTRIC DEVICES, LTD. Electrical measuring instruments. (4/3/20.)
 165 152 B. T. H. Co. (G. E. Co.). Electric switches. (11/3/20.)
 165 157 WESTERN ELECTRIC CO., LTD. (Western Electric Co., Inc.). Vacuum tubes. (16/3/20.)
 165 165 FLETCHER & JONES. Reflectors for electric lamps. (17/3/20.)
 165 187 SKAGEN. Locking-devices for valves and electric switches used in connection with internal-combustion and other engines. (19/3/20.)
 165 211 GABRIEL. Portable electric lamps. (24/3/20.)
 165 217 QUILTER. Thermionic devices. (24/3/20.)
 165 227 B. T. H. Co. (General Electric Co.). Protective devices for electric circuits and apparatus. (25/3/20.)
 165 272 SANDERS. Electrical double-pole switching-plug. (24/4/20.)
 165 275 AUTOMATIC TELEPHONE MFG. CO., LTD., & SAYIN. Call-indicators for telephone systems. (27/4/20.)
 165 279 TAGART. SCOTT, READ & ENGELBACH. Means of supporting electrodes in vacuum tubes, especially for use in wireless telegraphy. (28/4/20.)
 165 291 SULLIVAN & JOSEPH. Electrical condensers. (29/4/20.)
 165 298 RELAY AUTOMATIC TELEPHONE CO., LTD. & INMAN. Telephones. (5/5/20.) (Cognate Application, 4301/21.)
 165 318 JAMES & CHAMBERLAIN & HOOKHAM, LTD. Alternating-current measuring instruments. (5/6/20.)
 165 338 COLVILLE & SONS, LTD., & INGLIS. Electro-magnetic appliance for handling plates, rails, bars and the like. (6/7/20.)
 165 374 OSTIN. Electric switches. (3/12/20.)
 165 383 CARNEY & LACEY. Cooling of dynamo-electric machines. (22/4/20.) (Divided Application on 18797/19.)
 165 390 B. T. H. Co. (General Electric Co.). Electric switches. (11/3/20.) (Divided Application on 165 152.)
 165 392 FEREADY. Magnetic means for producing, modifying, and transmitting mechanical movements. (21/1/20.) (Divided Application on 165 137.)
 165 405 WILKINSON (Gos.) Electro-magnetic recording-apparatus for telegraph circuits. (18/9/18.)
 165 470 BARRY & TAYLOR. Methods of and means for reducing the lagging current on alternating current systems supplying induction motors and the like. (15/9/19.) (Addition to 152 703.)
 165 476 LAMKIN. Electric distributing switches for ignition purposes. (29/10/20.)
 165 498 HODGES. Apparatus for charging and discharging electric storage batteries. (25/2/20.)
 165 512 B. T. H. Co., LTD. (General Electric Co.). X-ray apparatus. (23/3/20.)
 165 514 DENNETT. Electric motors. (24/3/20.)
 165 515 KAY & JENNINGS. Telephones. (25/3/20.)
 165 517 PALMER TELEPHONE MFG. CO., LTD. Selector switches for telephones. (25/3/20.)
 165 535 COVILLO & DE TAY, SONS, LTD. Electrolytic deposition of iron and the treatment of the deposits. (30/3/20.)
 165 593 BOLTON. Electric overload circuit-breakers. (13/4/20.)
 165 599 AUTOMATIC TELEPHONE MFG. CO., LTD., SAVIN & SMITH. Call-indicators for telephone systems. (1/4/20. Addition to 129 563.)

APPLICATIONS FOR PATENTS

March 29, 1921.

- 9 216 AMY & GREENSHIELDS. Electric light extension switch.
 9 212 MIDLAND ELECTRIC MFG. CO., COX & SUTHERLAND. Electrical distribution fuse-boards, lighting boxes, &c.
 9 294 MURRAY. Switches.
 9 318 BRUNER & CLARK. Automatic electric heating device for glass furnaces. (29/3/20, U.S.)
 9 322 ARON. Electric dry-battery cells. (29/3/20, Germany.)
 9 352 SYMONS. Dipping tanks for electrical apparatus, &c.
 9 356 METROPOLITAN-VICKERS ELECTRICAL CO., BROOKS & GOWAN. Control of electric motors.
 9 363 SHARPLES. Flexible circuits.
 9 385 MICHEL. Devices for transforming electrical energy into mechanical energy, and inversely.
 9 389 CHONN. Switches. (23/4/19, Germany.)
 March 30, 1921.
 9 411 BATES. Speed-regulating devices for motors.
 9 445 MOISEWITSCH. Electrically-illuminated signs.
 9 470 GOS. FUR DRANTHOLZ TELEGRAPHIE. Wireless telegraph transmitters. (31/3/20, Germany.)
 9 471 GOS. FUR DRANTHOLZ TELEGRAPHIE. Telephone systems. (1/4/20, Germany.)
 9 473 B. T. H. Co. (G. E. Co.) Speed regulating systems.
 9 490 VON ROTTENBURG. Repair of metallic lamp filaments. (24/8/20, Germany.)
 9 490 MARKS. (Electric Aktiebolaget Volta.) Automatic circuit breaker, &c.
 9 491 MARKS. (Electric Aktiebolaget Volta.) Automatic circuit breaker, &c.
 9 494 SMITH. Storage batteries. (31/3/20, U.S.)
 9 498 MAGLICHKE-PETERSEN. Apparatus to be connected to telephone to deliver a message. (31/3/20, Denmark.)
 9 501 SMITH & YOUNG. Means for detecting breaks, &c., in submarine cables.
 9 507 HIBERS. X-ray tubes.
 9 515 RELAY AUTOMATIC TELEPHONE CO. & EDWARDS. Automatic &c. telephone systems.
 9 522 SATCHWELL. Electric controllers.
 9 524 FOSTER ENGINEERING CO. & DOBSON. Switches.
 March 31, 1921.
 9 529 GOSLING. Switch wall plug.
 9 532 SHARPLES. Control systems for electric furnaces.
 9 536 GIVELST. Continuous current systems.
 9 552 WHIDDINGTON. Wireless telephony.
 9 553 MAZZA, BETTICA & MACCHIONE. Reciprocating electric motors.
 9 557 SCOTT. Copper-contact plates for controllers for electric vehicles.
 9 591 BARLOCKER. Commutators.
 9 593 ROBINSON. Combined dynamo and motor.
 9 595 & 9 596 METROPOLITAN-VICKERS ELECTRICAL CO., COATES & DAVIES. Switch gear.
 9 599 COULSON. Accumulators for motor cars, &c.
 9 599 METROPOLITAN-VICKERS ELECTRICAL CO. & CHETHAM. Automatic circuit interrupting.
 9 604 MUNRO. Sockets or boxes of trolley poles.
 9 607 SKORPEK. Dry cell for pocket lamps. (25/3/19, Germany.)
 9 623 AKT. GES. BROWN, BOVERI & CO. Processing higher harmonic currents in secondary circuit of polyphase metal vapour rectifiers. (1/4/20, Switzerland.)
 9 654 DUNLOP. Means of recording and gauging duration of telephone calls.
 9 657 SCHATNER. Circuit making & breaking device.
 April 1, 1921.
 9 664 DUNLOP. Call-recording device for telephone instruments.
 9 707 BROOKMAN. Spring contacts of electric lamps.
 9 721 CUTLER-HAMMER MFG. CO. Electric heaters. (22/6/20, U.S.)
 9 724 BAERLOCKER. Resistance grids.
 9 741 IRELAND & LUCAS. Automatic switches.
 9 742 IRELAND & LUCAS. Electro-magnetic horns.
 9 752 MULLARD RADIO VALVE CO. Thermionic valves, &c.
 9 754 SMITH. Fittings for electric conduit.
 April 2, 1921.
 9 771 CUTLER-HAMMER MFG. CO. Switches.
 9 771 CUTLER-HAMMER MFG. CO. Switches.
 9 774 BRUSHMAN. Electrical indicator and controller for bearings.
 9 805 CHANER & LAMFOUGH. Electric, &c., lighting apparatus.
 9 814 EDERBERG, RANDT & MELLMAN. Electric fuse boxes.
 9 820 CARNEY. Means for controlling power factor of motor, &c., circuits.
 9 825 SYMONS (Electric Aktiebolaget Volta) & THESMAN, HENDERSON & RUSSELL. Electrically operated bells, &c.

Tenders Invited and Accepted.

DUBLIN Guardians require tenders by Sept. 7 for the supply of electric fittings, &c. Tender forms from the Master of the Workhouse.

LEFORD Urban Council want tenders by September 9 for an air compressor, motor and starter. Specifications, &c., from Mr. A. H. Shaw, Electricity Works, Ilford.

GREAT AND LITTLE USWORTH PARISH COUNCIL invite tenders by Sept. 5 for electric street lighting extensions. Particulars from the Clerk, 2, Manor-view, New Washington.

DORCHESTER Electricity Committee require tenders by September 10 for re-plating battery, &c. Particulars from Mr. G. Nicolson, Sunnybank, Stavordale-road, Weymouth.

BERMONDSEY (London) Guardians want tenders by Sept. 23 for six months' supply of electric lamps, &c. Forms of tender, &c., from the Clerk, 283, Tooley-street, London, S.E.1.

DUBLIN Electricity Supply Committee requires tenders by September 5 for the supply of brass condenser tubes. Particulars from the City Electrical Engineer, Fleet-street, Dublin.

MANCHESTER Tramways Committee require tenders by Sept. 13 for motors, controllers and trucks for tramcars. Specifications from Mr. J. M. McElroy, 55, Piccadilly, Manchester.

The Government of MALTA wants tenders by Sept. 15 for the supply of single phase meters. Forms of tender, &c., from the Crown Agents for the Colonies, 4, Millbank, London, S.W.1.

Tenders are required for the electric lighting of St. Michael and All Angels' Church, PORTSMOUTH. Form and tender, &c., from Col. G. E. Kent, Normanhurst, Cavendish-road, Southsea.

Tenders are wanted by Sept. 9 for six months' supply of electric light cable, flexible wire, switches, &c., to the District Asylum, BALLINASLOE. Forms of tender from the Clerk at the Asylum.

PLYMOUTH Guardians require tenders by September 9 for wiring and fitting the workhouse for electric lighting. Specification, &c., can be seen at the office of the Master of the Workhouse.

Tenders are required by September 14 for wiring the Glan Ely Hospital, Fairwater, near Cardiff. Specifications, &c., from the Secretary, Welsh National Memorial Association, Westgate-street, Cardiff.

WEST HAM Guardians require tenders by Sept. 8 for three months' supply of electrical fittings, engineers' oils and sundries, &c. Forms of tender from the Clerk, Union-road, Leytonstone, London, E.11.

WESTMINSTER Guardians want tenders by September 14 for supply of electric lamps and fittings, ironmongery, &c. Forms of tender from the Clerk, Prince's-row, Buckingham Palace-road, London, S.W.1.

LONDON County Council invite tenders for the supply and erection of h.-t. and l.-t. switchgear for sub-stations. Specifications from the Clerk of the Council, Spring-gardens, S.W.1, to whom tenders by Sept. 5.

Tenders are invited by DURBAN CORPORATION for supply of two 500-kW rotary converters, switchgear, &c. Tenders to Town Clerk's Office, Durban, by Sept. 28. Specifications at the Department of Overseas Trade.

Tenders are invited by Oct. 5 for the supply of bronze wire (schedule 536) to the Postmaster-General's Dept., State of QUEENSLAND. Specifications, &c., from the office of the High Commissioner for Australia: Room E.5, Australia House, Strand, W.C.2.

THE METROPOLITAN ASYLUMS BOARD invite tenders by Sept. 9 for repairs to electric lighting, fire alarm and domestic bell installations at St. George's Home, Millman-street, Chelsea. Specification, &c., can be obtained at the Board's Offices, Embankment, E.C.4.

THE VICTORIAN GOVERNMENT RAILWAYS invite tenders (by Sept 28) for the supply and delivery of a lifting-magnet and generating set, with control apparatus and accessories (Contract No. 34241). Specifications may be inspected at the Department of Overseas Trade, 35, Old Queen-street, S.W.1.

PETERBOROUGH CORPORATION ELECTRICITY DEPARTMENT invite tenders for the supply and delivery of a quantity of paper insulated, lead-covered cables, some for use on 6 600-V supply and some on 600-V. Particulars for the City Electrical Engineer, Albert-place, Peterborough.

The date for receiving tenders for the supply of electric light and power plant for BULAWAYO (Rhodesia) Municipality has been extended to October 12 if tenders are delivered to Messrs. Davis & Soper, 54, St. Mary-axe, London, E.C.3, and to November 15 if tenders are sent to the Town Clerk.

The Standing Joint Committee of the Glamorgan Quarter Sessions and County Council require tenders by Sept. 10 for the electric lighting installations in CWMGWACH Police Station (contract No. 6) and in PENRHINWEIBER Police Station (contract No. 15). Specifications can be obtained at Glamorgan County Hall, Cardiff.

The Belgian Ministry of National Defence invite tenders for the supply of 23 wireless telegraph and telephone installations required by the ARTILLERY DEPARTMENT. Tenders to the Minister of National Defence (3 Direction Generale), 10 Rue du Meridin, Brussels, by 10 a.m., Sept. 14. Specifications at the Department of Overseas Trade.

Tenders are also invited by Oct. 12 for the supply and delivery of galvanised iron and steel wire (schedule 537), and by Oct. 19 for the

supply and delivery of insulated wire (schedule 538) to the Postmaster-General's Department, State of QUEENSLAND. Tender forms, &c., from the office of the High Commissioner for Australia, Room E.5, Australia House, Strand, W.C.2.

THE ELECTRICAL COMMITTEE of the CORPORATION of BRISTOL invite tenders for the supply, delivery and erection at their Feeder-road generating station, St. Philips, Bristol, of a 1 500 kW rotary converter, 6 600 V, a.c., three-phase, 50 periods, to 500 V d.c. Specifications and forms of tender from Mr. H. Faraday Proctor, The Exchange, Cam-street, Bristol, to whom tenders by 10 a.m. Sept. 16.

THE RAND WATER BOARD invites tenders (by September 28) for supply and erection at the intake pumping station, Vereeniging, of two centrifugal pumps, direct-coupled to electric motors, one 10-ton travelling crane, and the supply and erection at the main pumping station site of two centrifugal pumps coupled to electric motors. Specifications of the Department of Overseas Trade, 35, Old Queen-street, S.W.1.

Tenders are also invited, by 12 noon, Nov. 7, for the supply, delivery and erection at the Board's Main Pumping Station, Vereeniging, of two steam-driven electrical generating sets of 350 kW capacity, each complete with switchboards and all accessories. Tenders to the Secretary, the Rand Water Board, Central House, P.O. Box 1703, Johannesburg.

PRETORIA (Transvaal) Municipality requires tenders by Oct 4 for coal handling plant (contract No. 6), 6 600 V cables (contract No. 7), induced draught and ash-handling plant (contract No. 8), and feed pumps, steam, air, and water piping, &c. (contract No. 9), for the electric light and power department. Specifications, &c., from the General Manager, or Mr. G. M. Clark, 40-42, Meischoe-buidings, Johannesburg.

THE URUGUAYAN BOARD OF STATE ELECTRICAL STATIONS require tenders for four electrical generating sets, including one 300 to 325 kW, 3-ph., 50 cycle (2 000 V between phases), one 175 kW, 3-ph., 50 cycle (6 600 V between phases), one 125 kW and one 100 kW, d.c., three-wire 2x230 V; and four 4-stroke Diesel engines, one for each set. Particulars from the Department of Overseas Trade, 35, Old Queen street, London, S.W.1. Tenders by Sept. 19.

The Secretary of the NEW ZEALAND PUBLIC WORKS TENDER BOARD (Wellington) invites tenders (by Nov. 1) for the supply and erection of new or secondhand auxiliary plant for the Rotorua electric supply as follows:—One oil engine (200 to 250 B.H.P.) and one three-phase 50 cycle alternator of 190-kW (power factor of 0.8) with exciter and switchgear. Specifications may be seen at Department of Overseas Trade.

The NEW ZEALAND Public Works Department are calling for fresh tenders for the supply and erection of steel pipe lines and fittings required in connection with the Mangahao power plant. While the quantities, &c., are substantially the same as those specified in the original call for tenders, some of the conditions appear to have undergone modification. The closing date for the receipt of tenders in Wellington is Nov. 1, 1921. Specifications can be inspected at the Department of Overseas Trade.

H.M. Consul-General at Lourenco Marques reports that tenders will shortly be invited by the DEPARTMENT OF POSTS AND TELEGRAPHS at LOURENCO MARQUES for the supply of 4 200 iron telegraph poles (approx. weight 177 lb. or 180 lb.), 15 000 g.-i. insulator stalks, 11 000 g.-i. insulator brackets, 15 000 porcelain insulators, 320 tons g.-i. wire (4 mm.) and 90 tons hard drawn copper wire (S.W.G. No. 14). Tenders (in Portuguese) by Sept. 30. Further particulars from Department of Overseas Trade.

HORSHAM URBAN DISTRICT COUNCIL invite tenders for the supply and erection of one three-crank triple-expansion engine, vertical enclosed type, direct coupled to a 300-kW continuous-current generator 460/500 V, shunt wound; alternatively, one two-crank compound, engine coupled to generator as above. Particulars from the Council's Electrical Engineer, Electricity Works, Stanley-street, Horsham. Tenders to Mr. A. Slyfield, clerk, Council Offices, Market Square, Horsham, by 5 p.m., Sept. 3.

THE ADMINISTRATION OF THE SOUTH AFRICAN RAILWAYS AND HARBOURS invite tenders for the supply, for 12 months ending December 31, 1922, of 85 560 incandescent train lighting lamps (tungsten filament) for 24 V, 8 to 10 c.p.; 8 125 engine headlight lamps, 150 W. 32 V (gas-filled 1/2 W type with concentrated filament); 50 472 incandescent lamps (tungsten filament); 5 545 incandescent lamps (carbon filament). Tenders by noon, November 7, to the Secretary, Tender Board, South African Railway Headquarters Offices, Johannesburg. Specifications may be inspected at the Department of Overseas Trade, 35, Old Queen-street, S.W.1.

The NEW ZEALAND Public Works Department invite tenders for the manufacture, supply and delivery, ex ship's slings at Auckland, of six sets of three-phase air-brake switches suitable for operation upon 50 000 V circuits in connection with the Waikato Electric Power Scheme. Tenders to the Secretary, Public Works Tender Board, Wellington, by noon on Sept. 27. Telegraphic tenders also accepted. Specifications at the Department of Overseas Trade, 35, Old Queen-street, London, S.W.1. A copy is also available for loan to firms established in the provinces.

THE PUBLIC WORKS DEPARTMENT OF NEW ZEALAND invite tenders for the supply of the following plant required in connection with the Mangahao electric power scheme: Section 12: Three water-wheels of 6 450 h.p., and two water-wheels of 3 225 h.p., complete with governors, couplings and accessories; Section 13: Three 6 000 kVA

belief that those difficulties were also being successfully mastered. For some time he had been personally watching and testing new apparatus. The results obtained during the last few weeks by the combination of various devices and inventions were of signal importance, and he now believed that, if they had not completely mastered the troubles arising from adverse atmospheric conditions, they had gone far enough to enable him to say that their work was of transcendental importance, and epoch-making in the conduct of wireless services. The new arrangements not only enabled communication to be carried on under conditions which previously made it impossible, but also allowed of a very considerable increase in speed and in accuracy. He had not the slightest doubt that, as a consequence of those inventions, the capacity of existing stations would be increased many fold and profitable services would result.

WIRELESS TELEPHONY.

Considerable progress had also taken place in regard to wireless telephony, both over long and short distances, and he had no doubt that that new method of communication might be profitably utilised at once as a reliable system between a great number of places, besides for communication with ships at sea. A great number of patents had been taken out by the engineers of the company and its associated companies, and results obtained which indicated very substantial progress in the technical development and practical application of wireless communication. They had mastered most of the technical and mechanical difficulties, enabling them to convert what hitherto had been for the most part an interesting scientific development into a practical commercial article. Subject to satisfactory arrangements with the Post Office they hoped in the near future to create telephonic services with several foreign countries, and provided they had the opportunity of creating a wireless telegraphic service between here and Australia, it was quite within the realms of possibility that, having the means of experimenting with their telegraphic stations, they might thereafter supply Mr. Hughes with a telephonic means of communication with this country besides the direct wireless telegraph service. Considerable progress had been made in perfecting wireless telephones for aeroplane services and their system had now reached such a stage of efficiency and simplicity that a pilot or mechanic of an aeroplane could operate it with ease and certainty covering ranges of 200 miles.

FOREIGN CONCESSIONS.

Towards the end of last year they erected a temporary station for the first Conference of the League of Nations, and so satisfactory were the results of the demonstration that the Federal Government had granted them a concession for 25 years for a wireless station in Switzerland to conduct international telegraph services. The company had also taken over the administration of the postal and telegraph services (both wire and wireless) of Peru, and Sir William Slingsby, who was representing them, had been appointed Administrator-General of Posts and Telegraphs. The agreement was also for 25 years, and they expected a substantial revenue in future from this source. In other countries in Europe and elsewhere negotiations were pending, and in Canada they were looking forward to developments of an important nature.

THE IMPERIAL CHAIN.

Referring to this subject, the chairman said that the English station at Leamfield had been completed, and a station at Cairo was in course of construction. He believed it had been the policy of the Post Office to erect those stations so as to avoid using any of the company's patents. There were four important companies in the world developing long-distance wireless telegraphy and the Marconi Company had the sole rights of all the patented improvements and inventions emanating from all those companies for the British Empire. Therefore to avoid using any of their patents meant using, in the construction of a station, patents which had expired. Needless to say, the station at Leamfield had not been kept clear of some of their patents. There were many patents of recent years protecting important inventions which it was essential should be used for the successful conduct of a wireless telegraph service, and they were being used in the construction of the American, French and German stations. As the present position was delicate he did not want to impair their future by saying more, particularly having regard to the fact that they were in negotiation with the Post Office.

Mr. GODFREY C. ISAACS, who seconded the motion for the adoption of the report and accounts, said he had that morning received a letter from the General Post Office asking, on behalf of the Wireless Telegraph Commission, if the Marconi Company was in a position to assist them in respect of the supply of one or more large thermionic valve sets suitable for the transmitting stations of the Imperial Chain. The Commission would be grateful to know if the company was yet in a position to contemplate the construction and supply of thermionic-valve sets capable of dealing with 100 kW and upwards of primary energy at wave lengths about 5 000 metres.

The directors of CROSSLEY BROTHERS, LTD., have declared an interim dividend on the preference shares.

The issue of £750 000 6 per cent debentures by the COUNTY OF SOUTH-LAND ELECTRIC POWER BOARD last week was immediately over-subscribed.

A petition for confirming the reduction of the capital of P. R. JACKSON & COMPANY, LTD. and REDUCED, from £120 000 to £60 000 has been presented to the High Court of Justice.

THE SOUTH METROPOLITAN ELECTRIC LIGHT & POWER COMPANY, LTD., notify that the warrants for dividends on the 7 per cent. cumulative first and 6 per cent. cumulative second preference shares have been posted.

The net earnings of the VICTORIA FALLS & TRANSVAAL POWER COMPANY, LTD., (including those of the Rand Mines Power Supply Company) for the quarter ended June 30 amounted to £203 041, before providing for taxation.

For the year ended June 30 the net profit of FERODO LIMITED, after charging depreciation, directors' fees, and providing for taxation, was £26 489, and with £3 782 brought forward the total is £30 271. Directors recommend a dividend of 12½ per cent. (less tax) on the ordinary shares for the year, and an additional dividend at rate of 3 per cent. per annum (less tax) on the preference shares (making 10 per cent. for year), carrying forward £3 688.

The report of the COMPAÑIA TELEGRAFICO-TELEFONICA DEL PLATA for 1920 states that receipts were \$504 715 m/n, compared with \$379 115 m/n in previous year, and working costs \$332 452 (against \$266 448). Two new cables had been purchased during the year, and as the Company had not the funds available to pay for the cables and their laying (\$160 000) it was obliged to have recourse to credit, and therefore, in spite of the good results obtained during the year no dividend was recommended, the surplus of \$126 437 (after payments to the directors and manager) being contributed towards the amortization of the cost of the cables.

The directors report of the NEW TRANSPORT COMPANY, LTD., for 1920, states that the railway companies are determined to oppose anything in the nature of a conclusive exhaustive experiment in the direction of replacing their present methods by modern mechanical appliances. The directors have done everything possible to persuade the Government and the railways to make a fair trial of the company's proposals, and, though they have failed, they have no intention of abandoning the struggle. Up-to-date patent fees have been paid out of money lent by the directors, who have also met current expenses, but the shareholders are to be asked to provide for these expenses in future.

The accounts of ESCHER, WYSS & COMPANY, of Zurich, for the year ended March 31, show a gross manufacturing profit of 6 888 988 frs., as against 6 097 790 frs. in the preceding year, while general expenditure has risen from 3 190 716 frs. in the year 1919-20 to 3 861 230 frs. A sum of 1 862 305 frs. has been written off, and the net profit for the year including the balance carried forward from the preceding year, amounting to 809 260 frs., or about 5 000 frs. more than the net profit for last year. The directors propose to pay a dividend of 6 per cent. as before; 150 000 frs. are again allocated to reserve, and 200 000 frs. to the benevolent fund, leaving 69 260 frs. to be carried forward. In the balance-sheet, factory premises, &c., stand at 6 371 850 frs. and stock at 19 750 876 frs., both of which items show a considerable increase on last year's figures, while creditors amount to 10 677 670 frs., as against 6 963 781 frs. Against this customers' debts are placed at 4 626 862 frs. Banks and other debtors amount to 5 807 715 frs.

The Theory of Heat Engines.

Messrs. W. Heffer & Sons, Ltd., Cambridge, have in the press a volume entitled "Notes and Examples in the Theory of Heat Engines," by John Case, M.A. The author's small work, "A Synopsis of the Elementary Theory of Heat and Heat Engines" having rapidly gone out of print, a second edition was called for. It was decided, however, to enlarge the work by adding a large number of illustrative examples worked out, and many more for the student to work out for himself, all taken from the examination papers of the Universities and Colleges. The book is not intended as an exhaustive text-book on the subject, but rather as a companion to lectures, to enable the student to see at a glance the essential points of the subject, and to help him with his revision for examinations. The engineer who has to deal with the elementary thermodynamics of steam and other heat engines will find the work of great value, as all the important formulae he may require are printed in heavy type and easily found.

German Debts Under the Peace Treaty.

The Controller of the Clearing Office (Enemy Debts), in view of agreements between the British Government and the Belgian and French Governments which are now awaiting ratification, and which apply the procedure under Article 296 of the Treaty of Versailles, relating to pre-war debts to the claims of French and Belgian Nationals resident in this country on January 10, 1920, desires to receive at the earliest possible moment the names and addresses of such claimants together with the amounts of their claims. These claims must be confined to debts against German Nationals as defined by the Article. A copy of the Treaty of Peace Order, 1919, containing the text of the Article may be obtained, price 2d., from H.M. Stationery Office, Imperial House, Kingsway, London, W.C.2.

X-Ray Treatment of Cancer.

With reference to recent claims put forward regarding the X-RAY TREATMENT OF CANCER, including that by the Erlangen school, that by means of their special method it is possible to administer a dose of X-rays which will cure cancer in one application, the Council of the British Association for the Advancement of Radiology and Physiotherapy, states that the time has not yet come when radiotherapy may be regarded as the first choice in the treatment of the majority of cases of cancer, and that extravagant claims are likely to lead to a reaction and bring discredit on the X-ray treatment in general.

Bankruptcies, Liquidations, &c.

A first and final dividend of 5s. 9d. in the £ is payable to creditors of **ALFRED ROWLAND MEGGITT**, 45, Thrumpton-lane, East Retford, Notts., electrical engineer, on Aug. 30, at the Official Receiver's Office, Lincoln.

THE MALAYA ELECTRICITY COMPANY, LTD., has decided to wind up voluntarily, and Mr. Frederick Charles Allwork, 39, Coleman-street, E.C.2, has been appointed liquidator. A meeting of creditors will be held at 39, Coleman-street, on Sept. 15, at 12 noon.

ARC & GENERAL EQUIPMENT, LTD., has decided to wind up voluntarily, and Francis Archer Gillies, of 37, Brown-street, Manchester, chartered accountant, has been appointed liquidator. Meeting of the creditors at the registered office of the Company, 37, Brown-street, Manchester, September 5, 2.30 p.m.

A meeting of creditors of HUDSONS ELECTRICAL ENGINEERING COMPANY, LTD. (in voluntary liquidation), of Leeds, was held this week. The company was incorporated in 1917, the total capital issued being £1,000, all the shares being ultimately acquired by Mr. C. W. Holman. Net assets represent approximately 7s. 3½d. in the £ on the claims to unsecured creditors. The creditors decided to appoint a committee of inspection to investigate the position of affairs.

At the first meeting of creditors of THOMAS HYDE, electrician, 180, London Road, Croydon, held on August 26, the statement of affairs showed liabilities £635 and net assets £142. Debtor attributed his position to general trade depression, and light and heating restrictions during the war. The matter was left with the Official Receiver as trustee. Among the creditors are Edison Swan Electric Co., Ltd., for £174 and A. Taylor, Thornton Heath, for £130.

Reference Books.

There is probably no branch of industry so well supplied with good reference books as electrical engineering, and among these GARCER'S "MANUAL OF ELECTRICAL UNDERTAKINGS AND DIRECTORY OF OFFICIALS" takes a high place. The 24th edition of this useful volume is divided into seven sections and includes particulars of 2,760 undertakings engaged in electricity supply, traction, telegraphy and telephony, manufacturing and contracting firms, also Colonial undertakings, &c. The financial and technical particulars are very complete and are tabulated for comparison purposes from official sources. The section devoted to the Progress of the Year contains a group of tables showing the capital invested, the average return and dividends paid, capacity of plant installed, load connected, units sold, &c.; and the Directory section contains the names and addresses of the company and municipal officials engaged in the industry, members of the I.E.E., lists of electrical contractors, Buyers' Guide, &c. About 35 large maps, showing the principal electric tramway systems, areas of electric power companies, &c., add to the utility of the Manual. It is published at 30s. net by the Electrical Press, Ltd., 13/16, Fisher-street, Holborn, W.C. 1.

Another interesting annual publication is the "ELECTRICAL ENGINEERS' DIARY," which, in addition to being a good diary, contains a lot of useful technical and business information for electrical engineers and contractors, station engineers, &c. Practically every application of electricity—lighting, industrial power and domestic purposes, telegraphy, telephony, electric vehicles, &c., is catered for by a series of well-written articles. The Diary also gives a glossary of technical terms and definitions, the Wiring Rules of the I.E.E., the Regulations as to the use of electricity in factories and mines, lists of streets in the Metropolitan area where mains are laid, particulars of British electric supply undertakings, &c. It is published at 10s. 6d. by Messrs. S. Davis & Company, 30 and 31, St. Swinham's-lane, London, E.C.

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"The Cabinet Maker."—"The Silk Industry of Great Britain"; "Syllabus of City and Guilds Examination in Cabinet Making for 1921-1922"; and "The Scandal of the 'Furnished' House."

"The Chemical Age."—"The Hydrogenation of Naphthalene (I)."; "The German Margarine Industry"; and "Indexing Chemical Equations."

"The Fruit-Grower."—"Carnation Growing for Market"; "Quick-crop Mushroom Culture"; and "The Limits of Organisation."

"Gardening Illustrated."—"Alpine Strawberries"; "Gladiolus Primulinus Utopia" (illustrated); and "White Oriental Poppy" (illustrated).

"The Gas World."—Special By-Product Coking Section: "The Coke Oven Position in Germany."

"The Hardware Trade Journal."—"Buyers and Business Success"; "Renovating Old Plated Goods"; and "Notes on Pumps, VII."

"Farm and Home."—"Soil Cultivation," by Dr. E. J. Russell; "Scientific Production on the Land"; and "National Farmers' Union and Repeal Act."

Forty Years Ago.

(THE ELECTRICIAN, SEPTEMBER 3, 1881.)

THE TELEPHONE IN SHEFFIELD.—There are now 150 subscribers to the Sheffield Telephone Exchange. The number of calls last week exceeded 7,000.

ELECTRIC LIGHTING OF TRAINS.—News from New York says that the Lehigh Valley Railroad Company is preparing to experiment with electricity, as a substitute for gas, in lighting the cars on all through trains.

TECHNICAL EDUCATION ABROAD.—The Gazette of Friday, the 26th of August, contains Her Majesty's commission "authorising and appointing Bernhard Samuelson, Fellow of the Royal Society; Henry Enfield Roscoe, Doctor of Civil Law, Fellow of the Royal Society; Philip Magnus, Bachelor of Arts and Bachelor of Science; John Slagg, Swire Smith, and William Woodall, to inquire into the instruction of the industrial classes of certain foreign countries, in technical and other subjects, for the purpose of comparison with that of the corresponding classes in this country; and into the influence of such instruction on manufacturing and other industries at home and abroad."

THE TELEPHONE AND RAILWAY COMPANIES.—The use of the telephone has been adopted on the system of the London, Chatham & Dover Railway Company, and during the past few days the office of the superintendent, Mr. Cockburn, at Victoria, has been placed in immediate communication with Holborn Viaduct, the City terminal station; with Loughborough Junction, where there are large sorting and make-up sidings; and with Wandsworth-road, where are the headquarters of the locomotive and other departments. The goods manager's office at Victoria has also been connected with the goods depot at Blackfriars. The instruments in use are constructed on the Gower-Bell principle, which, for some time, has been used satisfactorily to connect the Victoria Station with the residence of the chairman, Mr. J. S. Forbes, at West Wickham, near Beckenham.

Books Received.

(Copies of the undermentioned works can be had from THE ELECTRICIAN OFFICES on receipt of published price, plus postage.)

"Motor Cycles and Side-Cars." By H. Corbishley. (London: Cassell & Company, Ltd.) Pp. 152. 1s. 6d. net.

"Year Book of the Michigan College of Mines, 1920-1921." (Published by the College.) Pp. 125.

"Bulletin of Armour Institute of Technology." (Chicago: Armour Institute of Technology Press.)

"Technical College of Bradford, Diploma and Special Day Courses: Prospectus Session, 1921-22." Pp. 154.

Prices of Metals, Chemicals, &c.

			TUESDAY, Aug. 30.	
			Inc.	Dec.
<i>Copper</i> —				
Best selected.....	per ton	£68 0 0	£1 10 0	—
Electro Wirebars ..	..	£72 10 0	—	—
H.C. wire, basis	per lb.	0s. 11½d.	—	—
Sheet	..	0s. 10½d.	—	—
<i>Phosphor Bronze Wire (Telephone)</i> —				
Phosphor-bronze				
wire, basis	"	1s. 3¼d.	—	—
<i>Brass 60/40</i> —				
Rod, basis	"	0s. 8d.	—	—
Sheet, basis	"	0s. 10½d.	—	—
Wire, basis	"	0s. 11½d.	—	—
<i>Pig Iron</i> —				
Cleveland Warrants .	per ton	£6 15 0	—	—
Galvanised steel				
wire, basis 8 SWG ..	"	£25 0 0	—	—
<i>Lead Pig</i> —				
English	"	£24 5 0	—	—
Foreign or Colonial ...	"	£23 7 6	5s. 0d.	—
<i>Tin</i> —				
Ingot	"	£153 10 0	17s. 6d.	—
Wire, basis	per lb.	2s. 2d.	¾d.	—

Salmoniac.—Per cwt. 65s.-60s.

Sulphur (Flowers).—Ton £13.

" (Roll-Brimstone).—Per ton

£13.

Sulphuric Acid (Pyrites, 168°).—

Per ton, £9 17s. 6d.

Rubber.—Para fine, 1s. 0½d.; plantation 1st latex, 8½d. lb.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd.

Copper Sulphate.—Per ton £30.

Boric Acid (Crystals).—Per ton

£65.

Sodium Bichromate.—Per lb. 7½d.

Sodium Chlorate.—Per lb. 3½d.

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THE ELECTRICIAN

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Notes of the Week.

The British Association.

THE eighty-ninth annual meeting of the British Association opened at Edinburgh on Wednesday, but the arrangement of the programme, and especially the procedure of relegating the sectional presidential addresses to other than the opening day, prevents us from dealing at any length with its evolutions in to-day's issue of THE ELECTRICIAN. The presidential address of Sir EDWARD THORPE, of which a short abstract appears on another page, deals mainly with matters of interest to chemists only, while the sectional presidential addresses that have so far been delivered are also somewhat outside our purview. Some survey of the programme generally may, however, be made. For in commenting upon the general proceedings of the British Association meeting last year we called attention to the prevalence of papers on specialised subjects, and to the increasing tendency to transform the gathering into an embryonic summer meeting of one or other of the existing technical and scientific societies. This tendency, though not so marked this year, at any rate so far as Section G is concerned, is still evident, and is not by any means neutralised by the very wise arrangement of holding a number of evening discourses on subjects of general scientific interest. We believe that since the unfortunate tendency, to which we called attention, was mentioned last year those responsible for the conduct of the British Association have taken to heart the criticisms that have been made, and have been employing their best endeavours to re-direct the steps of the Association in the direction it was originally intended to pursue. This we feel sure is the right policy. For the progress of science and technology is so great at the present time, both in length and in breadth, that even with the numerous societies that already exist, there is still room for an association which shall lay before the public generally in plain and semi-technical language some account of the advances that are taking place, and instruct scientific

workers in what is being done in fields other than that in which they are most immediately interested. If the British Association can reorganise itself to do this it will be filling a real want.

The Heating of Cables.

It is inevitable that when several workers are investigating the same subject that not only is the line of approach different, but that owing to looseness in nomenclature and personal difference in the point of view, some complications arise which make the exact effect the research has had on the sum of our knowledge hard to discover. This difficulty increases with the amount of work that is done, and also with the wideness of the subject. That this is so is amply clear from the discussion which took place last winter before the Institution of Electrical Engineers on the Heating of Buried Cables, and from the somewhat similar discussion which was held at the Mid-Winter Convention of the American Institute. The article by Capt. P. DUNSHEATH, which we publish on another page, is, therefore, opportune. It is frankly an attempt to simplify this question by reducing the factors which have to be considered to three, the generation of heat, the dissipation of heat, and the maximum temperature rise. These factors are connected in a way similar to that which is familiar to electrical engineers in Ohm's law. Capt. DUNSHEATH, therefore, propounds what he calls a thermal Ohm's law, whose pivot is the thermal Ohm, a quantity which in honour of one of the early workers in this field he would like termed the "Forbe." That is, the "Forbe" would be the thermal resistance of a path through which a difference of temperature of one degree centigrade produces a heat flow of one watt, and the thermal resistivity, or specific thermal resistance, of a material is the thermal resistance in "Forbes" between the opposite faces of a centimetre cube of material, and is given by the temperature difference in degrees centigrade between the opposite faces required to produce a flow of one watt of heat from one face to the other.

The treatment in question certainly leads to simplification, and it will be interesting to have criticism as to the general utility it is likely to possess.

Electric Traction in Switzerland.

A GREAT deal has been published lately on the economic problems of electric traction, attention being drawn to conditions both in this country and on the Continent. But important as these economic problems are, and necessary as it is that they should be solved at as early a date as possible, the engineering questions that have to be dealt with in putting any scheme of electric traction to work are of equal importance, and even greater necessity. In publishing, therefore, an illustrated account of the electric locomotives which are now being used on certain of the Swiss railways, we are not only giving publicity to a matter which is of general engineering interest, but co-ordinating details which should be of real instruction to those who are concerned with this important question. It will be seen that by far the larger proportion of the electrified lines is operated on the single phase system at 15 000 V, the alternative being three-phase at either 3 000 V or 750 V. It is well to add, however, that the traffic conditions are not at present, and are not likely in future to be, the same as those existing in this country. The tracks lie over mountainous sections and the traffic, though heavy in trains, is light in numbers, i.e., there is little or no suburban traffic and rush hours are unknown. An attempt towards standardisation has been made by providing locomotives which can be operated equally on goods and passenger trains, while the electrical equipment generally has been designed to obtain a simple and rational arrangement, and to reduce the cost of upkeep of the locomotive. A study of the various details shows that this ideal has been realised to a large extent.

The Organisation of the Salaried Classes.

WE are glad to learn that the organisation of the salaried classes, in favour of which we recently argued, is slowly but surely coming into being. In this organisation two tendencies are noticeable, one where the societies in question lean rather towards trade unionism, as it is usually understood, while the other, although the administration employed is not unlike that of a trade union, allows a political, industrial, or professional independence to its members. Among the bodies that may be included in the latter group is the Society of Technical Engineers, who distinguished themselves at a recent meeting of the National Federation of Professional, Technical, Administrative and Supervisory Workers, a body organised to co-ordinate the claims of the various "middle-class" societies, by pointing out the necessity for a third party in industrial affairs. This third party would take up a position between shareholders on the one hand and the manual workers on the other. This is a standpoint with which we have the very greatest sympathy, not only in the interests of the workers themselves, but, as Mr. JOHN BRODIE pointed out in his inaugural address to the recent engineering conference, because such a third party can be of great benefit to the development of engineering generally in settling trade disputes as soon as they arise, and so smoothing the way to increased contentment and production.

Some Problems for the National Federation.

WE have no doubt that this point of view will be put forward again at the conference and congress which the National Federation is holding on Saturday, September 17, especially as its official programme shows that

among other matters for consideration are the formation of a standing joint committee to represent the combined views of all "middle-class" workers in their capacity both as producers and consumers, and another committee to draft a special constitution suited to the requirements of each group of which the Federation is made up. A special attempt is to be made by means of a *questionnaire* to obtain the views of members of and candidates for election to Parliament on the general subject of the combination of the non-manual workers. We sincerely hope that satisfactory answers to these questions will be obtained, and that in the interests of justice it will be possible to secure greater recognition for a class to whom the community is in many ways in debt. At the same time this movement will require the most careful management if it is not to move towards the left on the one hand or towards the right on the other. For movements of either of these kinds would result in a decrease in the value of any "middle-class" society to its own members and a corresponding diminution in the benefits that will accrue to the community generally from the existence of an independent body of this kind.

The Trades Union Congress.

THOSE who had been expecting a useful lead on the industrial situation from this year's Trades Union Congress will be sadly disappointed by the opening address of the President, Mr. E. L. Poulton, on Monday. With much of what he said about the results of unemployment and the natural desire of workers for improved social conditions nearly everyone will be in agreement, but of any evidence of a constructive policy or of a scheme likely to lead to an improvement there are few traces in the address. There are many stale platitudes and vague generalisations, but apparently his only remedies for unemployment are the restriction of output and the reduction of working hours! When a chosen leader of the workers deliberately urges these erroneous economical views one might almost despair of the statesmanship and constructive ability of organised labour. Not only is the restriction of output unsound economically and unlikely to lead to the results desired by the workers, but it is grossly immoral, and it has a most deleterious effect upon the moral fibre of those who practise it. Moreover, it takes away every incentive to work or to make progress. The general adoption of the practice can only lead to ruin and bankruptcy, and it is to be deplored that labour leaders display such gross ignorance of fundamental economic laws.

The Engineers' Club.

IF the gathering at Coventry Street on the opening day last week is anything to go by, the Engineers' Club has been born with a silver spoon in its mouth. On the occasion of our visit, which corresponded with the peak of the load, we saw many old friendships being renewed and many new friendships being made, and sensed above all an air of good fellowship, which is a happy omen for the future of an institution which we feel is not only a desirable but an absolutely necessary addition to the clubs of the metropolis. Not a word, but a whole sheaf, of congratulation is due to the committee, and especially to the honorary secretary, Mr. EDMUND L. HILL, for the enterprise and hard work which they have put into the formation of the club. It has been a high-speed operation, for it is less than a year since a long-sleeping chrysalis began to expand, and that time has been sufficient for the birth of a very flourishing butterfly, but, unlike the latter, destined to have a long and useful life.

Automatic Substations.

THE automatic substation is a phase of electrical development which has received much more recognition in the United States than it has done, or seems likely to do, in this country. We do not know whether there is some obscure psychological reason for this or whether our climatic and economic conditions prevent the wider adoption of what at first sight seems an excellent method of cutting down labour costs. It is, of course, equally obvious that the saving on revenue account from substation wages is not pure gain, but is off-set on the capital account by the necessary expenditure on the automatic part of the apparatus. And, if the automatic apparatus does not really operate automatically, by charges for supervision, repair and maintenance, which may go far to wipe out any savings that would otherwise be obtained. The solution of the problem, therefore, lies in a compromise between the cost of the substation attendant, who only operates in cases of emergency, and of the automatic apparatus which gives rise to an emergency when it fails to operate as it should. That under certain conditions the balance is in favour of the automatic apparatus is well illustrated by a series of articles in the "General Electric Review." These include a great deal of data which have been derived from comprehensive tests on this class of apparatus, and interestingly enough show that real economies are obtained by the use of automatic equipment.

Real Economies.

FOR instance, on the Chicago, North Shore and Milwaukee Railway a saving of \$3 804 per substation per year has been obtained, or a total of \$41 351 for the whole series of substations. Similar experience has been obtained with automatic apparatus on the Aurora, Elgin and Chicago Railway, in connection with which the statement is made that automatic substations are now an accomplishment, and no longer an experiment. They have in fact been found to be truly reliable, more so in fact than manual substations, and they also have shown great economies from the very start. It would, therefore, seem advantageous for railway engineers in this country to give a close consideration to this subject. There are now in the neighbourhood of London certain sections of electrically-operated railways where the traffic is by no means heavy, and where the employment of substation attendants seems a needless expense. Automatic operation in these cases would, therefore, mean a saving, especially when this automatic operation is carried as far as starting up and shutting down the substation plant, as is often done in similar circumstances in the States.

A New Direction Finder.

A RECENT issue of the "Radio Review" contains an interesting description of a new method of direction finding, which has been developed by the engineers of the Marconi Wireless Telegraph Company. As is well known, most direction-finding systems suffer under the grave disability of being affected by those reflection and refraction phenomena which are conveniently termed the "night effect." For instance, an ordinary direction-finder of the single or cross-coil type may give very erratic results at night, and more especially at sunrise and sunset. Mr. T. L. ECKERSLEY has recently shown that one of the main causes of this phenomenon is the presence of a wave with a horizontal electric field coming down at an angle on to the receiver after reflection from the upper atmosphere. Such effects would, therefore, be expected to be most in evidence when receiving from an inverted L aerial broadside

on to the receiving stations since the horizontal portion would radiate waves polarised in that direction to produce these disturbing effects. It is claimed that these disadvantages are obviated in the new system, which consists of a combination of the BELLINI-TOSI aerial and an open aerial which gives a heart-shaped diagram with a single zero. The combination in fact illustrates how it is sometimes possible to turn an inherently evil thing to useful purposes by bringing the plain aerial effect into the business. But although this arrangement is an improvement over what has been done up to the present, as our contemporary points out, a receiver of this type may give very inaccurate results, since although the position of the minimum remains unchanged the shape of the curve on either side of it may be different. If the signals are so strong that the minimum is sharply defined there should be no difficulty, but with weak signals where a wider silence range is present the correct zero could not be determined so accurately. In fact the agreement of the experimental results with those predicted from the diagrams only serve as a further confirmation of Mr. ECKERSLEY's theory of the causes of night effects.

Where is the Electrical Proving House?

WE have always held that the best advertisement electrical apparatus can receive is the one it obtains from its inherent good qualities and similarly that the worst advertisement it can receive is that with which it is unfortunately labelled when its design is bad, its construction faulty, and it is therefore constantly breaking down. While the former advertisement is only achieved after years of experience and the accumulation of much goodwill, the latter is obtained much too easily, even in a moment, and its effect is, nevertheless, exceedingly difficult to neutralise. It is, therefore, in our opinion, essential not only that electrical engineers should use all their endeavours to improve the design and construction of the apparatus which they place on the market, and this is particularly necessary in domestic apparatus, but that all such apparatus should receive some hall mark which will show the discriminating consumer that, given ordinary working conditions, his equipment will perform the duties which he expects from it. Now, this testing and discrimination are to be among the chief duties of that electrical proving house, whose establishment we hope to be able to chronicle in the near future. But the work of this body, when it is established, will be much facilitated and the anxieties of the manufacturers much diminished by due consideration of the specifications to which both will necessarily have to work. As we have said before, the time has come when standardisation can be applied to electrical plant equipment and apparatus with a good deal of benefit, and the desirability of such uniformity of practice is exemplified in the formation of the Engineering Standards Committee, with its sub-committees for each branch of engineering practice, and by the useful work which it so far has been able to do even in a limited way.

Standardisation versus Inspection.

UNFORTUNATELY, though standardisation is in theory realised to be an advantage, in practice it does not receive the support which it should. Moreover, the personal idiosyncrasies which in the course of years have sprung up in engineering practice have resulted in the recruitment of a large army of inspectors whose work consists mainly in travelling about the country testing small quantities of materials, and thus incurring non-productive expenses which must fall either upon the undertaking or upon the professional engineer himself. In conjunction with the

establishment of an electrical proving house the institution of sectional inspection and proving bureaux will be equally necessary. These local bureaux could be manned by inspectors who need, therefore, only travel short distances to inspect and prove work and material. This, besides saving expense, would ensure that the work of inspection was carried out on more systematic and efficient lines than is often the case at present. In case such an arrangement be thought too idealistic for a work-a-day world we may call attention to the inspection department of Lloyd's Register of Shipping, which carries out work of this kind for the shipping industry. We hope, therefore, that in connection with the establishment of an electrical-proving house this additional matter of the proper and economic inspection of all equipment turned out will receive the attention that it undoubtedly warrants.

The Chartered Electrical Engineer.

IN the short time that has passed since the granting of a Royal Charter to the Institution of Electrical Engineers, it has become evident how widespread is the gratification at this increase in status, accompanied as it is by so signal a mark of the Royal favour. This gratification, which is both natural and laudable, exists in spite of the feeling that the possession of such a document can have but a shadowy influence on the average electrical engineer's power of earning his bread and butter, or in assisting the Institution to take its proper place in leading the electrical profession and industry. Nevertheless, it was high time that the Institution should be invested with that prestige which is the prerogative of a State-constituted association as distinguished from a private company, and allowed to take the official position to which its influence and good work entitled it.

The Generation of Prestige.

But though the charter places a Royal seal on the work and influence of the Institution, after all prestige is a quality which is generated from within rather than from without. If, therefore, the Institution is to be worthy of a Royal Charter, it must be the aim of its members to ensure that its policy and action are worthy of a profession to which it is their pride to belong. In other words, although the possession of a Royal Charter confers a well-merited distinction on electrical engineers it requires from them a recognition that their profession has received a promotion which carries with it an additional responsibility. The possession of a Charter is a small thing, unless they continue to make the Institution worthy of the profession and industry it represents.

The "Paper" Electrical Engineer.

To discuss the new Institution which the possession of a Royal Charter will bring in its train is, therefore, opportune. It will, first, ensure, on paper, that no one may use the title of electrical engineer, unless he or she is a member of the Institution of the Electrical Engineers. It will allow a sharp line of demarcation to be drawn between authorised and unauthorised practitioners, and will place clearly before the public the choice of employing duly qualified men under certain guarantees as regards the knowledge and performance they bring to their work, or of availing themselves of piratical outsiders, accompanied by a certain risk that is by no means off-set by a problematical saving of their pockets. It is true that the public cannot

be forced to employ the real or chartered electrical engineer, but it should be the aim of chartered members to see that it is worth their while to do so by a display of individual skill and insight.

Moral, Not Penal, Sanctions.

If we continue to look at this matter from the public's point of view, however, we find that these sanctions are moral rather than penal. No attempt is to be made to force the public by Act of Parliament or Order in Council to employ only chartered electrical engineers. The attempt could only fail if it were to be made. In this connection the benefits that are conferred by the kind of recognition we are trying to obtain are enormously exaggerated, both as a means of protection and as a method of obtaining wealth and work. To be entitled to the designation "chartered electrical engineer" may, therefore, be little more than a barren honour, unless the public can be persuaded to realise that the holder of the title is able to do for them something that cannot be done so well by anyone else, despite protestations to the contrary, of which, incidentally, there will be many, both strident and voluminous.

The Case of the Medical Profession.

It is customary in such discussions to point the arguments that may be put forward by reference to the medical profession. Now the medical profession has an efficient, not to say an inquisitorial, organisation, and imposes upon candidates for entry into its circle not only the necessity of possessing certain qualifications, but compliance with certain rules of conduct, which, superficially at least, are designed to maintain the high character of the profession as a whole, no less than of the individuals belonging to it. Now, while we hold the medical profession in the greatest honour and, though objecting to some of the details of its administration, broadly approve the policy which it employs for regulating the conduct of its members, it must be pointed out that the carrying out of this policy would be impossible without the active approval of the public. We are threatened with a State medical system, but we already have something much better in a public medical system, that is a body of men with certain qualifications and with certain ideals who are supported in their doings by the force of public opinion.

The Growth of Quackery.

Great fears both within and without the medical profession are expressed at the growth of quackery, and certain penal enactments have recently been carried to prevent the activities of these unauthorised practitioners. Frankly, we think this is a mistake. For the ideals of good conduct which the medical profession rightly consider their chief support, are weakened rather than strengthened by legislative sanctions of this kind. The medical profession have nothing to fear so long as they have the public support for their regulations, and so long as they rigorously exclude all but properly qualified persons from their ranks.

The Lesson to be Learnt.

This, therefore, is the lesson the embryonic chartered electrical engineer has to learn. That he can do more for himself by working for a public than for a State service; that upon his own exertions alone depend the value of his title; that if to secure that title he imposes upon himself and upon candidates for admission to the profession the necessity of completing a certain course of education and of complying with certain rules, all will be well, and that to be called a chartered electrical engineer will be a mark of honour. That if this is not done and he allows his ranks to be thrown

open to all and sundry, the title, though high-sounding, will be empty and barren of any value.

Guarding Admission.

It is, therefore, essential that the Institution of Electrical Engineers should jealously guard admission to its ranks. Possession of a Royal Charter, the institution of registration for engineers, the laying down of standards of conduct are nothing in themselves. They are, indeed, little more than indications of a policy of purification, which to be successful must be justly and fearlessly carried out. The individual chartered electrical engineer has an equal responsibility in proving to the public, not only that he is competent in his profession, but that he is more competent than the unchartered free-lance man. While, therefore, we view with pleasure the constant growth of the membership of the Institution of Electrical Engineers, we must reiterate the importance of ensuring that such membership is not to be lightly granted.

German Commercial Methods.

THE Germans do not appear to have learned much from the war. At all events, so far as commercial methods are concerned things appear to be essentially as they used to be, and we are not, therefore, surprised to learn that considerable excitement has been aroused in Italian political and commercial circles by the publication of a letter, alleged to have been written by Herr Strohecker, Commercial Attaché to the German Embassy in Rome, outlining a scheme for obtaining complete control of Italian industries, and through them of the trade of the Balkans. Though the authenticity of the letter has been denied by the German Embassy, it is probable that the plan, which is the customary German method of commercial penetration, has a substantial basis of fact. According to the letter, which has appeared in "The Times," it is proposed to create a favourable situation in Italy by fostering the discontent of certain political parties against the Entente, and it is also intended to dispatch goods to be sold in Italy at a price much lower than the cost of production, thus inundating the Italian markets with German goods, and creating, it is hoped, a situation which would render further commercial activities by Italians impossible.

Anticipated Results of Dumping.

As our readers are aware, the Germans are adepts in the dumping of cheap goods on foreign markets, but in the case of Italy it is calculated that the immediate result would be to precipitate an acute industrial crisis which, besides keeping the country continually agitated, would enable the big German industrialists to become masters of its entire commerce by buying up very cheaply certain specified Italian factories and workshops. In this way Germany would, it is hoped, ultimately obtain control of the Italian trade with Jugo-Slavia and the whole of the Balkans, and provide good and expanding markets for German manufactures. It is well to have this candid but brutally frank confession of methods to be adopted; but to be forewarned is to be forearmed, and it may not be so easy as it is imagined to carry out the programme outlined. It is perfectly true that Italian industries have been badly affected by the war, but there is still keen resentment against the German commercial practices adopted in pre-war days, and we feel sure that our Allies will not now readily succumb to Teutonic wiles or blandishments.

Control of Electrical and Metallurgical Industries.

The most important part of this precious German scheme is the evident desire it discloses of securing a firm hold of the Italian electrical industry, for after enumerating certain German industries in which there is a field for expansion in Italy, the German Commercial Attaché points out that the Siemens-Schuckert Electrical Company have arranged for the absorption of the Fiat Company through the Stinnes Fiat in the Alpinen Gesellschaft, and through the purchase of a portion of the shares of the Deutsche Bank, which is interested (with the Siemens Company) in the Fiat and Alpinen shares placed in the Banca Commerciale Italiana. The siderurgical industry is also considered to be of the utmost importance to the Germans, and particulars are given of certain Italian workshops which are to be acquired and the probable purchase price. The letter proceeds: "We have also tendered for the Electric Railways, Milan, and for combination with Pirelli and others, which may be effected. Very important is the control of combustibles in Italy. The infiltration of the products of the A.E.G. has demolished the electric material industry, which will shortly be absorbed by us, and certain masters assure me that on account of the crisis the companies are on the look-out for foreign capital. Ruling the market for electrical material, we can obtain the supply of such materials for various electric establishments and for the State railways." Though the translation of the communication leaves a good deal to be desired, its meaning is so obvious that it admits of only one interpretation.

Concession to National Feeling.

It is pointed out that it is imperative that German companies should allow the Italian branches to retain their Italian names, and care should be taken not "to wound Italian susceptibilities." Incidentally, Herr Strohecker states that he has arranged for the signing of contracts with the "Societa Adriata" and the A.E.G. and Siemens for the supply of the necessary materials required for the province of Venice for the amount of eight million lire, and he concludes by stating "we can easily control the lignite industry, as the owners do not know how to profit by their mines. It treats thirty million tons, and only three millions are annually extracted, though we could handle 115 millions. By distillation we could obtain a million tons of oil. There are also the bitumen schist deposits, estimated at 115 million tons, with 8 to 12 per cent. naphtha, all poorly developed because of want of money. The Chemical Federation and Deutscher Bank are in treaty with certain Italian firms."

Anglo-Italian Trade.

No doubt it was intended that this precious communication should never have been published, for its author lays special emphasis on the fact that Italian pride must not be wounded. We think, however, that the contents of the letter will be deeply mortifying to our gallant Allies, and that this clumsily planned German plot will miscarry, even though Italian industry be in urgent need of outside financial and technical aid. Unfortunately, the condition of the exchange and the new tariff do not favour Anglo-Italian trade relations at present, but in view of the great activity in hydro-electric works and in railway electrification we think it would be well to pay closer attention to the possibilities of the Italian market. At all events, the publication of the German designs upon the country should assist in creating a revulsion of feeling in favour of British engineers and of their straightforward business methods.

THE HEATING OF CABLES.

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For some years past considerable attention has been given to the question of the heating of electric cables, but there seems to be a tendency in this, as in many other branches of intellectual activity, to lose sight of the fundamentals while extending the boundaries of the subject.

A large amount of experimental work has been done both in this country and abroad. Cables have been tested under practical and under laboratory conditions, and mathematicians have contributed to the theoretical side of the problem. Formulae have been published and data for current carrying capacity issued by the institutions and by cable manufacturers, yet anyone making a serious study of the literature of cable heating must be impressed by the lack of agreement between the authorities, and by the absence of order in the treatment of the subject.

Two Factors Making for Confusion.

In the present writer's opinion this state of affairs is largely due to two factors. On the one hand a wealth of results of research and investigation has sprung up and obscured the real problem, and on the other hand investigators have dealt with the cable and its surroundings as one entity instead of separating them into two distinct problems. We need to stand back from the trees and readjust our perspective of the whole forest. The impression has got abroad that the heating of cables is an abstruse matter, whereas in reality it is susceptible to very simple treatment.

The following notes lay little claim to originality. The simple principles emphasized were recognized by the earliest writers on cable heating and several investigators have, to some extent, interpreted their results in the manner discussed. As a general thing, however, it may be said that the treatment has sometimes been unnecessarily obscure and, in what follows, an attempt is made to show the logical order of the fundamentals involved and to construct a framework into which some of the mass of published data may be built.

The Basic Problem.

As the basic problem concerns cables operating under steady loads, and as the question of intermittent rating involves a more comprehensive treatment than is possible within the scope of the present article, only continuous rating is considered.

When an electric cable is carrying current there are three factors to be considered in an investigation into the effect of heating on rating. They are as follows: (1) The generation of heat, (2) the dissipation of heat, (3) the maximum temperature rise. These three are intimately connected in the following manner: Factor No. 3 is the criterion of safety of the cable fixed by physical considerations, referred to more in detail later. Factor No. 1 operates to increase No. 3, while No. 2 has the reverse effect. When balance is maintained between Nos. 1 and 2, then No. 3 remains constant. The fixing of a maximum value for No. 3 means that, for any particular value of No. 2, there is a limit beyond which No. 1 must not be carried. These three heads constitute a convenient division of the subject and will be treated in turn.

Generation of Heat.

There are three sources of heat in a cable: (a) I^2R losses in conductor; (b) dielectric losses; (c) sheath losses. Of these three the first plays by far the most important part. The effect of dielectric losses is negligible except in super-pressure cables, say for 20 000 V. and upwards, which cases require special consideration. Sheath losses, in certain cases, may be appreciable; but although they form a factor on which more reliable data is required than at present exists, their effect on the heating of cables as used in practice is generally accepted as being of secondary importance.

The heat to be considered in the general case, then, is given by the product of the square of the current into the *hot* resistance of the conductor. If there are two or more conductors in the cable the total heat generated is, of course, the sum of the I^2R values of all. Strictly speaking, with

alternating currents traversing heavy conductors, the value of R should be slightly increased to allow for eddy currents and skin effects; but in the worst case this amounts to only a few per cent., and, in view of the low order of accuracy with which other factors of the rating problem may be determined, the increase can be ignored.

As will be more evident later, it is desirable to restrict consideration of the heating of a cable to a short unit length, and for this purpose a length of 1 cm is found to be convenient. Then, if there are n equal cores in a cable each having a hot resistance R , and carrying a current I , the heat generated is nI^2R watts per cm run.

The Dissipation of Heat.

The three well-known modes of heat transfer—conduction, convection and radiation—all enter into the cooling of cables. Heat is transferred from the conductor to the outer surface of the cable by conduction. If the cable is surrounded by air, radiation and convection come into play in transferring the heat from the outer surface of the cable to the air. If the cable is laid in water, convection is responsible for the transfer, while in the case of buried cables in intimate contact with the soil, conduction takes place outside the cable as well as inside.

The laws governing heat conduction are very simple. The quantity of heat transmitted through a body is proportional to the temperature difference maintained on the two opposite faces and inversely proportional to the thermal resistance of the body. The laws governing convection and radiation are not so straightforward. For strict accuracy formulae involving higher powers of temperature difference than the first should be used; but, for all practical purposes in cable calculations, it is found that the emission of heat from a surface to the air may be taken as being directly proportional to the temperature difference.

The Thermal Equivalent of Ohm's Law.

In view of these considerations, it is fairly evident that the transfer of heat through a series of bodies can very conveniently be considered in terms of a thermal equivalent of the electrical Ohm's law, and this treatment is found to provide a most satisfactory instrument for dealing with cable heating.

The three primary quantities in the thermal circuit corresponding to current, resistance, and potential difference or electromotive force in the electrical circuit are as follows:—

Thermal Circuit.	Electrical Circuit.
Rate of Flow of Heat, or Thermal Flow.	Current.
Resistance to Flow of Heat, or Thermal Resistance.	Resistance.
Cause of Heat Flow or Temperature Difference.	Electromotive Force.

The law may be stated thus:—

$$\text{Thermal Flow} = \frac{\text{Temperature Difference}}{\text{Thermal Resistance.}}$$

The question of units is important in applying the method. Those for temperature are already defined, and in what follows the Centigrade degree is used. The unit of thermal flow may be calories per second; but, to simplify the calculation arising, a more convenient unit is the watt (joule per second).

In dealing with the denominator of the expression it seems necessary to comment on the difference between conductivity, resistance and resistivity. Writers who are authorities, and who could not possibly confuse the related electrical expressions, sometimes use these three terms loosely to the detriment of the clear understanding of the question. It seems desirable to avoid entirely the use of thermal conductivity, and to reserve thermal resistivity for the specific value.

The "Forbe" as a Heat Unit.

So far no name is generally accepted for the unit of thermal resistance. The term "Thermal Ohm" could be used, but

there are advantages in having a new and distinct title, and the author has ventured to adopt the title "Forbe" in honour of one of the early workers in this field.*

Employing the centigrade degree for temperature, and the watt for heat flow, the unit of thermal resistance, the Forbe, is the thermal resistance of a path through which a difference of temperature of 1°C produces a heat flow of 1 W.

On the same lines the thermal resistivity or specific thermal resistance of a material is the thermal resistance in Forbes between the opposite faces of a centimetre cube of the material, and is given by the temperature difference in degrees C. between the opposite faces required to produce a flow of 1 W of heat from one face to the other.

As thermal resistivity in connection with the heating of cables has, up to the present, been expressed in "degrees C. per centimetre per watt per square centimetre" the adoption of the Forbe tends to considerable simplification of the nomenclature.

Application of the Thermal Ohm's Law to Cables Heating.

In applying the thermal Ohm's law to cable heating it will be seen that the problem is parallel to the electrical one of insulation resistance. The thermal resistance of a cable, from the conductor outwards, like the dielectric resistance, is inversely proportional to the length and, as has been noted under "Generation of Heat," it is convenient in the heating problem to consider unit length of cable of one centimetre. The normal heat path then takes the form of a short cylinder (1 cm thick) extending out from the conductors to the heat "sink" or point considered to be at a base temperature. A simple illustration is the case of a single core lead-covered cable suspended in flowing water where the lead sheath becomes an isothermal layer maintained by the water at a uniform base temperature.

If, then, a cable carrying a steady current I in each of its n conductors has a thermal resistance per cm length of R_{th} Forbes, and an electrical (hot) resistance of R ohms per cm of conductor, the statement of the thermal Ohm's law is:—

$$nIR = \frac{t_c - t_1}{R_{th}}$$

where t_c is temperature of the conductor and t_1 the temperature of the lead.

It is very probable that, in the future, tables will be produced in which the thermal data for cables will be given in the same way that electrical data now appears, and if we could turn up from such a table the value of R_{th} , the thermal resistance in Forbes per centimetre, for the cable under consideration the simple relationship just stated would lead to the current carrying capacity for a given temperature rise of conductor over lead very directly.

Before proceeding to the conditions external to the cable it will be convenient to mention more in detail the factor R_{th} for various types of cables. The thermal resistance of the heat path consists of two factors—first, the thermal resistivity (ρ_{th}) of the material; and secondly, the dimensions of the cable. Sufficient work has not been done up to the present to fix with certainty the values of ρ_{th} for all materials, found in the constitution of cables, and to clarify the consideration of the problem the writer has found it convenient to adopt a term, "thermal modulus of section," to signify that factor in the thermal resistance which depends only on dimensions. The thermal modulus is independent of the make of cable and is that quantity which, when multiplied by the thermal resistivity of the dielectric, gives the thermal resistance.

The Thermal Modulus of Section.

The value of the thermal modulus of section for a single-core cable is given by the familiar logarithmic expression:—

$$\frac{1}{2\pi} \log_e \frac{R_2}{R_1}$$

$$\text{or} \quad 365 \log_{10} \frac{R_2}{R_1}$$

where R_2 = Radius under the lead
 R_1 = Radius of the conductor.

* "On the Thickness of Wires Required to Carry Different Electric Currents Without Overheating." Prof. G. Forbes. THE ELECTRICIAN. Vol. IX, p. 497, October 7th, 1882.

Concentric cables are treated in the same manner, each layer of dielectric being calculated separately and the results added. Care should be taken, of course, in applying the thermal Ohm's law to the case of the concentric cable, to note that the thermal resistance to the heat escaping from any particular conductor is the sum of the thermal resistance of those layers which are outside the conductor under consideration.

For three-core cables several formulæ have been evolved, the most important of which are those published by Mie* (independently confirmed by Matsumoto†) and by Russell.‡

Adopting a uniform notation and modifying for convenience, we get the following:—

Russell.

$$\begin{aligned} \text{Modulus} &= \frac{1}{6\pi} \log_e \frac{R_2^3 - R_1^3}{3R_2^2 R_1} \\ &= 0.122 \log_{10} \frac{R_2^3 - R_1^3}{3R_2^2 R_1} \end{aligned}$$

Where R_1 and R_2 have the meaning already assigned to these terms, and R_3 is the radius of conductor centres.

In view of R_3 being very small in comparison with R_2 , the formula may be simplified in practice to the following:—

$$\text{Modulus} = 0.122 \log_{10} \frac{R_2^3}{3R_2^2 R_1}$$

which, by a trial over a range of practical sizes, is found to agree within 1 per cent. of the values obtained from the extended formula.

Mie and Matsumoto.

$$\text{Modulus} = \frac{1}{6\pi} \log_e \frac{(1-\alpha\beta) + \sqrt{(1-\alpha^2)(1-\beta^2)}}{\alpha-\beta}$$

where

$$\alpha = \left(\frac{R_1 + R_2}{R_2} \right)$$

and

$$\beta = \left(\frac{R_2 - 3R_1}{R_2 + 3R_1} \right) \left(\frac{R_2 + R_1}{R_2} \right)$$

In practice the numerator $(1-\alpha\beta) + \sqrt{(1-\alpha^2)(1-\beta^2)}$ approximates to the value 2 and if this value be substituted the formula becomes

$$\text{Modulus} = 0.122 \log_e \left(\frac{R_2}{R_2 + R_1} \right)^3 \left(\frac{R_2 + 3R_1}{3R_1} \right)$$

but by testing over a range of sizes this formula is found to vary as much as 20 per cent. from the full formula results.

There is a wide discrepancy between results obtained on the formulæ of Russell and Mie, more particularly for low-tension cables. The difference increases with the size of conductor, and inversely as the thickness of insulation. For 33 000 V sizes there is a difference of about 10 per cent.

Until more work has been done on these formulæ it seems desirable to use R_{th} , the thermal resistance in Forbes per cm, a quantity which can be determined experimentally for any particular type of cable, and the following figures give the order of the values which may be expected for a 0.1 sq. in. three-core lead-covered paper cable of various working pressures.

Working Pressure.	R_{th} .
660 V	35 to 40 Forbes per cm
2 200	45 to 50
6 600	55 to 60
11 000	65 to 70
33 000	75 to 85

Dissipation Outside the Cable.

So far, the dissipation of heat within the cable only has been considered, and in approaching the second part of this branch of the problem, the dissipation outside the cable, it is desirable to bear in mind the absolute detachment of the two parts. The analysis of external conditions applies equally well,

* "Über die Wärmeleitung in einem verselten Kabel." G. Mie. E. T. Z. Vol. XXVI, p. 137. 1905.

† "Carrying Capacity of Underground Power Cables." H. Matsumoto. Tokio, 1916.

‡ "Theory of Electric Cables and Networks." A. Russell. 1920. Chap. VI.

steam pipe or a cable carrying current is under consideration, so long as the outside surfaces are identical. In either case a cylinder of a given diameter is passing out heat through its surface at a known rate, and, from what has been said previously, no matter how this heat leaves the cylinder, whether by radiation, conduction or convection, in the practical problem the rate of flow can be considered proportional to the temperature difference. The principle of the thermal Ohm's law, found so useful under the lead, can thus be applied to the continuation of the problem beyond the lead.

External conditions may be classified as follows:— α Perfect conduction; β partial conduction; γ no conduction. The case α has already been referred to. A cable effectively cooled by flowing water in intimate contact with its surface has no external thermal resistance. For calculation of current-carrying capacity the path of heat-flow ends at the surface (lead or serving), but the "sink" is not so easily defined. If a cable were buried at the centre of a large mass of earth, then its temperature would continue to rise as long as the current flowed, and the heat-sink would be an ever-widening cylinder concentric with the cable. In the practical case, however, a steady temperature is attained owing to the cable being laid near the surface of the ground where the heat is ultimately dissipated and the isothermal surface considered as the heat-sink becomes distorted. The analysis of the problem is difficult and the attempts that have been made to deal with it mathematically are not very useful. On the other hand, experimental data is being collected, and if this is put into the form of thermal resistance per centimetre run for various classes of soil and diameters of cable, the application to the fundamental problem should be very simple. From figures given by R. W. Atkinson* it appears that the value is of the order of 20 to 50 Forbes per cm for a buried duct system.

The Case of Buried Cables.

Case β covers buried cables where the surrounding ground carries away the heat by conduction through the earth; but a difficulty is encountered here in fixing limits for the heat-path. The "source" is, of course, the outer surface of the cable (lead or serving), but the "sink" is not so easily defined. If a cable were buried at the centre of a large mass of earth, then its temperature would continue to rise as long as the current flowed, and the heat-sink would be an ever-widening cylinder concentric with the cable. In the practical case, however, a steady temperature is attained owing to the cable being laid near the surface of the ground where the heat is ultimately dissipated and the isothermal surface considered as the heat-sink becomes distorted. The analysis of the problem is difficult and the attempts that have been made to deal with it mathematically are not very useful. On the other hand, experimental data is being collected, and if this is put into the form of thermal resistance per centimetre run for various classes of soil and diameters of cable, the application to the fundamental problem should be very simple. From figures given by R. W. Atkinson* it appears that the value is of the order of 20 to 50 Forbes per cm for a buried duct system.

Effect of Several Cables Together.

When several cables are laid near together in the ground the resulting diminution of current-carrying capacity of each due to the heating effect of the others can be arrived at by the thermal Ohm's law treatment. Temperature difference can represent potential drop exactly as it does electro-motive force, and if m cables (each n -core) are each producing $n I^2 R$ watts the total heat-flow from the group is $m n I^2 R$, and the drop of temperature from the group to the base or sink is this "current" multiplied by the thermal resistance—that is, m times what it was with one cable only (subject to a small correction for the necessary distance between the different cables).

The γ case in the above classification frequently calls for attention and embraces cables in air. This time the Ohm's law treatment seems to fail, as the heat passes from the surface to the air without traversing a path of any length. It is found, however, that data can be determined for different types of surface which can be treated as thermal resistances. Many investigators have contributed to this part of the subject, and values are published for lead, bright and painted, and for servings. To be consistent with the other units dealt with, the thermal resistivity of a surface to air transfer would be expressed in Forbes per square cm. So long as the distinction between conduction and surface transfer is recognised, the use of the common unit should cause no confusion, and the total surface resistance of a cm length of cable is obtained by dividing the specific value per square cm by the circumference in cm.

In addition to the three cases, α , β and γ , there are combinations such as when a cable in air is touching a heat-conducting surface or, when lying in a duct, is in contact on the lower side and separated by air elsewhere. These require special treatment and the writer has indicated elsewhere* the temperature distribution in such cases.

Maximum Temperature Rise.

Although left to be dealt with last, the third main factor in the problem of heating, the fixing of temperature limits, is really the basis of current rating. We have seen that calculations employing experimentally-determined data give the total temperature rise. At one end of the range the lower temperature—the base or datum temperature—is fixed by the conditions in which the cable is installed; the other end, the maximum allowable temperature, is that temperature above which it is unsafe to work the material composing the dielectric.

In cases where the temperature conditions, under which a cable is to work, are known with some degree of accuracy, a definite base can be adopted; but, owing to weather variations, the values accepted for general use are somewhat arbitrary. In this country figures commonly employed are—for air, 80°F., and for ground, 60°F.

The question of the safe operating temperatures for materials used in cable manufacture has not until recently received the attention which its importance merits. For some time the current-carrying capacity tables of the Institution Wiring Rules have been based on 130°F. for paper, and 100°F. for rubber; but these are on the safe side, and the same rules give higher temperatures at which the materials may be maintained without risk of damage. The American Institute of Electrical Engineers employ a sliding scale in which the maximum temperature is a function of the pressure. With E kilovolts between conductors the temperature in degrees C. is given by the following:—

Impregnated Paper	85 — E
Varnished Cambrie	75 — E
Rubber Insulation	60 — $\frac{E}{4}$

Converting these to degrees F. for comparison with the British standards, we see that the range is from 185°F. for paper and 140°F. for rubber on low-pressure cables; to 150°F. for paper and 130°F. for rubber on 20 000 V. cables.

Permissible Operating Temperatures.

The question of the permissible operating temperatures for paper cables took a very definite step forward in the early months of the present year when several papers were read on the subject at the Mid-Winter Convention of the American Institute.† The most important portion of the work is the development of a tearing test by which the effects of heating on paper have been clearly determined. The results show that a temperature of about 85°C. (185°F.) can be maintained for an indefinite period without injury to the paper. For higher temperatures the deterioration is a function of the total time of heating, and as a result it has been proposed to adopt different working temperatures for different load factors, varying from 90°C. (194°F.) to 105°C. (220°F.). It is doubtful whether such a proposal will have practical application, but it does appear that, for low pressure cables at any rate, the figures of 130°F. for paper and 100°F. for rubber could be increased as a basis for the determination of current-carrying capacity.

In conclusion the writer hopes that, by emphasizing the usefulness of a simple and ordered treatment of the subject along the lines indicated, he may have added to the practical value of the large amount of work already carried out, and may have rendered some little assistance in the formulation of future research programmes.

* "The Current-Carrying Capacity of Lead Covered Cables." R. W. Atkinson. "Transactions" American Institute of Electrical Engineers. Vol. XXXIX, p. 881, 1920.

* Discussion on Buried Cable Research. Journal I. E. E. Vol. 59, p. 218. 1921. THE ELECTRICIAN, Vol. LXXXV, p. 738, December 24th, 1920.

† see THE ELECTRICIAN, Vol. LXXXVI, p. 372, April 1, 1921.

ELECTRIC TRACTION IN SWITZERLAND.

Technical Details of Some Interesting Schemes.

In the following article we give a review of the development of the electrification, since the war, on some important sections of the Swiss railways, which have hitherto been worked by steam. In 1917 the Federal Railways began to electrify the sections Berne-Thun and Brigue-Sion. These were completed in 1919. At the same time, the electrification of the section Erstfeld-Bellinzona of the St. Gothard railway was begun. The two sections Lucerne-Erstfeld and Bellinzona-Chiasso may be electrified by the end of this year; after which the connections Arth-Goldau-Zug-Zurich and Zug-Lucerne will be undertaken. Preparations are also being made for the electrification of other parts of the Federal system.

The Bernese Railways.

Since the opening of the Lötschberg Railway*, which has been worked electrically from the outset, the Canton of Berne has taken in hand the electrification of Bernese subsidised lines. Among these may be mentioned the Gürbetal and the Simmental lines and the sections Spiez-Interlaken-Boenigen and Berne-Schwarzenburg, all of which were to be ready in 1920; while the section Burgdorf-Langnau of the Emmental line was opened in 1919. The further section Burgdorf-Solothurn of this line and the section Berne-Neuchâtel are now being studied. The present position is shown in detail in Fig. 1.

The Rhaetian Railways.

The Rhaetian Railway, after electrifying the Engadine lines St. Moritz-Schuls and Samaden-Pontresina in 1913, has since 1918 been engaged on the electrification of the other parts of its system. The sections Bevers-Filisur, Filisur-Thusis and Filisur-Davos-village have been in service since 1919; while the sections Davos-village-Klosters and Thusis-Chur-Landquart will be ready in 1921.

Except for the section Brigue-Sion of the Federal railways and Burgdorf-Langnau in the Emmental, which will be worked three-phase, all the other lines are to be equipped on the single-phase

system at 16½ cycles. The total length of lines electrified between the beginning of 1918 and the end of 1920 is as follows:—

Railways.	1-phase.	3-phase.
Federal	280 km, 15 000 V.	68 km, 3 300 V, 16 ~
Bernese subsidised	113 km, 15 000 V.	22 km, 750 V, 10 ~
Rhaetian	86 km, 10 000 V.	~

Power Supply Details.

The electrification of these lines has entailed the construction of new power stations. The Federal Railways are building three stations—one at Piotta supplied from Lake Ritom, another at Amsteg, and the third on the Barberine at Châtard, the total initial power being 120 000 kVA. The Bernese lines are supplied from the stations at Kandergrund and Spiez, having a total capacity of 20 000 kVA, while a further 10 000 kVA will be supplied from the power station at Mühleberg.

Electric Locomotives Supplied for the Swiss Railways 1917-1921.

Firm.	Railway.	Number of locomotives.	Type of locomotives.	Total H.P. per locomotive.
Brown, Boveri	St. Gothard	26	1-B + 1-1	4 600
	"	1	1-B-1 + 1-B-1	4 700
	"	8	2-C-1	3 700
Oerlikon	"	1	1-C-1	2 825
	"	1	1-B + B-1	4 562
	"	10 + 13 + 10	1-C + C-1	4 525
Brown, Boveri	Bernese	7	1-B + B-1	2 600
Oerlikon	"	3	"	2 500
Brown, Boveri	Rhaetian	1	1-D-1	2 415
	"	6	C-C	2 600
	Brigue-Sion	2	D	2 895

* See THE ELECTRICIAN, Vol. LXII., p. 729, Feb. 6, 1914.

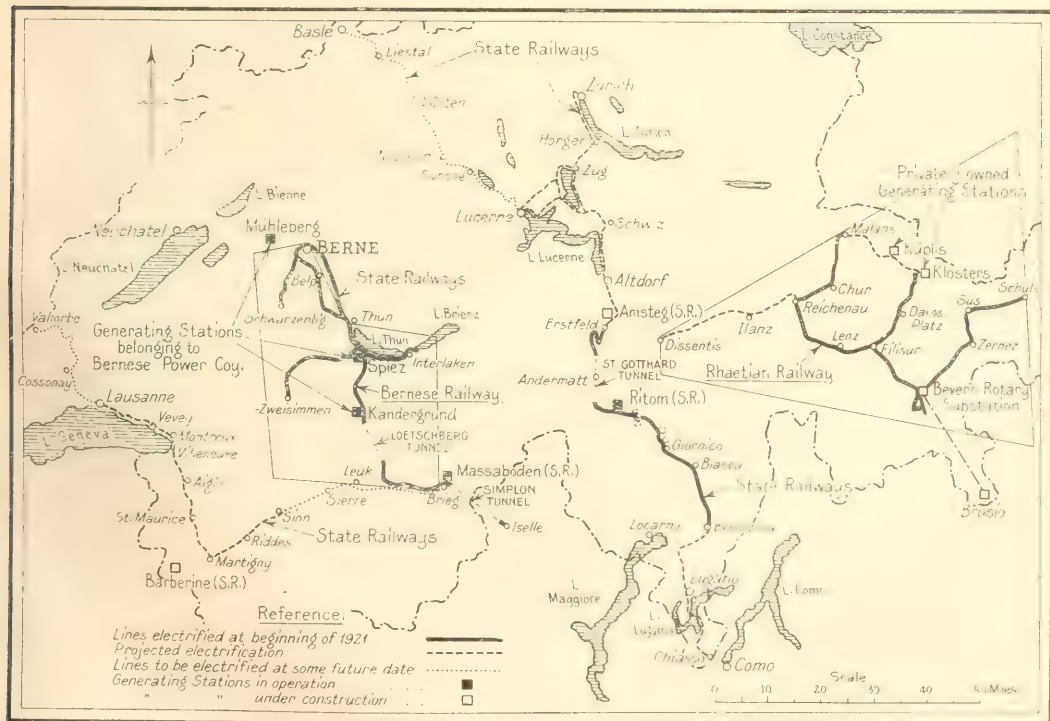


FIG. 1.—MAP OF THE SWISS RAILWAYS SHOWING ELECTRIFIED LINES.

The Rhaetian lines are fed from Brusio (3 600 kW), while the new station at Thusis will supply 4 000 kVA and a further 4 000 kW will be obtained from the station at Kublis.

For these newly electrified lines, a large number of locomotives

parts being generally supplied by the engineering and locomotive works at Winterthur. The Rhaetian lines have 1 m gauge—all the others are standard. The Burgdorf-Thun and the Brig-Stion lines are three-phase and the locomotives have four running speeds.

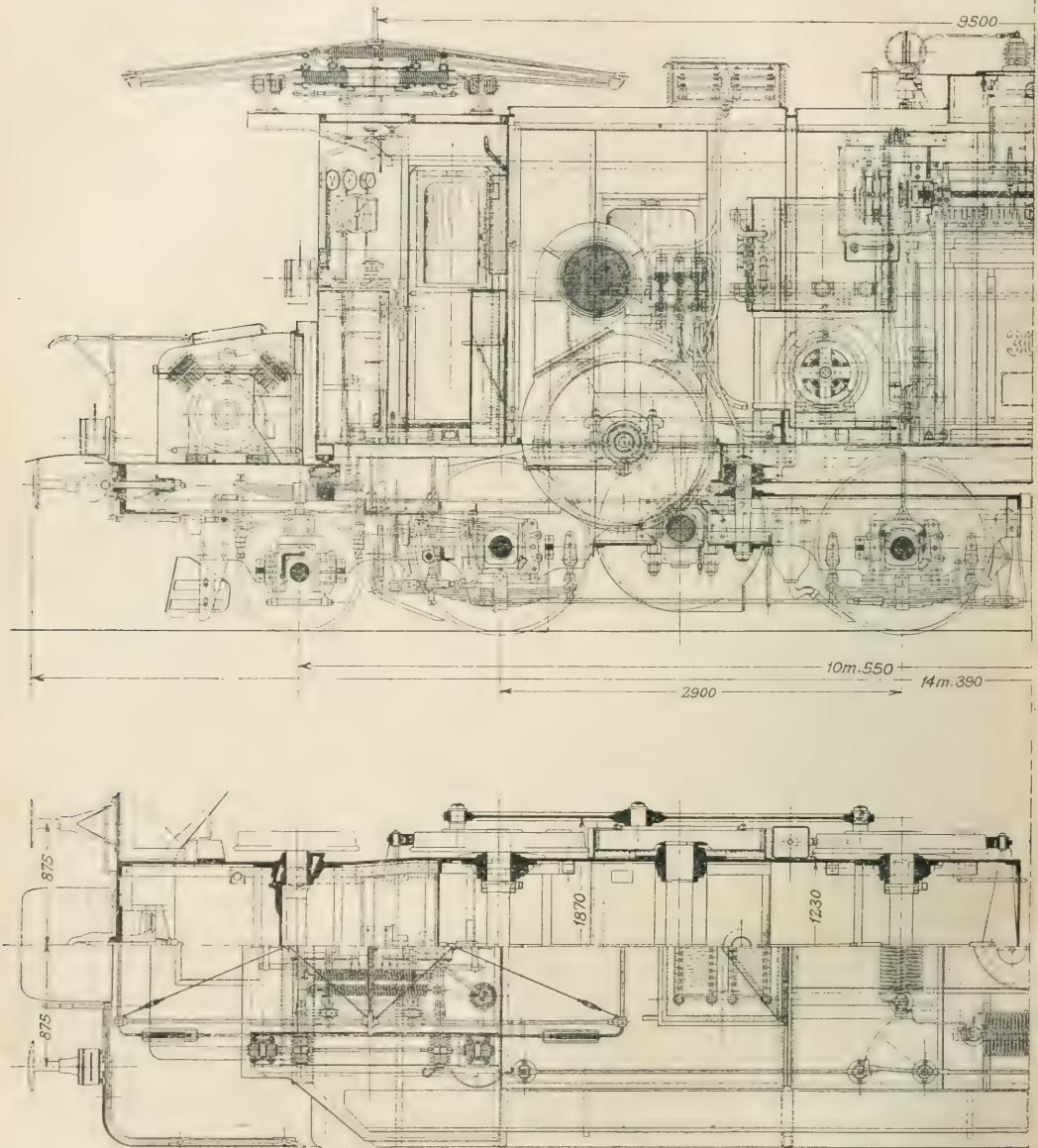


FIG 2 DETAILS OF 1-B+B-1 LOCOMOTIVE

have already been supplied or are under construction. The table on p. 321 shows the equipment that has been or will be supplied by Messrs. Brown, Boveri, and by the Oerlikon Company, the mechanical

All the other lines are single-phase at a frequency of $16\frac{2}{3}$ cycles and a pressure of 15 000 V, except the Rhaetian lines, where the pressure is 10 000 V.

The 1-B+B-1 Locomotives for the Bernese Subsidized Lines.

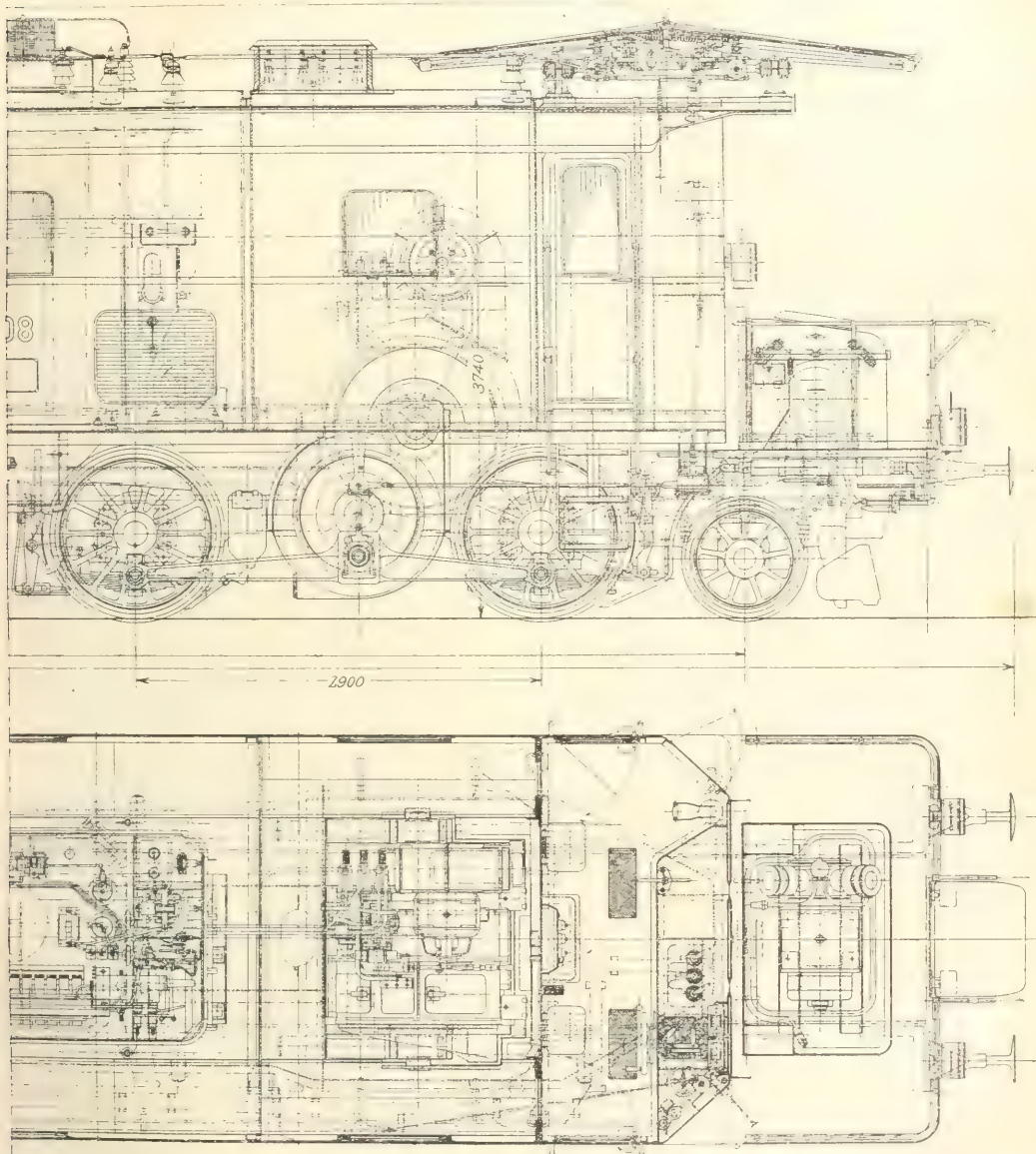
The two reasons which led to the decision in 1918 to electrify forthwith the lines subsidized by the Canton of Berne were the increasing cost of coal, which made steam less economical than electric traction, despite the great expense of electrification; and the competition of the neighbouring electrified lines. The power for this group of newly-electrified lines, which are interconnected with the

Lötschberg Railway, is obtained from the generating stations at Spiez and Kandergrund and from the new station at Mühleberg. Fourteen single-phase locomotives were ordered, the mechanical parts of which were supplied by the Locomotive and Engineering Works at Winterthur. The electrical equipment for seven of the locomotives was supplied by Brown, Boveri & Co.,

Limited; five of these are for the Gurbetal line and two for the Berne-Schwarzenburg line. All the locomotives have been delivered, and the trials of the first machines were made last May on the Spiez-Brigue (Lötschberg) line.

It was decided to build locomotives of the 1-B-B-1 type with the following particulars:

Length over buffers	14 390 mm.
Length over frame	10 300 mm.



The new locomotives are intended for both passenger and goods service, particularly on branch lines where the axle loads must be kept small.

The guarantees are as follows:

Traction effort at wheel rim on one hour's rating at 35 km. per hr. = 8000 kg.

Loads hauled at this speed:

310 tons on a gradient of 15 in 1 000.

180 tons on a gradient of 25 in 1 000.

Time to attain a speed of 35 km. per hr. from rest not to exceed 4 mins.

Maximum speed: 60 km. per hr.

Total weight of locomotive not to exceed 72.5 tons, nor the weight per metre length 5.2 tons.

Width of frame	2 900 mm.
Total height	3 755 mm.
Total wheel base	10 550 mm.
Fixed wheel base	2 900 mm.
Diameter of driving wheel	1 230 mm.
Diameter of running wheel	850 mm.
Distance between kn. pins	4 150 mm.
Maximum load per motor axle	12 500 kg.
Maximum load per running axle	11 000 kg.

Mechanical Parts.

An illustration of these locomotives is shown in Fig. 4 and of mechanical structure in Figs. 2 and 3. There are two bogies, on each of which one motor is mounted.

Between the two driving axles there is a jack axle, having very liberal bearings: 250 mm long and 200 mm in diameter. At each end of the jack axle there is a gear wheel with helical teeth 140 mm. wide,

engineers of the Löetschberg Railway appointed to supervise the design and construction of these locomotives took care that these principles were scrupulously observed, and made full use of their

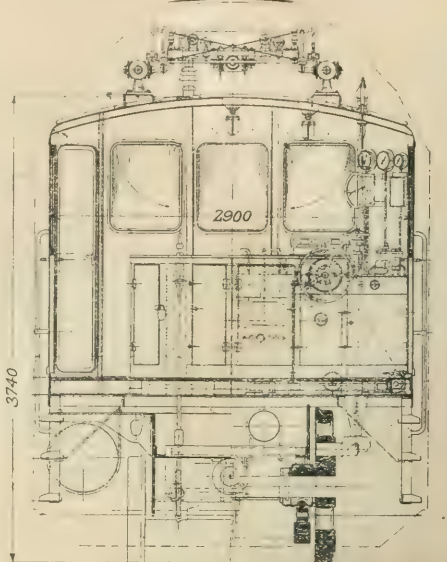
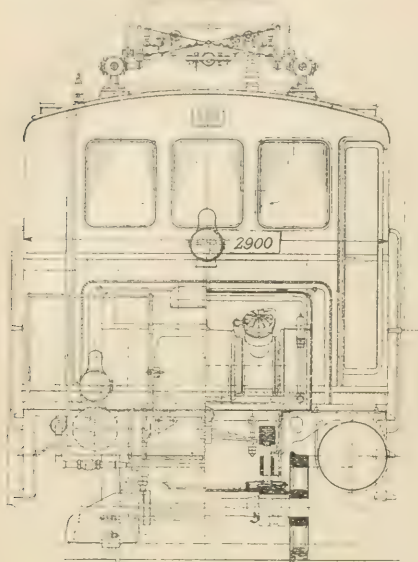


FIG. 3.—END VIEWS OF 1-B+B-1 LOCOMOTIVE.

previous experience with single-phase traction. As a result of this experience, electric or multiple-unit control, regenerative and rheostatic braking were dispensed with, the electric equipment being operated mechanically or pneumatically. To protect the installation against current surges, differential current relays are relied upon everywhere. All parts of the apparatus are readily accessible and can be dismantled without difficulty.

The chief parts of the electric equipment are:

- The high-tension circuits at 15 000 V.
- The motor circuits at 500 V.
- The train-heating circuits at 800-1 200 V.
- The auxiliary-service circuits at 220 V.
- The lighting circuits at 36 V.

In the last case, direct current is used, and in all the others single-phase current.

Main Oil-Switch.

There are two pneumatically-operated collecting bows connected through two isolating links which are controlled from the locomotive in case of damage to either bow. From the bows the current passes to the high-tension switch through an inductance which protects the transformer against pressure surges. The high-tension oil-switch is just above the transformer in the middle of the locomotive. The switch is amply proportioned, having a ten-point contact, two auxiliary contacts and a protective resistance. In case of explosion, two openings permit the gas and oil to escape outside; while the high-tension circuit in the locomotive is earthed when the oil-switch is open. Tests have shown that the high-tension switch can cope satisfactorily with powers over 100 000 kVA. The switch is actuated by a chain from a two-cylinder engine beneath it, but is arranged to open automatically despite this control. In the circuit of the air compressor motor there are two maximum time relays and a no-volt relay connected to the 220 V circuit.

There are no special oil-switches for the motors, but either or both can be cut out by the relays just mentioned. All the high-tension controls are mounted on the top of the transformer in an enclosure which can be opened only when the earthing switch is closed. Opening this compartment causes the high-tension switch and all the air valves to open automatically, thereby rendering it impossible to make the high-tension parts alive so long as the door is open. The high-tension switch can also be controlled by hand from either end.

Transformers.

Experience has led both client and designer to give preference to the oil-cooled type of transformer. At 15 000 V, the security is greater and the upkeep is less than with an air-cooled type, which is always exposed to dirt and is difficult to insulate against surges. In order to diminish the amount of oil and to approach the weight of the air-cooled type, forced cooling is necessary. The transformer in this way gets similar heating characteristics to those of

the two gears being cut in opposite directions to secure uniform loading. The gears are made of Martin steel and are replaceable. The gear ratios is 1:3.86. The body of the locomotive is mounted on the framework. It consists of a central compartment in which the machines and apparatus are installed and the driver's stand at each end. The cabin in front of the driver's stand contains the compressors and the sand sprayers and is mounted on its respective bogie. To facilitate dismantling the motors or the equipment, the cover is divided into three detachable parts. Each locomotive has two speed indicators and a double Westinghouse brake acting on the four driving axles and capable of developing an effort equal to 90 per cent. of the adhesive weight. The hand brakes act on the wheels of their own bogie only.

Electrical Details.

The principles on which the whole of the electric equipment are based emanate from a desire to obtain a simple and rational arrangement, and to reduce the costs of upkeep of the locomotive. The



FIG. 1.—VIEW OF A B-B-1 LOCOMOTIVE FOR THE BERNESE RAILWAY (BROWN, BOYKEE AND CO.)

the motors with forced cooling. The oil is circulated through a cooler acted on by a fan (Fig. 5) the pump and fan being driven by the same motor. This new system of cooling has given very good results. The total oil is circulated in 9 minutes and its temperature is reduced by 6 to 8°C. The transformer is of the auto-transformer type. It is insulated for 45 000 V, and the end-turns for 60 000 V. The secondary has 13 tappings for pressures from 100 to 620 V, and three auxiliary tappings for 800, 1 000 and 1 200 V for train-heating. The output of the transformer is :

Starting and speed-variation of the main motors are obtained by means of a regulator (see Fig. 6) in conjunction with a variable-ratio transformer having 13 tappings. The normal pressure, 500 V, at the motor terminals corresponds to the eleventh tapping. The last two tappings are for compensating a drop up to 20 per cent. in the pressure of the overhead line. The regulator is operated by hand from the driver's cabin through a transmission mounted on ball-bearings. Each revolution of the controller wheel moves the contact switch one notch. In passing from one step to the next, the

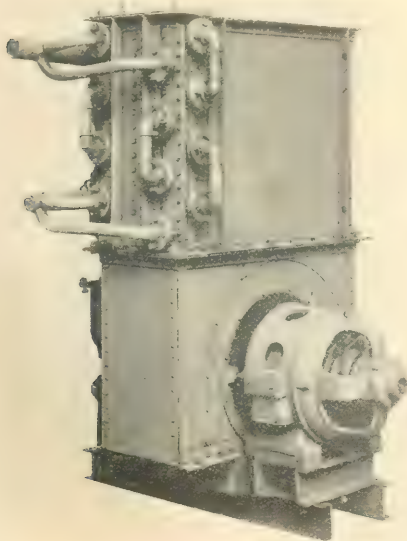


FIG. 5.—COOLER OF MAIN TRANSFORMER.

or the motors, 900 kVA at 500 V, for auxiliary services, 50 kVA at 220 volts, for train-heating, 160 kVA at 800 V.

It can be overloaded 20 per cent. for 1 hour, 30 per cent. for 15 minutes and 100 per cent. momentarily. It is designed for either 15 or 16½ cycles, so as to be suitable when the Bernese adopt the same frequency as the Federal railways.

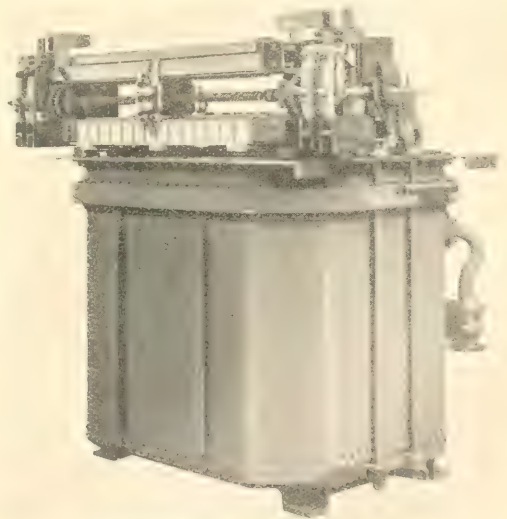


FIG. 6.—950 kVA TRANSFORMER SLIDING CONTACTOR VOLTAGE REGULATOR.

corresponding section of the transformer winding is short-circuited momentarily through a resistance by means of special contactors. With this arrangement the locomotive can be started either light or loaded without any trouble, despite the relatively small number of notches. Though it might be objected that hand control demands a

certain effort on the part of the driver, this effort is rather small on account of the ball-bearings, while its numerous advantages render hand control very suitable in this case.

Traction Motors.

In the circuit of the two main motors (Fig. 7) are the current transformer, the cut-outs and the reversing-switch. The motors are

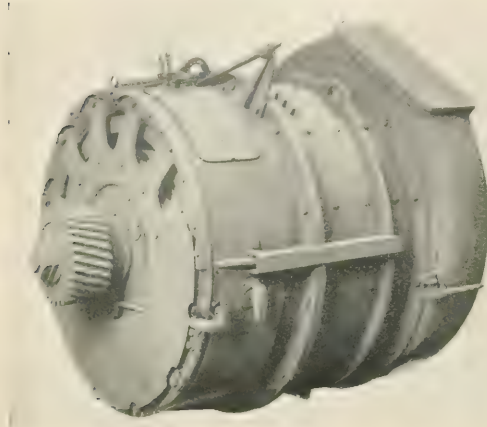


FIG. 7. 525 H.P. SINGLE-PHASE MOTOR FROM THE COMMUTATOR END. of the single-phase series compensated type. There are twelve poles and there is a diverter in parallel with the interpoles. Resistance connectors are used between the commutator and the armature winding. At 660 revs. per min. (corresponding to 40 km per hr.) each motor develops 525 H.P. continuously, or 645 H.P. for one hour. The maximum speed corresponds to 60 km per hour, but the motors were tested at 75 km per hour. The motor, without pinion, weighs 5 300 kg., or about 8 kg. per H.P. For a single-phase motor this is low, being only 10 per cent. heavier than a 50-cycle,

three-phase motor running at a 10 per cent. higher speed. The use of resistance connectors permits a higher terminal pressure and consequently a lower current, smaller cables and carbon brushes (viz., 18 x 60 mm). The temperature rise of the resistance connectors is about 85° C. when running on 900 A, and about 200° C. when the motor is at rest and traversed by a current of 1 000 A for thirty seconds. These rises are very low, as the resistance material does not melt below 1 400 to 1 500° C.

Auxiliary Services.

There are three additional tapings on the transformer to give 800, 1 000 and 1 200 V for supplying energy for heating the train. The lowest of these corresponds to normal heating.

The lighting circuit for the locomotive is fed at 36 V continuous current from a small 1·5 kW set. To make this independent of voltage fluctuations in the overhead line, the generator works in parallel with a storage battery of 100 Ah capacity.

Test Results.

The weight of the locomotive was found to be—

Mechanical part.....	39 540 kg.
Electrical equipment.....	28 425 kg.
Personnel, sand and oil.....	510 kg.

Total weight in service..... 68 475 kg.

This is about 4 tons less than the permissible weight. The weights per axle were measured and found to be: 9 875, 12 200, 12 375, 12 100, 12 000, 9 925 kg. (total, 48 675 kg.).

The following loads were hauled during the trials:

Section.	Load hauled in tons.	Max. grad. in 1 000.	Max. speed.	
			km. p. hr.	step No.
Spiez-Frutigen.....	288	15·5	36	11
Frutigen-Brigue.....	153·6	27	37	..
Brigue-Goppenstein ..	..	..	38	..
..	..	..	42	12
..	171·6	..	..	..

As will be seen, the speeds exceed by a good margin the guarantees of 35 km per hour. In these tests the temperature rises were measured to be 62° C. in the motors and 28° C. in the transformer. Starting at Blausee, on a gradient of 27 in 1 000 and a curve of 300 m. radius with a load of 153·6 tons, the locomotive took 130 seconds to reach a speed of 38 km. per hr. the maximum current being 135 per cent. of the normal. The locomotive runs smoothly at all speeds, either along straight track or round curves.

Transformer Sub-stations on the Brigue-Sion Railway.

The generating station which has recently been erected at Massaboden, in the Canton of Valais for supplying the Simplon Tunnel, is equipped with two 2 000 kW, three-phase alternators for 3 000 V. The Simplon Tunnel gives a peak load of 2 200 to 2 500 kW with single track working. When the second tunnel is finished, the peak demand will be about 3 500 kW, though the mean load will be about 520 kW only. Thus there is a considerable excess of power which can be provisionally used for traction on other lines. This power is therefore transformed up to 25 000 V and transmitted to the sub-stations at Loeche (Leuk) and Granges on the electrified line Brigue-Sion (Sitten), where it is transformed down to 3 300 V—the three-phase pressure at which this line is worked.

Transformer Sub-stations.

The two sub-stations have been designed with a view to simplicity and reliability. They are built near their respective stations and are supervised by the personnel of the latter. The apparatus containing oil—the main transformers, switches, current transformers, &c.—are on the ground floor, while the various protective devices are on the first floor. The oil switches are erected in separate cells united by a channel along which the oil can be drained off in case of accidental fire. All ordinary switching operations can be carried out in the lower chamber, and it is rarely necessary for the attendants to go on the first floor. The main transformers can be run direct into the building on the special trucks constructed by the Federal Railways for this purpose.

Transformers.

All the sub-stations are equipped with similar 2 000 kVA, three-phase transformers with forced oil cooling—the oil being pumped through an external cooler—Fig. 8. Secondary tapings are provided to compensate for the potential drop in the feeders. To facilitate transport, the transformers run on wheels with standard gauge (1 435 mm). The cooling water for the sub-station at Granges is obtained from the service mains and at Loeche (Leuk) from the River Rhone. The oil is circulated through a cooler by means of a gear pump coupled direct to a three-phase, squirrel-cage motor. In this way a belt drive has been avoided which would not have been so reliable for starting in very cold weather when the oil had become coagulated.

The oil-switches on the primary side are provided with a protective resistance capable of reducing the pressure by 10 per cent. when the magnetising current of the transformer flows through it. When

all this resistance is inserted, the current rush or switching-in is halved. The stations are protected against pressure surges on the high-tension side by three choking coils and by three earthed coils

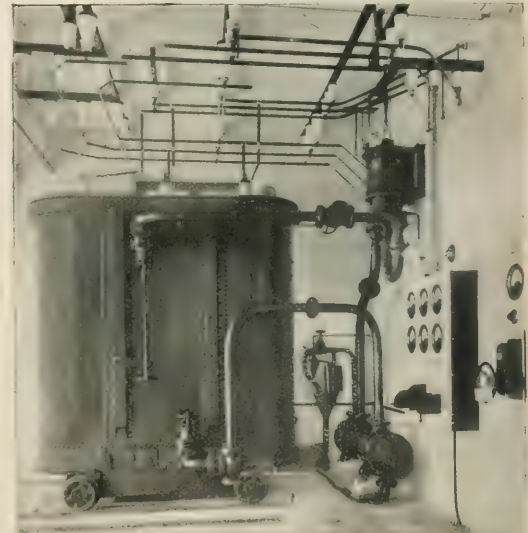


FIG. 8. TRANSFORMER CELL IN SUBSTATION AT LOECHE.

with secondary windings and control voltmeters. Atmospheric discharges are led to earth by lightning arresters with liquid resistances.
(To be concluded.)

Progress of Science.

IN his Presidential Address to the British Association at their opening meeting on Sept. 7, Sir T. Edward Thorpe recalled that the Association owed its origin largely to the interests in science of Scotsmen. Its founder was Sir David Brewster; its scope and character were defined by Principal Forbes. The President proceeded to recall the meetings held in Edinburgh in 1834 and in 1850. Brewster's association with this work was noteworthy for his lofty ideal of the place of science in the intellectual life of a community and his enthusiasm for research. The meeting in Edinburgh in 1871, under the Presidency of Lord Kelvin, was also a memorable occasion. Lord Kelvin likewise emphasised the claims of research and the institution of physical laboratories for experiment, and not merely for teaching purposes. There were, however, signs of progress. The institution of the Cavendish Laboratory at Cambridge was a great achievement, and in the National Physical Laboratory we have now an approach to the ideals outlined in these addresses.

Fifty Years' Progress.

The President recalled that he himself joined the Association at the Edinburgh meeting fifty years ago. During this period great advances had taken place. In pure chemistry the discovery of argon by Rayleigh, of radium by Mme. Curie; of neon, xenon and krypton by Ramsay and Travers; and the discovery of helium, first as a terrestrial element, then as a production from radium, amongst other discoveries, challenged attention. In applied chemistry there had been the application of the Gilchrist-Thomas process of iron-purification, the production of calcium-cyanamide by the Frank-Caro process, Haber's work on ammonia synthesis, &c. In pure physics the period had seen the rise of the electron theory, Hertz's discovery of electromagnetic waves, Lenard's investigation of cathode rays, the elucidation of crystal structure by Bragg. In the practical field the period had seen the invention of the telephone, the establishment of electric incandescent lamps, the electric transmission of force, wireless telegraphy, Röntgen rays—to mention only a few of many achievements. Another development has been the more rapid dissemination of scientific information through the publication of transactions, abstracts, &c. The present high cost of printing is, however, a grave drawback. Turning to the industrial applications of science, the President alluded to the formation of the Department of Scientific and Industrial Research, and the growing recognition that industrial prosperity depends upon scientific discovery and invention. In this connection some particulars were given of recent work of this Department and of the manifold activities of the British Association.

Structure of the Atom.

After this general survey the President turned to the discussion of the molecular theory of matter—a subject which was directly connected with Lord Kelvin's address of fifty years ago. At that time the latest molecular hypothesis was exhibited in the kinetic theory of gases worked out by Joule, Clausius and Maxwell. But it was evident that this was only a preliminary to the ultimate question of the inner mechanism of the atom. A full knowledge of this mechanism must account both for chemical and physical facts. Although Dalton's atomic theory has been accepted for nearly a century, it is only within the last few years that a view of the mechanism of the atom of service alike to physicists and chemists has been reached. The discovery of the electron, the production of helium by radioactive disintegration of atoms, the recognition of the existence of isotopes, the conjecture that all elementary atoms are composed either of helium atoms or atoms of helium and hydrogen, and the further possibility that such atoms are built up of two constituents, one of which is the electron, a particle of negative electricity with a mass $1/1800$ of that of the hydrogen atom, and the other a particle of positive electricity of identical mass—all these are pregnant facts that have completely altered the fundamental aspects of the science. The idea of a primordial "ylé," or of the essential unity of matter, has persisted throughout the ages. The belief has become intensified that some natural law must underlie the fact that determined atomic weights on the oxygen standard are whole numbers. But there has been the further recognition that so-called elements may consist of a mixture of isotopes—substances of identical chemical attributes, but of varying atomic weights. The theory that all elementary atoms are composed of helium atoms, or of helium and hydrogen atoms, appears to be an extension of Prout's hypothesis, but with better experimental justification. The hydrogen isotope, first detected by J. J. Thomson and confirmed by Aston, seems to be

an integral part of atomic structure. It is surmised that it is identical with the hypothetical "nebulium" from which our elements are held by astro-physicists to be originally produced in the stars through hydrogen and helium. Mr. F. W. Aston has succeeded in showing that various elements, for instance, neon, argon, chlorine, fluorine, bromine, &c., are in reality a mixture of isotopes, and this probably applies to other elements.

The properties of the atom will, however, depend not only on its constitution, but on the forces between the electrons and on those between the electrons and the positive charges or protons. (One possible arrangement involves a central proton, with negative electrons arranged around it on the surface of a sphere. The number of electrons that can be accommodated on the outer layer will depend on the force between them and the positive charge. Sir J. J. Thomson has shown that this number will be eight, with a law of force of a simple type. All these results have an important bearing, as offering an explanation of the Periodic Law and the conception of valency, and the President illustrated this by reference to various elements. The oxygen atom, for instance, is believed to have six electrons; it can therefore link up with the electrons of two atoms of hydrogen, and is divalent. The valency of other elements can be similarly explained. Thus the term "atomic weight" has acquired for the chemist a much wider significance. The full study of its properties involves co-operation between the chemist and the physicist. While there are many apparent difficulties, such as the present impossibility of isolating isotopes and their presumed instability, our new knowledge may lead ultimately to a great general simplification.

In the final portion of his address the President referred to the profound effect upon the world of the great struggle through which it had recently passed, and the danger that in future conflicts science, and in particular chemical knowledge, might be applied to warfare on a vaster scale with appalling consequences. He remarked that when nations were at grips and their existence was threatened, there was apparently no limit to the agencies that might be employed to cripple their adversaries. Civilisation protests against this retrograde development, and surely comity among nations should be adequate to arrest it.

Boiler-House Extensions at Wimbledon.

ELECTRICITY supply conditions at Wimbledon, where for the first years of the electricity undertaking's history the load was almost entirely lighting, but where there has since been a continuous increase in the demands for power, have recently necessitated an interesting extension to the steam-raising plant at the station in order to keep pace with the demand which is still mounting up. This new boiler-house plant consists of two Spearing water-tube boilers, which are among the latest of the horizontal tube designs of boilers in which the water circulates from the tubes through the headers to the drums, and which contain a number of other features which will be of interest to our readers. Each boiler installed at Wimbledon has an evaporative capacity of 25 000 lb. per hr. with an overload capacity of 25 per cent. for eight hours. The working pressure is 250 lb. per sq. in. superheat. As will be seen from the illustration, each boiler contains three drums, namely, the main steam and water drum, which is 4 ft. in diameter; the top circulating drum, 3 ft. in diameter; and the bottom reservoir mud drum, 2 ft. 6 in. in diameter.

The Reservoir Mud Drum.

Next to the main steam and water drum the reservoir mud drum is the most vital link in the design of the boiler, combined with the down-comer pipes which connect the main steam and water drum with the reservoir mud drum. The down-comer pipes in this case are of 8 in. internal diameter. The feed water is delivered into the usual type of trough in the main steam and water drum, and by gravity travels down the down-comer pipes into and through the mud drum. The result is that all the water in the boiler must circulate and recirculate during working operation through the mud drum, which thus becomes a real mud collector. In this respect the "Spearing Boiler" differs from most other header types of boilers through the mud boxes of which there is no circulation, the water in them being stagnant, except when the blow-off cock is open. Another purpose served by the reservoir mud drum, which again distinguishes the Spearing from the other header types of boilers, is that the water is supplied to the steam generating tubes in the natural order, and the bottom tubes, which do the greatest proportion of the evaporation, get their water first, and the upper tubes later in the true order of their demand.

Again, the nipples connecting the headers to the bottom reservoir

* Abstract of Presidential Address to the British Association by Sir T. Edward Thorpe, C.B., D.Sc., F.R.S.

drum and the front circulation drum are 4½ in. in diameter, that is to say, having an internal area of about 14 sq. in. Four-inch nipple tubes have about 11 sq. in., so that 4½-in. nipples have about 28 per cent. more area for the inlet and outlet of water and steam

effective grate area in the boiler of approximately 165 sq. ft. The grates are built up of Bennis patent links, with hard joints and corrugated air spaces, and each grate is provided with a totally enclosed change-speed gear-box, which allows six variations in speed, so that travel can be regulated within wide limits. This gearing is made as fool-proof as possible, and means are provided for automatically stopping the grate in the event of jamming. The stokers are driven by a belt through a continuous line shaft running overhead, which shafting is driven from a 10 H.P. Brook motor.

Ash Handling.

An underground system is employed for handling ashes. They fall over the end of the chain-grate stokers on to the radial dumping plates, from which they are dropped when required into capacious hoppers, which are sufficiently large to hold the ashes of about an eight hours' full run. These hoppers can be discharged into an ash truck, which is operated by hand on a light tramway track along the basement floor to an electric hoist at the end of the ash channel. This truck, which is large enough to hold 4 to 5 cwt. of ashes, is then raised to the boiler-house level by the hoist, whence it passes to the tipping platform outside.

This hoist is electrically operated, and is provided with two vertical sliding iron caps, which open and close automatically as the car travels, and with safety devices, which hold the car and load if the rope should break. The motor is fitted with an electro-mechanical brake and with over-winding limit switches. The induced-draught installation consists of a 55-in. diameter Sirocco induced-draught fan made by Messrs. Davidson & Co., of Belfast. This fan is driven by an a.c. three-phase 37 H.P. motor running at 380 revs. per min., at a fixed speed from a Hans Renold double driving chain. The feed pump is of the Worthington-Simpson vertical simplex double-acting piston type, and is capable of

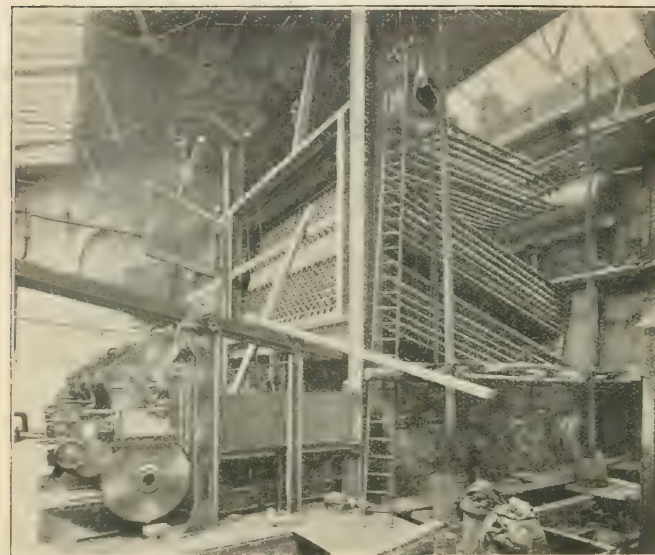


FIG. 1.—SPERING BOILER EQUIPPED WITH "BENNIS" STOKERS (IN COURSE OF ERECTION).

to and from the headers. The circulation through the tubes and headers is thus greatly improved.

A further distinctive feature is that the headers are straight and not sinuous. It is claimed that this also facilitates circulation and that other advantages, such as more uniform thickness in construction and ease in cleaning, are obtained. The front circulation drum also deserves remark. Its value is in steadying the circulation, increasing the thermal storage, and in checking surging at high rates of duty. There is also the advantage that it enables the upper row of tubes connecting the front circular drum to the steam drum to be made steam carriers. These steam tubes also act as steam dryers.

The number of tubes in each boiler is 308, contained in twenty-two sections. The diameter of the tubes is 4 in. and the length 18 ft.

Superheater Details.

The superheater, which is of the well-known Ferguson type, consists of twenty-two complete sections, comprising three mild drawn steel tubes 1½ in. external diameter and 1¼ in. internal diameter. To facilitate repairs and withdrawal for inspection each section of the tubes can be taken out separately. Each set of three superheater tubes is expanded into a 1 sq. in. mild steel plate, the plates being secured to the superheater headers by studs and nuts, and the joints being made by copper and asbestos rings, which we are informed will stand up to 850°F. Each superheater is designed to give 250° superheat at full load.

The coal used at Wimbledon is Midland nutty slack, with induced draught, and to deal with this Bennis chain grate mechanical stokers have been fitted to the boilers. There are two stokers to each boiler, each 6 ft. wide by 13 ft. 9 in. long, giving a total

380 revs. per min., at a fixed speed from a Hans Renold double driving chain. The feed pump is of the Worthington-Simpson vertical simplex double-acting piston type, and is capable of

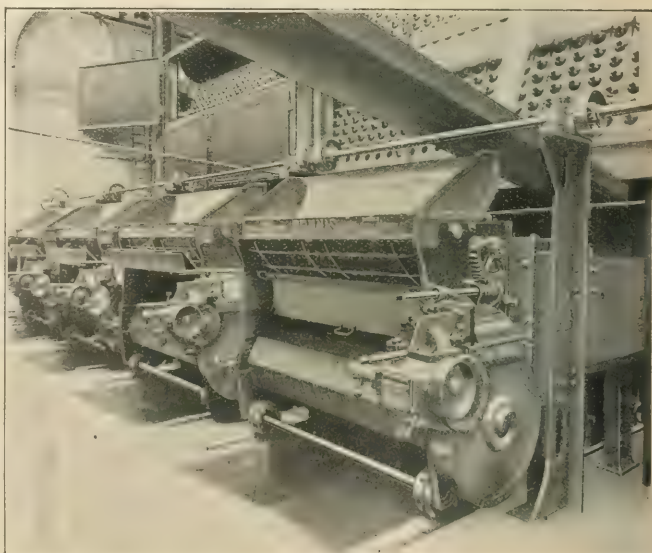


FIG. 2.—"BENNIS" CHAIN GRATE STOKERS APPLIED TO SPERING BOILER.

delivering up to 10 000 gallons of feed water per hr. when working against a boiler pressure of 250 lb. per sq. in. steam having 250°F. superheat.

Railless Traction at York.

The relative advantages and disadvantages of railless cars compared with other systems of road traction is a subject which has long been of great interest in the tramway world. On the one hand, there are those who argue that in these days of high costs the railless car is the only economic method of extending tramway routes, and on the other there are those who equally stoutly maintain that the real solution of the difficulty lies in the bus either operated by electricity or by petrol. Comparing the tramcar and the railless car it may be said that while tramways are distinguished by low working costs their standing charges are high. The motor bus has a high earning power and moderate standing charges with excessive working expenses. Railless cars, it may be admitted, occupy an intermediate position between these two methods, for while their earning power is at least as high as the earning power of the motor bus and their standing charges are



VIEW OF RAILLESS CAR AT YORK, SHOWING "RUNNING ROUND" ARRANGEMENTS, HEWORTH TERMINUS.

lower, their working costs are comparable with the working costs of tramways. In particular cases these relations may, of course, be modified, but with the high prices of petrol and inflated charges for track, both in first cost and maintenance, the position of the railless car has been considerably improved in recent years, especially as experience has shown that the life of the equipment is long, and that on less busy routes it is possible to reduce the labour costs by adopting a "Pay-As-You-Enter" system. To use railless cars is also an advantage where streets are narrow and other physical obstacles have to be overcome, as it is possible in this way to obtain a flexibility quite equal to the motor bus, together with the other advantages we have just detailed.

Some Results from York.

All these considerations led the York Corporation to adopt this system about twelve months ago, when it was necessary to improve the transport facilities between the centre of the city and Heworth. This installation has now been running ten months and we were recently given an opportunity of inspecting it at work. As regards charges, we were informed that the actual operating expenses for ten months' working came out at $11\frac{1}{2}$ d. per car mile, the charge for energy being 2d. per unit. This amount is increased by standing charges, interest, etc., to a total of 1s. 7d. per car mile. This rather high increment is due to the fact that four buses were provided at a time when it was thought that the housing scheme of the city would be much more extensive than it is, or is likely to be at present. The consumption per car mile works out at 1.42 units at the station.

The general appearance of the cars, which were provided by Railless Ltd. in accordance with their usual design, is obvious from the illustration, which shows the running round arrangement at the Heworth terminus. Two complete sets of trolley wires are provided throughout the $1\frac{1}{2}$ mile route, and there is therefore no difficulty when cars meet, while with the 17 ft. trolley arms, provided a turn out of 15 ft. on each side of the centre is possible, the overhead wire being 21 ft. above the road level, there is equally no difficulty about passing other vehicles. The cars which have the exceptionally narrow overall width of 6 ft. 3 in. are of the single deck type and have a seating capacity of twenty-four passengers. There are five seats at the back and two rows of seats

arranged longitudinally. The off-side seating accommodates ten passengers and the near side nine. Each bus is equipped with two 22 h.p. motors, which operate separately on the back wheels, the control being by the usual series parallel arrangement, operating from a 525 V circuit. Two independent brakes are fitted, each being capable of stopping the vehicles at a speed of 20 miles an hour when fully loaded, on a 1 in. 15 gradient. Provision is made for cutting out either motor and working the other motor on the series notches in case of any electrical trouble arising. The trolley arms are of the "railless" patent cam controlled type, and are made of steel suitably insulated and taped, the heads being of specially tough gunmetal.

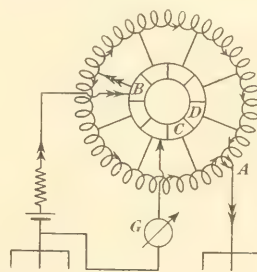
Correspondence.

LOCATING THE POSITION OF EARTHS ON AN ARMATURE. TO THE EDITOR OF THE ELECTRICIAN.

SIR: Should an earth occur on one of the coils of an armature it is very convenient to be able to determine its position without unsoldering the commutator connections: this is especially the case with very small armatures, such as from a fan motor, where the restricted size makes manipulation difficult and the nature of the winding makes it impossible to locate the fault by a method of burning out.

Up to the present the location of such faults in machines has been very little dealt with in books and the knowledge of many useful and simple tests, though known and practised by a few, has not been generally diffused. Having often required an earth location test and having been unable to hear of a method, I lately devised the following simple plan which is very successful in practice. It has, I believe, some claim to novelty, although I have since discovered that there is a test in use which, though quite distinct, does resemble this method.

Suppose an earth has occurred at a perfectly unknown point on the windings, such as at A in the figure. Connect a cell and suitable series resistance to the frame and to any random commutator bar, as at "B," also connect one terminal of a low reading voltmeter or galvanometer to the



frame and, by means of a piece of flex, connect the other terminal to each succeeding commutator bar in turn, starting at "B."

The readings from each bar will steadily decrease as the earth is approached until, when touching C or D, the readings are a minimum, increasing again as the earth is passed. The faulty coil is clearly the one connecting C and D; by comparison of the readings, when connected to these two points, the position of the fault in the coil can be inferred. I am, &c.,

Cambridge, September 5th.

E. B. MOULLIN.

The HARBOUR DREDGE "TACOMA," of the Puget Sound Bridge and Dredging Company, of Seattle, Wash., was recently equipped electrically. The 20 in. centrifugal section pump has been supplied with a new runner, and is coupled direct with a 1 000 h.p. 2 300 V A.C. motor, which has increased its capacity to 1 200 cubic yards of material per hour. A 150 h.p. 440 V motor operates the winding mechanism, and another motor of 75 h.p. the equipment for manipulating the spuds and swinging cables. Electrical energy is supplied to the dredge at 2 300 V from a substation on shore by a submarine cable. A scow attached to the dredge contains a cable reel, on which cable of sufficient length is carried to enable the dredge to operate at varying distances from the shore.

Reviews.

Steam Turbo-Alternator. By L. C. GRANT, A.M.I.E.E. (London: Sir Isaac Pitman & Sons.) Pp. xvi + 260. 15s. net.

The author states that this book is a treatise for "Central Station Engineers and Operators, Designers and Engineering Students." After reading it through it may be conceded that it is a suitable book for station engineers and operators, but it is certainly quite unsuitable for designers and students. It has a distinctly American flavour in that it is full of description of particular turbines and details which are generally very good. As long as the author deals with these and not with any question of theory or opinion, he is on pretty safe ground.

The station engineer and operator takes a prime mover as he finds it, and is not as a rule instructed as to why it has a particular form. The student and designer on the other hand always approach such a subject, and must necessarily so, from the point of view of what it is desired to effect, and then from that to devise the best means of producing the effect. None of this class of knowledge is really contained in this book. Many well-known English terms are used in an entirely different sense. For instance, the word "throat" as applied to a nozzle has a perfectly definite meaning in turbine design, whereas the author uses it as applied to the "entry" of a nozzle.

His remarks touching on theory are generally unorthodox, particularly where he touches on thermodynamics, suggesting that pressure *per se* is a form of energy. Many dogmatic statements are made having an element of truth, but often misleading, which are very irritating to the trained engineer.

The book shows a rather unfair bias against the reaction turbine, and some of the statements are certainly not correct. The illustration of a "strip" is in doubtful taste.

The chapters on turbo-alternators are exceedingly good for giving a rough practical idea, and to sum it up, the book certainly is suitable and interesting to the operator

who has not had an orthodox theoretical training. The illustrations are numerous and good, and the book is well printed.

W. M. SELVEY.

Engineering Electricity. By R. G. HUDSON, S.B. (London: Chapman & Hall, Ltd.) Pp. viii + 190. 13s. 6d. net.

There are 144 pages of reading matter followed by forty pages of photographic reproductions of electrical apparatus, three pages of tables and five pages of index in this book. It is an outline of a course of lectures to technical students (at Massachusetts Institute of Technology) who are not specialising in electrical engineering. The author tells us that the keynote of the instruction is brevity coupled with rigour, in view of the maturity of the students involved. He also states that an important aim of the course is to develop the reasoning power of the student rather than to encourage the accumulation of disconnected facts—a truly laudable aim. It is not our opinion, however, that this aim is realised in this book. It is quite possible that the actual course of which this book is the outline, and which includes recitations after each lecture, and laboratory work may produce the necessary development.

The subject matter is divided into sixteen chapters (averaging nine pages per chapter) thus, direct current circuit; electromagnetism; electromagnetic induction; the D.C. dynamo; D.C. measurement; alternating current circuits; A.C. measurements; three-phase currents; A.C. transmission line; synchronous generator; synchronous motor; synchronous converter; mercury arc rectifier; transformer; induction motor; A.C. series commutation motor.

The forty pages of photographic reproductions consist largely of exterior views—such as are shown in makers' catalogues—and some interiors in which the details are hopelessly unrecognisable. We hope that these reproductions have not been responsible for the high cost of the book. That may be due to the limp cover. We cannot see that the book, separated from its course at Massachusetts, makes any special appeal or fills any special need.

J. PALEY YORKE.

Industrial Research.

The Quarterly Progress Report of the British Electrical and Allied Research Association contains particulars of several important researches which are being conducted. Since the issue of the last report new sections have been formed to deal with certain matters too big for subordinate classification. For instance, the work of the Joint Committee on Dielectric Losses has developed so as to demand independent treatment, and the new section will conduct researches in the fundamental properties of insulating materials. Immediate attention will be given to the question of thermal resistivity. Preliminary tests on fibrous insulating materials revealed wide differences in the manufacture of both treated and untreated fabrics. These are under investigation, with the co-operation of the manufacturers, and the requirements of the users of treated fabrics are also being considered as a basis for the purposes of standardisation. A similar policy is being pursued with treated papers. Draft specifications for fibres and boards are under test prior to publication. Work on composite insulating materials has emphasised the difficulty of dealing with materials of this class, subject to such wide variations in properties. The results of this work are under consideration and methods for bringing them into perspective have been developed. Of the extensive programme of research an insulating porcelain, based on preliminary researches by Messrs. Langton and Harris, much yet remains to be done, including researches on insulating resistance, improvement of surface, dielectric strength and uniformity of vitrification. Two reports by the Committee on mica are being prepared. The first is based on collected data on the use of mica and micanite for commutators, and the second report deals with the use of mica in condensers. A preliminary specification for insulating oils has been drawn up and is in the hands of the British Engineering Standards Association for their consideration. There are extensive researches in hand on thermal transference co-efficients, vapour pressure, thermal conductivity, and the action of catalysts. Samples of oils, subjected to severe arc discharges in oil circuit breakers, have yielded data under the spectroscopic and the ultra-microscope, and these results will be valuable later in developing the research programme.

Conductors and Switchgear.

The researches of the Section on Conductors include further tests on the heating of buried cables and tests on overhead wires. The tests on overhead wires, which involved the provision of special apparatus for testing long lengths under service conditions, are ready.

The Committee on control apparatus has collected valuable data from power plant engineers and others. The voluminous material,

collected from all sources, on the phenomena of switching and arcing has required careful reconsideration before it could be reduced to a *résumé*. Large scale tests, with the practical co-operation of power station engineers, have been arranged. The Newcastle-upon-Tyne Electric Supply Company has promised plant in the autumn for short-circuit tests on existing oil switches and for the general study of the phenomena of circuit breaking.

Tests on mining switchgear have been arranged with the Home Office. These include studies in the magnitude and relief of pressures set up by arcs in switch cases and by gas explosions. The Committee is also collecting data and samples of British standard ordinary-duty fusible cut-outs, preliminary to tests on heavy-duty fuses. Power plant engineers have been invited to co-operate in collecting information and in experimental work on direct-current circuit breakers. A comprehensive programme of researches undertaken on the resistivity of joints and contacts is in hand, and data are being obtained concerning plant under service conditions. Temperature rise is also under consideration. The Committee on corrosion researches is reviewing the phenomena of corrosion, with special reference to the corrosion of condensers.

Two new Committees have been set up to deal with researches in turbines and turbine blading, and to deal with the whole question of the manufacture of insulating materials with a synthetic resin base. The first of these new Committees will co-operate with the Institution of Mechanical Engineers in the research on turbine nozzles which is being carried out at Manchester University.

Industrial Lighting Boxes.

With the extension of electric lighting for industrial purposes, colliery lighting, &c., demands arise for boxes to meet special requirements. Messrs. W. T. HENLEY'S TELEGRAPH WORKS COMPANY, LTD., who have had a long and successful experience in the manufacture of industrial lighting boxes and of all distribution material, have recently designed and placed on the market a new range of Henley boxes for collieries, factories, and warehouses which will meet the demand for reliability, coupled with compactness in design and sound construction.

The range illustrated and described in the company's list is a distinct advance in the standardisation of lighting boxes for underground installations. One cast iron base is used for all boxes in the range, thus reducing the cost appreciably and providing a conveniently adaptable installation. A patent flame-proof and a water-tight cover joint is provided for use in fiery mines, and a rubber cord joint for other situations. The boxes comply fully with the regulations governing the use of electricity in mines and factories, and they can be employed in any indoor or outdoor situation where

it is necessary to install a flame-proof or water-tight service, and where efficiency and simplicity are desiderata.

The boxes set out in the present list are suitable for use with unarmoured or steel wire armoured twin V.I.R. or paper insulated cables up to 7/0/036, having a maximum diameter under armouring of 9/16 in. and an overall diameter of $\frac{3}{4}$ in., the company's larger boxes being described in another list.

The Universal cable gland, which consists of a heavy pressed brass cone and malleable iron armour grip, is fitted to the boxes, and when twin V.I.R. cable is installed, a packing of Henley adhesive tape will enable a box to withstand a hydraulic pressure of 70 lb. per square inch. For lead-covered cables a Henley lead cone bond takes the place of adhesive tape. The gland is also used for

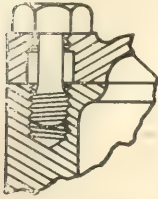


FIG. 1.

wire-armoured cables, the armouring being clamped between the brass cone and the outer grip. All metal parts of the box are in electrical contact with one another, and all parts are standardised and interchangeable. Fig. 1 shows the lid secured by means of

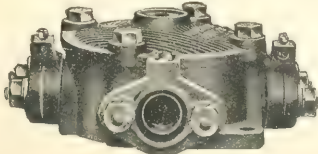


FIG. 2.

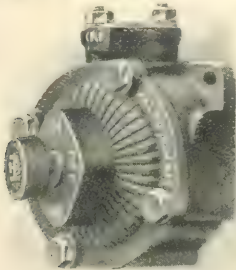


FIG. 3.

four special screws, which cannot fall out accidentally, but may be removed when desired. Fig. 2 is an illustration of a three-way box fitted with cable glands and machined cover, and Fig. 3 is a switch-box, also fitted with cable gland and machined cover.

Electric Traction in France.

Several costly and important schemes are shortly to be undertaken in the BOUCHES-DU-RHONE, the department of France in which Marseilles is situated. Although the projects, with the exception of one relating to waterworks—for which a Bill has been introduced into the Chamber of Deputies—have not passed beyond the preliminary stages, it is understood that they are to be carried through with as little delay as possible. The following summary of the schemes, given at a meeting of a Marseilles society by the chief engineer of the Department, has been forwarded by Mr. Vicars, H.M. Consul-General at Marseilles.

Hydro-Electric Works on the Durance.

The first scheme is for the construction of hydro-electric works on the Durance, and the utilisation of the power generated for the irrigation, by means of water drawn from the Rhone, of the Plain of the Crau, and for the reclaiming, by means of pumping, of the Plain of the Camargue, in the Rhone Delta. This scheme will involve the construction of a small dam on the Durance, from which the water calculated at an average volume of 150 cubic feet per second during the six months of high water, although considerably less during the remainder of the year, will be deflected to a power station at Meyrargues, where it is estimated that an average of 32,000 kW will be generated. After leaving this station the water will be carried by a canal to a second one, situated at St. Christophe, also with a capacity of 32,000 kW. in normal conditions. The power generated at the Meyrargues station will be utilised for pumping water to the arid plain of the Crau and for drawing off the salt water from the adjoining Plain of the Camargue. The St. Christophe power station will, on the other hand, be used to supply electricity to Marseilles and the Department of the Bouches-du-Rhone for various public services, in the proportion of three-fifths

for the town and two-fifths for the Department. Any surplus available will be placed at the disposal of electric light and power companies on certain conditions.

Electrification of Light Railways.

A second scheme projected includes the electrification of the Departmental light railways and the construction of new lines between Salon and Marseilles, and between Martigues and Marseilles, to supplement the existing facilities by ordinary rail.

Waterworks at Fontaine l'Evêque.

The third scheme is for the construction of waterworks at Fontaine l'Evêque (Var), on the River Verdon, a tributary of the Durance, for the purpose of providing Marseilles and Toulon with a constant supply of pure drinking water.

The cost of these schemes is estimated as follows: Power stations on the Durance and laying of power lines, 160,000,000 frs.; works on Crau and Camargue, 36,000,000 frs.; extension and electrification of Departmental railways, 80,000,000 frs.; Fontaine l'Evêque waterworks, 245,000,000 frs.; making a total of 521,000,000 frs. Of this total of 521,000,000 frs.; or £20,840,000, the Department of the Bouches-du-Rhone will have to provide 252,000,000 frs.

A Floating Exhibition.

According to present plans the specially designed Exhibition Ship, "British Industry," will sail from the Thames in the summer of 1923, for the chief ports of the world. She will proceed to the West Coast of South America, and will call at Bahia, Rio de Janeiro, Monte Video, and Buenos Ayres. She will then sail due East to South Africa, calling at Cape Town and Durban, and thence to Australia, where the ports of call will be Fremantle, Adelaide, Hobart, Sydney, and Brisbane. After proceeding to New Zealand and calling at Wellington, Lyttleton, and Auckland, the ship will steer North by way of Fiji to Yokohama, Kobe, Shanghai, and Hong-Kong. Seven days are allowed for docking and repairs at Hong-Kong, and on the 358th day after leaving London the ship is timed to start on her homeward voyage via Manila, Saigon, Singapore, Batavia, Penang, and Rangoon. In India the ports to be visited are Calcutta, Madras, Colombo, Bombay, and Karachi, and on the way home the vessel will make a short stay at Aden, Malta, and Gibraltar.

During the voyage of 18 months' duration, a distance of 43,000 miles will have been covered and 34 important trade centres visited. The table allows for a stay of from a week to a fortnight at each place, showing a total of 346 days during which the Exhibition will be open. This British Trade Ship will be specially constructed for the Exhibition, and every detail of her equipment, from the engines to the fittings and furniture, will itself be an exhibit of British workmanship at its best. She will be as large as a first-class liner, having a gross tonnage of 20,000 tons, and in her internal arrangements will differ from any ship that has ever been floated. There will be eight decks, four of which will be devoted to the Exhibition proper. On the other decks, besides numerous cabins set apart for the trade representatives who will undertake the journey, accommodation will be provided such as few buildings on shore can show. Round a large reception-hall are grouped the principal exhibition offices, an enquiry bureau, a bank, an insurance office, interpreters' offices, telephone exchange, writing-rooms, and cloak-rooms, opening out of the grand entrance hall is a restaurant, capable of seating 500 persons. A reception- and ball-room, with domed roof, extends nearly the whole length of the boat deck. A cinema, which can be used for exhibition purposes and for showing processes of manufacture, will be installed at one end, and at the after end there will be a veranda café. On the shelter bridge, and promenade decks are committee and private reception-rooms, a spacious library, &c.

For many years the idea of equipping a vessel as a floating exhibition of British manufacture to proceed overseas has been mooted, and the promoters of the present scheme realised that the first necessity was to construct a ship specially for the purpose. Therefore they approached Messrs. Swan Hunter and Wigham Richardson, who have produced the design under notice. A company called the British Trade Ship, Ltd., has been formed, with registered offices at 12, Grosvenor Gardens, S.W. 1, and a strong board assembled under the Chairmanship of Earl Grey. Among the directors are the Vice-Chairman, Sir G. B. Hunter (Chairman of Messrs. Swan Hunter, &c.), the Duke of Northumberland, Commander R. W. Day, Major G. P. Denton, Sir Maxwell Hicks, Messrs. J. W. Beaumont Pease, Noel E. Peck, T. E. Thirlaway, and Edmund L. Hill (General Secretary of the Federation of British Industries). It is hoped that the venture will be of the greatest benefit to the export trade of the Empire, and should make a strong appeal to merchants and manufacturers. Arrangements will be made for forwarding fresh samples to meet the ship at any particular spot, so keeping the Exhibition both up-to-date and appropriate to the countries visited. The arrival at each trade centre of the great white ship, "British Industry," will be an event long looked forward to, for at each port reception committees, formed in advance, will make known the advent of the sea-borne Exhibition, prepare lists of important firms and individuals, &c. Fuller details concerning the Floating Exhibition are available at the Shipbuilding, Engineering and Machinery Exhibition at Olympia, which was opened on Wednesday.

New Italian Customs Tariff.

H. M. Consul-General at Milan (Mr. W. A. Churchill) points out that the new ITALIAN CUSTOMS TARIFF, which came into force on July 1 last, does not appear to be generally known or understood by United Kingdom firms. The effect of the high exchange and the high Customs tariff has been to bring imports into Italy from this country, in common with others, to a standstill. Exporters to Italy should, therefore, make careful inquiries as to duties and other points before shipping. The complete new Customs Tariff appeared in the *Board of Trade Journal* of July 21.

Amongst the import duties under the new tariff are the following. The rates are 100 kilograms and the coefficients of increase on the old rates are shown in parentheses: Lamps, chandeliers, candelabra and other lighting apparatus, of copper and its alloys, gilt or silvered, 180 lire (0.5); other than gilt or silvered 112.5 lire (0.5); electric generators and motors, without commutators, weighing more than 5,000 kilograms 60 lire (1), more than 1,000 and up to 5,000 kilograms 70 lire (1), more than 250 and up to 1,000 kilograms 90 lire (1), more than 50 and up to 250 kilograms 120 lire (1), more than 10 and up to 50 kilograms 150 lire (1), up to 10 kilograms 180 lire (1); with commutators weighing more than 3,000 kilograms 70 lire (1), more than 1,000 and up to 3,000 kilograms 80 lire (1), more than 250 and up to 1,000 kilograms 100 lire (1), more than 50 and up to 250 kilograms 140 lire (1), more than 10 and up to 50 kilograms 190 lire (1), up to 10 kilograms 240 lire (1).

Electrical instruments, rheostats, resistances, &c., imported with the electric machines with which they are to work, but separable therefrom, are dutiable separately according to their own classification. Static transformers, weighing more than 3,000 kilograms 70 lire (1), more than 1,000 and up to 3,000 kilograms 80 lire (1), more than 250 and up to 1,000 kilograms 100 lire (1), more than 50 and up to 250 kilograms 140 lire (1), more than 10 and up to 50 kilograms 190 lire (1), up to 10 kilograms 240 lire (1). Electric accumulators, weighing more than 10 kilograms 40 lire (1), more than 1 and up to 10 kilograms 60 lire (1), up to 1 kilogram 80 lire (1); magnetos 650 lire (0.5). Apparatus not specially mentioned, for electrical application, and parts thereof, weighing more than 250 kilograms 80 lire (1), more than 25 and up to 250 kilograms 100 lire (1), more than 5 and up to 25 kilograms 130 lire (1), more than 1 and up to 5 kilograms 160 lire (1), up to 1 kilogram 200 lire (1). Power transmission gear, including shafting, 28 lire (1). Electricity meters 180 lire (0.8). Telegraphic and telephonic apparatus, including switchboards for telephone exchanges, 180 lire (0.5).

Electric clocks and watches and movements of electric clocks follow the classification of apparatus not specially mentioned for the application of electricity.

Tramway vehicles: With motors 44 lire (1), trailers for passengers, upholstered 44 lire (1), not upholstered 40 lire (1), other 34 lire (1). Insulators for electrical purposes, of glass, even if combined with other materials, weighing more than 1 kilogram 52.5 lire (0.5), more than 500 grammes and up to 1 kilogram 60 lire (0.5), more than 100 and up to 500 grammes 75 lire (0.5), up to 100 grammes 97.5 (0.5).

Business Items, &c.

THE IRONCLAD SWITCHGEAR CO., LTD., announce that they have considerably reduced their prices.

MESSRS. BAXENDALE AND CO., of Edinburgh, have removed from 3, St. Andrew's-square, to Grassmarket. Their telephone number is unchanged.

MESSRS. CHARLES CHURCHILL AND CO., of Leonard-street, E.C., have been appointed sole agents for Great Britain for the National Acme Company, of Cleveland, Ohio, U.S.A., manufacturers of Grindley automatics, Acme automatics, &c.

MR. C. B. MAURICE has joined the board of directors of Messrs. Catchpole and Maurice, Ltd. Mr. Maurice will continue to act as the London agent for Messrs. Cranmore and Co., Ltd., Birmingham, and Messrs. W. H. Cheadle and Waltho, Ltd., Wolverhampton.

MESSRS. NOEL B. ROSHER & FRANK J. MOFFETT, consulting engineers, Union Chambers, Temple Row, Birmingham, have dissolved partnership. Mr. Rosher has retired from active partnership, but retains an active interest in the firm. Mr. Moffett is continuing the work of the firm on the same lines as heretofore, the firm retaining its original title.

THE MILNS ELECTRICAL COMPANY, 17, Whitefriars-street, E.C. 4, have been appointed by Messrs. G. Meidinger & Co. (Basle, Switzerland) as their sole selling agents for Great Britain and the Colonies. Messrs. G. Meidinger's manufactures include a.c. and d.c. motors up to about 300 H.P., dynamos and alternators, motor generators, loom motors, forge blowers, and all classes of blowers for general ventilation, dust removing, &c., turbo-compressors, transformers, starting and control gear.

The staff and employees of MESSRS. J. H. TUCKER & CO., LTD., Tulseley, Birmingham, held their 16th annual outing on Saturday, last. The party went by train to Evesham, and the usual sporting events took place in the morning, after which dinner was provided in the Town Hall. The after-dinner speeches included a vote of thanks to the Directors and the Sports and Recreation Committee by Mr. G. Scrivenier. This was supported by Mr. S. R. Davies. Mr. J. B. Tucker replied on behalf of the Directors. Mrs. J. H. Tucker then distributed the prizes to the winners of the various sporting events. The afternoon was spent either on the river or in the meadows, according to personal tastes. Tea was served at the Granville Hotel.

Institution Notes.

The second dinner of the INSTITUTE OF TRANSPORT, which was originally fixed for April 26, will be held at the Hotel Cecil on the 10th prox.

Dr. J. E. Stead, president of the IRON AND STEEL INSTITUTE, has been forbidden by his doctor to attend the autumn meetings of the Institute in Paris.

At the request of the UNION OF INTERNATIONAL ASSOCIATIONS the League of Nations has appointed a commission to study questions relating to the organisations of brain workers.

Members of the MIDLAND BRANCH OF THE ASSOCIATION OF MINING ELECTRICAL ENGINEERS recently visited the Witton works of the General Electric Company, and witnessed the various processes in the manufacture of dynamos and motors for the electrification of towns, railways, harbours, mines, etc., and the special work being done for home and foreign Governments. The visitors were entertained to luncheon at the Imperial Hotel, Birmingham, at which Mr. T. Evan Davies, general manager of the Witton Works, presided, and those present included Messrs. F. R. Unwin and W. W. Wood (officials), H. Jennings and T. H. Greaves (Nottingham representatives), A. W. Williams (Nottingham) and E. R. Hudson (Ilkeston), president and secretary respectively of the Midland branch of the Association of Mining Electrical Engineers.

MR. E. E. HOADLEY, M.I.E.E., Engineer and Manager of the Corporation Electricity Supply Undertaking at Maidstone, has been appointed hon. secretary of the ELECTRIC VEHICLE COMMITTEE in succession to Mr. F. Ayton, M.I.E.E., who has held the position since the Committee's inception, and who resigned upon his appointment as joint managing director of Messrs. Ransomes, Sims & Jefferies, Ltd. Upon severing his connection with municipal work Mr. Ayton ceased to be a representative of the I.M.E.A. on the Committee, and accordingly, at the last meeting of the Committee, he was elected a member in his personal capacity, and re-elected Chairman for the year ending March 31 next. All communications in connection with the Electric Vehicle Committee and its work should in future be addressed to Mr. E. E. Hoadley, Electricity Works, Maidstone, Kent.

With the return to more normal conditions the LONDON STUDENTS' SECTION of the I.E.E. has had a very active session. There have been eleven general meetings and the annual general meeting, held at various technical colleges in London. The average attendance at the meetings was thirty-nine, the highest recorded being seventy-five. The opening address to the Section was delivered by Mr. C. C. Paterson, O.B.E., on Nov. 19, 1920, at the City and Guilds (Eng.) College, South Kensington. The address was on "The Incandescent Electric Lamp from the Inside."

By the invitation of the Graduates' Association of the Institution of Mechanical Engineers, two joint meetings of the London Students' Sections were held on Nov. 8 and Dec. 3 respectively. A summer tour of the Glasgow district at the end of July proved a great success. The award of premiums for this Session has not yet been made. On the occasion of the visit to the works of Messrs. Everett, Edgcombe & Co., on Feb. 11 last, Major Edgcombe kindly offered two prizes for the best description of the works; the first prize (value £2 2s.) was awarded to Mr. H. S. Petch and the second prize (value £1 1s.) was awarded to Mr. F. La Budgett. The Council have consented to make a grant to the London Students' Section to cover the expenses of publishing advance abstracts of students' papers for distribution to students before or at the meetings. It is proposed to form a sub-committee to review students' papers and select those suitable for publication in abstract.

Legal Intelligence.

Lavery v. Glasgow Corporation.

On the appeal, the Sheriff of Lanarkshire (Mr. A. O. M. Mackenzie, K.C.) has reversed the decision of Sheriff-substitute Thomson in the action brought by Mr. Alex. Lavery against Glasgow Corporation for £52 damages for injuries caused while boarding a tramway car. Pursuer alleged that he had only one foot on the lower step of the car when, without warning, the car suddenly started with a jerk and he lost his footing and was dragged some considerable distance before the driver pulled up. He alleged the accident was caused by the negligence of defendants' servants in starting the car without taking proper care to see that passengers were first safely on the car.

In his judgment, the Sheriff states that the obligation of defendants' servants to give time to intending passengers to get safely on board cars did not arise until an indication to board a car had been given, and it was common knowledge that it was the duty of drivers of trams to stop for taking up or setting down passengers. Every post which marked a stopping station bore the words "All cars stop here," or "Cars stop here if required." Intending passengers, therefore, must be taken to know that they were not invited to board cars while they were still in motion, and if a passenger did that it appeared to him that he did it at his own peril. Therefore, he inclined to the view that the pursuer had failed to show that the accident which he met with was due to fault on the part of the driver; and pursuer was also guilty of contributory negligence, as his act in boarding the car while in motion contributed directly to the accident. The action was, therefore, dismissed with costs.

Electricity Supply.

SWINDON electricity undertaking made a profit of £6 600 last year.

IPSWICH Electricity Supply Department has acquired the Corn Exchange Chambers for use as a showroom for electric fittings.

MAIDSTONE Corporation has applied for a loan of £5 135 to cover the excess on the estimated cost of new plant for the electricity works.

SOUTHPORT Electricity Committee has been authorised to take steps to dispose immediately of some of the present show-room stock, much of which is stated to be out of date.

WAKEFIELD CORPORATION is applying for a Special Order to authorise the extension of its electricity supply area, so as to include a portion of Lupset in the Wakefield Rural District.

TONBRIDGE electricity undertaking during the past year, after paying interest on capital and providing for sinking fund, together amounting to £4 015, have a balance in hand of £270.

REIGATE Council has revised the charges for electricity for heating, cooking, and power, and from this month's reading of the meters the charge will be 6d. per unit heating and cooking, and 4d. for power.

A public inquiry was held at AYLESBURY last week into the application of the Corporation for sanction to borrow £27 632 for extensions of the electric generating plant, and £4 500 for services and mains.

In order to deal with the winter load two 1 260 h.p. Diesel engines which were formerly in the German submarine U 63 are now being erected at YORK. This course has been taken on the score of economy and to save floor space.

ABERAYRON Urban Council has decided to engage an electrical engineer to report on an electric supply scheme. Mr. Eric Richards, of Lampeter, has purchased Llyswen mill for the purpose of generating electricity in the town.

The renewed application of the ISLE OF WIGHT Electric Light Company for power to raise the charge for electricity supplied to Carisbrooke and Northwood to 1s. per unit, will be opposed by the local authority, on the ground that the price of coal and other stores has decreased.

HEXHAM Urban Council recently protested against the proposal of the Hexham and District Electric Supply Company to employ overhead wires on wooden poles, and the Electricity Commissioners, when appealed to, refused to hold a local inquiry, and sanctioned the work. By six votes to four the Council adhere to their resolution sanctioning the erection of steel poles only.

The proposal to utilise water power at Loch Doon for generating electricity for AVR is being severely criticised by the ratepayers. One critic thinks that there is no need to go so far afield as Loch Doon, and suggests that harnessing the tides in the harbour would involve infinitely less cost. A London engineer might, he suggests, be engaged to report on the matter.

The Ministry of Transport has informed WALMER Urban Council that it has deferred consideration of the question of revoking the electric supply powers of the local gas company for the year, but if, at the expiration of this period, no active steps have been taken to establish electric supply, the Minister will at once proceed to consider the question of revoking the powers.

WREXHAM Town Council held another meeting last week to discuss the position of the electricity undertaking. The Dolgarrog scheme was discussed at length, and it was decided to refer the whole question to a special meeting of the Council. In a discussion on the general position of the undertaking, Alderman Hughes explained that recent readjustments of staff and other economies would effect a saving of £772 per annum.

BARNARD CASTLE, MICKLETON, and ROMALD KIRK Councils have agreed to pay their share of 100 guineas for a report by Messrs. Vickers, Ltd., on a scheme for generating electricity by water power on the Tees. In the event of the contract being secured by Messrs. Vickers the fee will be returned. At the recent meeting it was decided to inform other local authorities of this decision, and to ask them to co-operate in sharing the cost.

An inspector of the Ministry of Transport held a public inquiry last week with reference to the application which is being made by the CHIPPING NORTON ELECTRIC SUPPLY COMPANY for authority to enable them to increase the maximum price charged for electricity for lighting purposes from 1s. to 1s. 3d. per unit, with 7d. per unit for power. The company stated that for the time being they did not propose to increase the charge beyond 1s. 2d.

BLACKBURN Corporation has approved a scheme for the supply of electricity to the districts of Rishton, Great Harwood, Wiltshire, Clayton-le-Dale, and Ramsgrave, and has authorised an application to the Electricity Commissioners for a Special Order for power to give a supply in these districts, and also for authority to sell electric

fittings and apparatus. Alderman Kenyon, who protested against the inclusion of the latter part, was informed by the Town Clerk that similar powers had been possessed by the Council over twenty years.

The proposal to form a joint electricity authority for the MID-LANCAIRE ELECTRICITY DISTRICT will probably be postponed. It was proposed to erect three capital stations to cover the districts of Blackburn, Blackpool, Burnley, Preston, Accrington, Bacup, Colne, Darwen, Haslingden, Nelson, Lytham, St. Annes, Fleetwood, Rawtenstall, and Brierfield. At a conference on Monday it was, however, decided to postpone the scheme *sine die* in view of the heavy financial obligations involved. Our correspondent was informed that, though this does not amount to actual abandonment, the proposal is not likely to be put into operation for some time.

After hearing the reports of their representatives at a conference of local authorities regarding reorganisation of supply in the North-East Midlands Electricity District, LINDBSEY County Council supported the following resolutions passed at the gathering:—(1) That in view of the incomplete state of legislation concerning electricity, this conference is of opinion that the holding of an inquiry into any scheme for the constitution of a Joint Electricity Authority for the North-East Midlands Electricity District would be premature. (2) That this conference recommends that the provisions of Section 19 of the Electricity (Supply) Act, 1919, be exercised in the proposed electricity district to meet any emergency.

At a meeting of RAWTENSTALL TOWN Council it was stated that during the past year great extensions of plant and mains had been carried out by the Electricity Department, and were still being carried out. One firm of local contractors had been paid £20 545, and another £1 564. The generating plant cost £58 549, and included a 5 000 kW turbo-alternator, a boiler, cooling tower, wet air filter, and a 500 kW rotary converter. To meet this expenditure a sum of £51 570 has been borrowed at 6½ per cent, making the total loans, &c., £155 000. It is hoped that when the extensions are complete the Corporation will be in a position to supply all mills, workshops, &c., with electric power, and all dwellings with light at a cheap rate.

The Ministry of Health has issued its decisions on the applications of the LEEDS and BRADFORD CORPORATIONS for EXTENSIONS of THEIR RESPECTIVE AREAS. The whole of Horsforth Urban District and part of Rothwell Urban District, together with some adjoining parishes, have been added to Leeds. The Urban Districts of Shipley, Baildon, and Clayton have been added to Bradford, and the Borough of Pudsey and the Urban Districts of Farsley, Calverley, Rawden, and Yeadon are to be divided between the two Corporations. Electricity supply is given in, or electric lighting powers have been granted for most of the added areas, but no doubt the Corporations will co-ordinate the supply if the extension orders are sanctioned by Act of Parliament.

At the monthly meeting of the BELFAST City Council on the 1st inst., Councillor Sir James Johnston, in proposing the adoption of the minutes of the Electricity Committee, said that a report had been received from the consulting engineers, Messrs. Preece, Cardew & Rider, but the Committee had not had time to examine it. A special meeting of the Council in Committee would be held on the 22nd inst. for the purpose of discussing the whole question. The ordering of switchgear had been referred back, and the Committee had decided to re-advertise the contract. Subsequently, Councillor T. E. Alexander moved a resolution, that, in view of the grave state of the city electricity undertaking, the Corporation dispenses with the services of their consultants, and that the opinion of counsel be taken as to their responsibility and the responsibility of Sir John Snell in the matter. Various appeals were made to Councillor Alexander to postpone the motion, but he declined to do so. The councillor reviewed the position fully, and after a lively discussion the question was referred to a special committee meeting, which will be held on the 22nd inst.

At a recent meeting of the GREYFRIARS WARD COMMITTEE, ABERDEEN, Councillor Gibb, convener of the Electricity Committee of the Town Council since 1910, said the income of the department for the year was about £175 000, whereas in 1910 it was £45 000. The total capacity of generating plant was 16 500 kW, compared with 4 649 kW eleven years ago, and the maximum load on the station last year was 10 923 kW; in 1910 it was 3 218 kW. The total capital expenditure on the undertaking now amounted to about £700 000, on which approximately £265 000 has been repaid. In 1911 the capital expenditure was £368 000. There had been connected to the mains during the year 1 566 h.p. of motors, which made a total of 22 410 h.p. of motors connected to the department's supply. Eleven years ago the department sold for power purposes one and a third million units per annum, and for the year just closed it had sold approximately 12 million units for industrial power purposes. The Ferryhill generating station was now filled with plant to its utmost capacity, and extensions would be an absolute necessity in the near future. Parliamentary powers had been obtained for the construction of a railway for the transport of coal from the railway station to the Ferryhill works, and for the acquisition of the land required for extensions in Dee Village-road, which it was proposed to close up and build over. It was not proposed to carry out those works immediately. It was hoped that in the not too far distant future they would be able to reduce their price for electricity.

Electric Traction.

SWINDON Corporation tramways were run at a loss of £1 512 last year.

The MUNICIPAL TRAMWAYS ASSOCIATION propose to take action with a view to giving power to local authorities to run motor omnibuses in connection with tramways.

About 250 men, mostly ex-Service men, engaged in relaying the BELFAST tramway track, went on strike last week on being notified that on Sept. 1 their wages would be reduced from 1s. 4d. to 1s. 2d. per hour.

WALLASEY Tramway returns for July show a decrease of 1 541 in the number of passengers carried, as compared with the same period last year. Owing to the increased fares, however, the receipts amounted to £14 281 against £12 285.

The scheme put forward some six months ago for running trackless trams in the North Ward of MAIDSTONE has been definitely abandoned, and the Light Railway Committee recommend the purchase of four motor 'buses instead.

Mr. A. R. Fearnley has visited BLACKBURN in order to examine the tramway undertaking, and to make suggestions for extending the system or providing for motor-omnibus routes. The monthly return of the tramways shows a decrease of 230 385 passengers, a reduction of 13 501 in car-miles, a decrease of £1 729 in expenses, and an increase of £199 in receipts.

A tramway siding is to be constructed at the south end of the wholesale market at BRADFORD, to serve as a terminus for the Daubhill and Dean route, in order to relieve the congestion of traffic in Great Moor-street. In their next Bill it is proposed that BRADFORD Corporation should apply for powers to carry coal and goods on the municipal tramways.

MR. JAMES SOUTHWORTH, of WIGAN, an engine driver on the Lancashire and Yorkshire Railway, has invented and patented a new system of sanding rails to prevent locomotives and other railway and tramway vehicles slipping. Successful tests have been carried out on an engine fitted with the invention at the Wigan sheds of the Lancashire and Yorkshire Railway.

RAWTHENSTALL tramways for the past year show a deficit of £1 861. The credit account shows a balance of £3 239 5s., but there are accounts owing to the value of £5 100 8s. 1d. The uniforms for the tramway service cost £1 097 16s. 1d., and the office staff, exclusive of manager, £841 11s. 7d. The accounts thus show that, though £1 500 have been taken from rates, there is still a loss of £1 861.

At the monthly meeting of ASHTON-UNDER-LYNE Joint Tramways and Electricity Committee, the question of granting free passes to a number of blind people in the town was considered, at the request of the Hyde Branch of the National League of the Blind. On account of the difficulty with regard to insurance that such a privilege would entail, the Board found it impossible to comply with the request.

The following UNDERGROUND STATIONS, which have hitherto been closed on Sundays, are now open from about 9.30 a.m. onwards:—St. Mary's, West Brompton, Park Royal, South Acton, Gillespie-road, Down-street, South Kentish Town, Chancery-lane, Clapham-road, Kennington, and City-road. The following, which have remained closed until 3 p.m. on Sundays, now open at 9.30 a.m.:—Maida Vale, Caledonian-road, Goodge-street.

A mass meeting of SALFORD tramway men is to be held to-morrow (Saturday) to decide the course of action to be taken in regard to the 21 inspectors who have seceded from the United Vehicle Workers Union. The men have already in a ballot decided by an overwhelming majority in favour of withdrawing their labour if the inspectors persist in remaining outside the union. The national executive of the union has intimated that it will support them in whatever they may decide to do.

As a result of a conference between Mr. J. M. McElroy, general manager of the MANCHESTER TRAMWAYS, and officials of the United Vehicle Workers' Union, to which the tramworkers belong, it is hoped to avoid the dismissal of thirty car cleaners who for reasons of economy had been given notice. The date of expiration of their notice has been suspended while the cleaners are considering a suggestion from the general manager that as a body they should work shorter hours in order to enable the men threatened with dismissal to be kept on.

Two lines of motor 'buses are already run in connection with the Huddersfield Tramways to the outlying industrial villages, and Parliamentary powers have been obtained for six other lines. It is proposed to use two types of car, a heavy vehicle for rush hours and a much lighter one for the slack periods. In this connection tests are being carried out with a new type of car called the Wallace-Pullman. This car, which runs on giant pneumatic tyres, weighs only about two and a half tons, and will give, it is claimed, 14 miles run per gallon of petrol as against four miles per gallon on the big cars. The cost is estimated to be about two-thirds, or less, of the larger type.

The *in situ* method of reducing the wear on the tread of tramway rails, although successful in various towns, has been proved ineffective in London, especially at car stopping places where it is most needed. The reason for this is said to be that the LONDON COUNTY COUNCIL tramways, unlike most others in the country, use the

magnetic track brake as a service brake. In other towns if a track brake is employed it is only employed as an emergency brake. With a very frequent service of cars, the regular use of the track brake at stopping places, the rail tread becomes heated to such an extent that the metal loses the special hardness imparted to it by the *in situ* tempering.

GLASGOW Corporation Tramways Committee have agreed to recommend that certain omnibus routes be included in the Provisional Order to be promoted in the coming session of Parliament. In connection with the proposed extension from Baillieston to Coatbridge, the Committee have also agreed to recommend, as suggested by the general manager of the tramways, that a light railway, 22 ft. in width, be constructed at the south side of the existing roadway, at an estimated cost of £140 000. General approval has been given to the proposal to provide tramway facilities in connection with the new housing scheme at Mosspark. This will involve an extension of the system from the present terminus at Dumbreck to a suitable point at Mosspark.

Personal and Appointments.

Congratulations to CAPTAIN WEDGWOOD BENN and MRS. BENN on the birth of a son and heir on the 5th inst.

COMMANDER H. E. H. SPENCER-COOPER, M.V.C., has been appointed to the light cruiser "Raleigh," flagship of the North America and West Indies Station, for wireless duties.

Mr. A. P. RUTHERFORD, late burgh electrical engineer of Leith, has been awarded £4 000 for loss of office on amalgamation of the burgh with Edinburgh. Edinburgh Corporation only offered £1 500.

MR. CHAS. MALLINS, late general manager of the Liverpool Corporation tramway and motor omnibus services, has consented to join the board of the Samuelson Transport Company, Ltd., after allotment.

McGill University has conferred the degree of Doctor of Law on SIR WILLIAM POPE, Professor of Chemistry at Cambridge, who opened the convention of the Society for Chemical Research, now being held in Montreal.

Mr. W. M. MILNES, chief assistant engineer of the Coventry Corporation Tramways, who is leaving to become general manager of the Corporation Tramways at Wigan, has been presented by the staff with a silver fruit dish, rose bowl, and *attache case*.

Mr. WILLIAM WALKER, C.B.E., Director of Health and Safety in the Mines Department of the Home Office, has retired under the age limit. Mr. Walker acted as Chairman of the Miners' Safety Lamps Committee and the Mine Rescue Apparatus Research Committee.

Mr. F. AYTON, M.I.E.E., at present Chief Engineer and Manager of the Corporation Electric Supply and Tramways at Ipswich, is taking up his new position with Messrs. Ransomes, Sims, & Jefferies, Ltd., on the 14th inst., after which all communications should be addressed to him at Orwell Works, Ipswich. On and after the date mentioned communications relating to the business of the Corporation Electric Supply and Tramways Departments should be addressed to the new Chief Engineer and Manager, Mr. A. S. Black, M.I.E.E.

In connection with the British Association Meeting in Edinburgh, the Senatus Academicus of the University will confer the HONORARY DEGREE OF DOCTOR OF LAWS upon the following:—Prof. S. Arrhenius, Director of the Physico-Chemical Department of the Nobel Institute in Stockholm; Sir Oliver Lodge, late Principal of the University of Birmingham; Sir Edward Thorpe, President of the British Association; Professor Volterra, Professor of Mathematical Physics at Rome; and Professor R. W. Wood, Professor of Experimental Physics in Johns Hopkins University, Baltimore.

THE FOLLOWING OFFICERS of the Electric Lights Companies Fortress Engineers (Territorial Force) have retired under the age limit rule: Captain P. Thompson (who retains his rank), Dundee Engineers; Lieutenant T. T. Richards (who has been given the rank of captain), Cinque Ports Engineers; Lieutenant A. B. Gregson (who retains his rank), and Lancashire Fortress Engineers. Lieutenant J. Clark, and Lieutenant H. J. Waller, London Electrical Engineers, have also retired, and retain their rank. The vacancy for a captain in the Electric Lights Company, Lancashire Fortress Engineers, has been filled by the promotion of Lieutenant J. L. Gibbs.

Obituary.

The death is announced of Mr. L. B. SCHLESINGER, Chairman of the National Electric Construction Company and its subsidiary companies.

We regret to announce the death, at Bristol last week, of SIR FRANCIS W. T. BRAIN, the well-known mining engineer, and pioneer of the use of electricity in mines, particularly for blasting.

We regret to record the death of Mr. VICTOR E. JOYCE, Works Manager and also a Director of Park Royal Engineering Works, Ltd. On his return from his holidays Mr. Joyce was taken ill with blood poisoning, and died within a week. The funeral took place at Ealing on the 3rd inst., and was attended by a large number of the staff.

Overseas Notes.

The TORONTO Street Tramways have been acquired by the Municipal Council.

COOLAMON (N.S.W.) Council is obtaining a report on the desirability of establishing electricity works.

The first of six new electric cranes on order for wharftide use has been delivered to DURBAN Harbour authorities.

Tenders for an automatic telephone exchange for JOHANNESBURG are being considered, and it is expected that an English company will get the contract.

It is stated that the MADRAS Corporation intends to invite the public to subscribe for a loan of 2 500 000 rupees (£156 250) for electric lighting, water supply and other purposes.

A recent statement shows that the working of the MELBOURNE (Victoria) municipal electricity undertaking for the five months ended May 31 shows a net deficit of £338, compared with a profit of £13 885 for the corresponding months of last year.

Messrs. Cadbury Brothers' new chocolate factory at CLAREMONT, near Hobart (Tasmania), is expected to be ready for working by November next. The permanent electric plant for lighting and for working machinery and lifts is now due for delivery.

An electrical generating plant has been installed for supplying current in BLACKHALL (Queensland). The works contain a 70 H.P. Kynoch steam engine, a 100 H.P. gas producer, a 36 k.W. Siemens generator, and a 380 Ah battery. The supply is d.c. 240 V.

It was reported recently that anxiety was being felt in LAUNCESTON (Tasmania) in consequence of the delay that has taken place in the delivery of a new 750 k.W. set required for meeting the winter demand for electrical energy. The existing plant has been loaded to its full capacity at times of peak load.

The Imperial authorities had decided to discontinue the working of the wireless station erected during the war at ROSE BELLE, in MATRITUS, but as a result of representations by the commercial community it is believed that the decision may be reconsidered, provided that the local Government assume financial responsibility for the station.

A company in ONTARIO, who manufacture and deal in power-plant equipment, will represent United Kingdom manufacturers of steam or electric power-plant machine specialities and mechanical goods. Particulars may be obtained from the Canadian Government Trade Commissioner's Office, Portland House, 73, Basinghall-street, E.C. 2.

Under the new scheme for the redistribution of portfolios in the GOVERNMENT OF INDIA, the administration of the Posts and Telegraphs, Aviation and Telephones will be controlled by the Public Works, Stamps by the Commerce, the Peace Treaty and Clearing House by the Legislative Departments. The Railway Committee recommend, however, that Posts and Telegraphs should, with the railways, be under the control of a proposed Member for Communications.

A manufacturers' representative established at WELLINGTON is desirous of obtaining the representation for the whole of NEW ZEALAND of United Kingdom manufacturers of electrical generating plant, transformers, pelton wheels for hydro-electrical installation, switches, switchboards, insulators, electrical accessories, electrical travelling cranes, copper cable, electrical lamps, constructional steel work, bridges, etc. Reference No. 176. Particulars from the Department of Overseas Trade.

The State Government has recently been approached in regard to the raising of capital for re-starting the CARBIDE WORKS AT ELECTRONA, near Hobart (Tasmania). The company owning the works proposes to issue £140 000 short-dated 8 per cent. debentures, and has asked the Government to subscribe for a portion of the issue and guarantee principal and interest, the Government to have the right to acquire all the assets covered by the debenture deed if the company fail in regard to payment of interest or redemption. The assets comprise carbide and electrode factories, lands, limestone quarries, &c.

In order to encourage the use of electric foundries in BRAZIL, the Chamber is considering granting a subsidy of 200 contos of reis (£10 000) to each of the first three electric foundries to be established in Brazil.

According to the Dutch Consul at Zurich, SWISS GLOW-LAMP MAKERS and electrical contractors are suffering from an increased scarcity of orders, and makers of porcelain for electrical purposes have been compelled further to reduce their production.

According to the Westphalian newspapers, the new TRUST FORMED BY KRUPP'S, the General Electricity Company, the Rhenish Metal-works and the Wolf Company has further plans, which include the absorption of four new coal and engineering concerns, thus making the trust equal in magnitude to the Stinnes' electro-mining concern.

The improvement and extension of railways in the FRENCH ZONE OF MOROCCO is shortly to be undertaken. The question of the electrification of the railway system is under consideration, but to

begin with it is stated that motive power will be supplied by steam locomotives. If the indications of a Moroccan oilfield are proved correct, oil-burning engines will probably be used.

It is reported that in connection with the operation of HIGH TENSION ELECTRICITY UNDERTAKINGS in Switzerland in 1920 there were 80 accidents, compared with 53 in the previous year. Of the 83 persons involved, 25 were members of the engineering staff and 33 were engaged in installation work. There were 41 deaths (against 29 in 1919), including 27 from touching parts of apparatus under high tension and 14 under low tension.

It is reported that the Municipality of VIENNA has concluded an agreement with a company, in which all the great Viennese bankers will participate, for the supply of electrical energy to the capital by means of water power obtained from the river Ybbe. Plans for the preliminary work, which will start in October and must be completed by June, 1926, have been approved. It is anticipated that the scheme will cost 10 000 000 000 crowns.

It is reported that the dispute between the UNITED STATES AND JAPAN over the YAP-GUAM SUBMARINE CABLE will probably be settled on the following terms: The United States will receive full control of the Yap-Guam cable, including the landing at the Yap end. The United States will recognise the Japanese mandate over the island. The control of the cable from Yap to the Dutch island of Menado will be arranged between Japan and the Netherlands Government.

It is reported that GERMAN TRADE CONDITIONS continue to improve, and certain industries are very busy, including the engineering, textile and paper and printing trades. The railway rolling stock works have received large foreign orders, and the electrical companies are also enjoying a boom, which is mainly due to foreign buying. The Electrical Foreign Trade Board has found it necessary to issue a warning declaring that the heavy fall in the mark has stimulated exports. German exporters are therefore recommended to put up their mark prices to foreigners or to insist on invoicing in the buyers' currency.

The AMALGAMATION OF ELECTRICAL COMPANIES continues to be the order of the day in Germany. The Ostpreussen Aktien Gesellschaft, which was recently formed to take over the undertakings of the Ueberlandzentrale Ostpreussen A.G. and the Ostpreussische Kraftwerke A.G., has increased its capital to 150 000 000 marks, and the German Republic, Prussia, and the province of East Prussia have each taken one-third of the shares. In addition, loans (without interest) of 50 000 000 marks will be made to the company by the Republic and 25 000 000 marks by Prussia.

The BELGIAN MINISTER OF PUBLIC WORKS calls attention to the fact that tenders for contracts are frequently accepted in the interests of the Treasury, despite the fact that they deviate from the prescriptions laid down in the specification in respect of the materials to be used, and states that in future a clause will be inserted in specifications to the effect that any tender sent in by contracting parties which does not conform with the prescription of the specification will be considered null and void. If irregular tenders are submitted despite this warning, it will be permissible to make use of them in the examination of similar undertakings.

To the list of high-voltage, direct-current railway electrifications already in successful operation is soon to be added the Paulista Railway of BRAZIL. The substitution of electricity for steam as motive power on this road is, it is stated, being made first on the division between Jundiá and Campinas, a double-track section 45 kiloms. (28 miles) in length. However, the immediate plans of the company contemplate the extension of this electrification over the adjoining division from Campinas to Cordeiro, a distance of 72 kiloms. (45 miles), making a total of 117 kiloms. (73 miles). All the apparatus and equipment is of such design and capacity as to be suitable for operating over the probable continuation of the electrification to Sao Carlos, an overall distance of 206 kiloms. (128 miles).

Plans are going forward for the electrification of the railways in FINLAND, although financial difficulties stand in the way of a speedy realisation of the schemes. According to the Director-General of the State Railways, electric power will chiefly be applied to the railways in the south, where it is more difficult to obtain wood and the question of water power is easiest to solve. The railway system will be divided into sections, these being successively electrified as capital becomes available. In the first place, the section Riihimäki (a junction to the north of Helsingfors)—Wiborg will be electrified. There is a large amount of traffic over this line and water power can be obtained in the immediate vicinity. Sections with a large amount of local traffic will then be electrified—e.g., those in the neighbourhood of the capital.

Tests recently carried out by Mr. D. J. Price and H. R. Brown, of the U.S.A. Bureau of Chemistry (Washington, D.C.), prove that ELECTRIC LAMPS are the SAFEST FORM OF ILLUMINATION IN DUST-LADEN ATMOSPHERES, and the hazard involved in their use can be eliminated by proper installation and protection. Experiments were made with coal dust and grain dust in an explosion chamber to ascertain whether the exposed filament in a broken lamp remained hot long enough after the globe is broken to ignite the surrounding dust clouds. Dust explosions and fires can, it appears, be caused by both vacuum and gas-filled lamps, but the temperature of the dust must be raised at least 150° F. above the maximum temperature of the bulb to cause ignition. All electric lamps in places where explosive dust is present should be equipped with vapour-proof globes and protected by heavy guards to prevent breakage.

Municipal Electricity Accounts.

The accounts of the WEXMOUTH and MELCOMBE REGIS electricity undertaking for the year ended March 31 show revenue £23 359 (compared with £21 981 in the preceding year), working expenses £21 673 (£18 748), and gross profit £6 686 (£3 233). After providing for capital charges the net profit was £1911 (compared with a deficit of £1551). Total cost per unit was 4.04d. (3.74d.), exclusive, and 5d. (4.77d.), inclusive of capital charges. Maximum load was 606 kW (549 kW), and load factor (22.6 (23) per cent. Units sold were 1 202 591 (1 110 223). Heating apparatus on consumers' premises amounts to 446 kW, and motors to 1 459 H.P.

The accounts of the ABERDEEN Municipal Tramways Department for the year ended May 31 show tramway revenue £191 470, compared with £169 731 in previous year, and working expenses £157 585 (£141 852), leaving gross profit £33 885 (£27 879). Interest required £1 491 (£1 526), and sinking fund £6 767 (£6 364), and, after providing £23 833 (£22 616) for depreciation and renewals and £215 (£2 577) for special expenditure, the net profit was £1 581 (compared with a deficit of £5 205), and to this is added net profit of £762 on the motor omnibuses and of a revenue of £3 842 after providing for working expenses and interest. Passengers carried were 42 953 807 (compared with 45 544 807), and car-miles run 2 307 260 (2 440 087). Average total revenue per car-mile was 19.2d., and working expenses were 16.39d., in both cases an improvement upon the previous year.

The accounts of OLDHAM Corporation Electricity Department for the year ended March 25, 1921, show total revenue £146 122 and expenditure £102 802, leaving a gross profit of £43 319. After providing for income tax, sinking fund, interest, and other payments, including the cost of change-over mains from D.C. to A.C., £3 366, and purchase of meters, £1 335, there remains a net profit of £3 836. The credit balance of £10 774 brought forward from March, 1920, has been transferred to the reserve, leaving a credit balance of £9 836 to be carried forward, and bringing the reserve up to £16 043. The total units sold during the year was 18 340 242, an increase of 1 646 727 over last year. The maximum demand, including traction, was 11 446 kW, and the maximum load 10 996 kW. The l.t. supply mains were extended 9 148 yards, and the e.h.t. mains 8 528, bringing the total length of l.t. distributing mains to 94 913 yards and of the e.h.t. feeders to 31 387 yards. Nine consumers' sub-stations have been erected during the year, and alterations to existing sub-stations have been carried out. Considerable structural alterations have been made to the generating station building in preparation for the installation of new plant.

Catalogues, Price Lists, &c.

We have received from BELLING & COMPANY a number of leaflets illustrating and describing their numerous electric cooking and table appliances.

Every kind of silk shade for electric light is designed and manufactured by CHARLES SELZ, 83, George-street, Portman Square, W. 1. The latest booklet issued by the firm contains innumerable illustrations, some in colour, and is altogether a fascinating production.

A descriptive leaflet relating to the E.9952 "Universal" Portable Radiator, one of the 97 "Universal" domestic labour savers, has just been issued by L. G. Hawkins & Company, the manufacturers. The radiator, as stated above, is portable and will fit any electric light holder. The price has been reduced to 47s. 6d. until further notice.

SEMAPHORE LTD., 2, Bayley Street, Tottenham Court Road, W.C. 1, have issued a small folding card giving a list of standard sizes and prices of Semaphore dry cells and batteries. Quotations for other sizes, round, square, or oblong, for every purpose, may be obtained on application. The various types of the firm's pocket lamps, torches, and box refill batteries, with particulars of size and price, are also given.

Wiring contractors and supply engineers will be interested in the new list of LOOP-IN HOUSE SERVICE CUTOUTS which has been issued by Messrs. W. T. Henley's Telegraph Works Company, Ltd., Blomfield-street, London Wall, E.C. 2. The range of cutouts described and illustrated have been designed to meet the various requirements in connection with the lighting of groups of houses, and among the advantages claimed for them are that they almost eliminate the use of joint-boxes and reduce the cost of "opening-up" to a minimum.

An illustrated booklet has just been issued by SIEMENS BROTHERS & COMPANY, LTD., giving particulars of the ebomite which the firm manufacture in very large quantities in the form of rod, tube, sheet, and mouldings, at their Woolwich works. Various useful tables are given. One of diameters of ebomite rods contains 78 different sizes, varying from .0156 in. to 1 in., together with their approximate weights. The dimensions of 100 sizes of tubes, varying from .118 in. x .039 in. to 1.032 in. x .460 in., are also given with their approximate weight per 100 metres, and the firm will be glad to forward the complete range of sizes on application. Thirty-one sizes of ebomite sheet, the thickness of which varies from .015 in. to 1.000, are also shown in table form, with the approximate weights of the various dimensions.

Telegraph and Telephone Notes.

HERR ANTON STACHEL has been appointed departmental head of the AUSTRIAN telegraph, telephone, and radio-telegraph services.

The Republic of POLAND and the free city of DANTZIG have adhered to the RADIO-TELEGRAPH CONVENTION, but the former makes certain reservations.

The SWEDISH TELEGRAPH ADMINISTRATION is experimenting with a system for connecting the ordinary telephone to wireless telephone installations, so that a wireless call at any time can be connected to the wire system.

A telegraph money order service between the UNITED KINGDOM and CYPRUS commenced last week. A feature of the new service is that the telegrams of advice may be sent at the deferred rate, which is one-half of the full rate. The full-rate service is available for cases of special urgency.

Any APPARATUS FOR WIRELESS TELEGRAPHY may now be sold (or purchased, made, or held) in Great Britain (but not in Ireland) without permit or restriction. The Postmaster-General's authority is, however, still necessary under the Wireless Telegraphy Act, 1904, before any wireless apparatus may be installed or worked.

The Marconi Company is fitting two WIRELESS TELEGRAPH AND TELEPHONE SETS on board Sir Ernest Shackleton's ship the "QUEST." One of these is for permanent use on the ship, and the other for base work on land. Their range is about 100 miles. The Avro aeroplane which is being taken with the expedition will also be fitted with a Marconi wireless telephone.

The total length of aerial TELEGRAPH LINES in DENMARK at March 31, 1920, was 6 885 km (4 269 miles), and of submarine and underground cables 958 km (about 510 nautical miles). The total length of telegraph and telephone conductors was 63 633 km (39 452 miles). The number of State telegraph offices was 624, of which 82 were also central telephone exchanges. There are nine telephone companies, possessing 745 929 km (461 478 miles) of conductors and with 203 888 subscribers. All the figures show substantial increases over the previous year.

A new public telephone exchange named Grosvenor was opened last Saturday. The address of the new exchange is 39, South Audley-street, Oxford-street, W. 1, and, as it is within the five-mile circle from Oxford Circus, it is within the local fee area of all exchanges within a radius of ten miles from Oxford Circus. GROSVENOR EXCHANGE, which has up-to-date central battery equipment, will start with the transfer of 850 and 110 lines from Mayfair and Gerrard Exchanges respectively, and two weeks later another batch of 200 lines will be transferred from Mayfair.

In his report on the STATE OF BRUNEI, the British Resident (Mr. G. E. Cator) states that during 1920 a wireless telegraphic installation, which will place Brunei in communication with Singapore and Europe, was under construction. Purchases of material were made in England on behalf of the Government by Mr. F. H. Dupree, of the Singapore Wireless Telegraphic Station, from the Disposals Board and War Office. By the end of the year the four stations—Brunei, Labuan, Brooketon, and Temburong—had been erected and equipped, and were to be ready for use as soon as the balance of the material arrived from England.

The French Post and Telegraph Department has been experimenting with ALUMINIUM CONDUCTORS FOR TELEPHONE CABLES. Three cables, which were lead-armoured and paper insulated, were tried. The first consisted of 112 pairs of conductors of 1.28 mm. diameter, the second of twenty-eight pairs of 1 mm., and the third of seven pairs of 2 mm. No difficulty was experienced in laying the cables or drawing them into the conduits, but the question of jointing required a special study. It was found that twist joints did not give good results from the electrical point of view; soldering presented various difficulties which put its use out of the question; but sleeve joints were found to give very satisfactory results.

The following Exchange message from New York has been widely published in the daily press:—Mr. J. C. H. Macbeth, the London manager of the Marconi Wireless Telegraph Company, startled a luncheon assembly by the description of recent wireless experiments aboard the Marconi yacht "Electra" in the Mediterranean, which led Mr. Marconi and other experts to believe that Mars or some other planet was seeking to communicate with the world. Mr. Macbeth said the apparatus intercepted wireless wave lengths of 150 000 metres, whereas the maximum wave length produced in the world to-day is 14 000 metres. He said the regularity of the wave lengths disproved the belief that it was due to electrical disturbances.

The SYDNEY correspondent of the "Daily Telegraph" states that Sir Thomas Hughes, Chairman of the Amalgamated Wireless Company (the Australian representatives of the Marconi Wireless Company) is strongly opposed to the wireless scheme submitted to the Imperial Conference, on the grounds of inefficiency, finance, and defence. The company's experimental stations in Australia are capable of receiving direct messages at all hours of the day and night from the high-power stations in Europe. The company also proposes to erect a high-power station in Australia, which would be able to communicate with all the capital cities in the Commonwealth, and would have a range of 12 000 miles, thus putting Australia in direct communication with all parts of the world. The company is willing to finance the scheme itself or in conjunction with the Federal Government. It is understood that the scheme will be reconsidered by the Government on Mr. Hughes's return.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published has been specially compiled by Messrs. NEWBURN, ELLIS & Co., Chartered Patent Agents, Strand 72, (Chancery Lane, London, W.C.).

COMPLETE SPECIFICATIONS.

- 139 514 WESTINGHOUSE LAMP Co. Electron tube apparatus. (27/2/19.)
Comprises an electron-tube having an electron-emitting cathode, a plate cathode, an electron-accelerating screen electrode, and a gas or vapour filling capable of exhibiting the phenomenon of resonance potential, in which the said screen electrode is maintained at such a positive potential with respect to the other electrodes that the phenomenon of resonance potential occurs whereby the rate of change of the resultant plate current with increase of screen potential is zero.
- 139 518 WESTINGHOUSE LAMP Co. Electron tube apparatus. (27/2/19.)
Addition to 139 514.
- 141 688 ELECTROLYTIC ZINC Co., or AUSTRALIA PROPRIETARY, LTD. Electrolytic treatment of ores containing zinc and other metals. (14/4/19.)
- 141 690 DUBILIER CONDENSER Co., LTD. Electric condensers. (11/4/19.)
- 145 483 LEFEVRE, P. J. M. Ignition magnets for internal-combustion engines. (27/3/19.)
- 148 570 CONSTRUCTION ELECTRIQUES DE BELGIQUE Soc. ANON. Contact finger for rheostats and other similar electrical apparatus. (2/4/19.)
- 148 835 DIAMOND ELECTRIC SPECIALITIES CORPORATION. Electric flash-lights and the like. (2/10/19.)
- 151 959 MAGNETO BELGE Soc. ANON. Lighting magnets for bicycles and the like. (2/10/19.)
- 156 070 MELOTTE, A. Means for electrically driving the bows of centrifugal separators. (26/12/19.)
- 157 238 BENDMANN, H. P. Electric arrester. (9/8/19.)
- 161 154 REED, R. R. Electric furnaces. (27/3/20.)
- 165 460 WITHERS, J. S. (Cox, K. C.). Electro-magnetic recording apparatus for sound signals. (19/9/19.)
- 165 470 BARRY, H. A. L., & TAYLOR, A. M. Methods of and means for reducing the lagging current on alternating current systems supplying induction motors and the like. (15/9/19.) Addition to 152 708.
- 165 476 LAMKIN, A. E. Electric distributing switches for ignition purposes. (29/10/20.)
- 165 498 HODDER, H. C. Apparatus for charging and discharging electric storage batteries. (25/2/20.)
- 155 512 BRITISH THOMSON-HOUSTON Co., LTD. (General Electric Co.). X-ray apparatus. (23/3/20.)
- 155 514 DENNETT, W. S. Electric motors. (24/3/20.)
- 155 515 KAY, J., & JENNINGS, J. Telephones. (23/3/20.)
- 155 517 PALMAR, H. J., & THE TELEPHONE MANUFACTURING Co., LTD. Selector switches for telephones. (25/3/20.)
- 165 535 LOVERICK & SONS, LTD. Electrolytic deposition of iron and the treatment of the deposition of the deposit. (18/3/20.)
- 155 563 BOLTON, A. R. A. Electric overload circuit breakers. (13/4/20.)
- 165 569 AUTOMATIC TELEPHONE MANUFACTURING Co., LTD., SAYN, J., & SMITH, S. R. Call indicators for telephone systems. (4/4/20.) (Addition to 129 563.)
- 165 621 ALLBRIGHT, W. J., & ALLBRIGHT, L. J. Electric burglar alarms. (13/5/20.)
- 165 623 MUMFERY, C. S., & EVER READY Co. (GREAT BRITAIN), LTD. Electrical cells. (14/5/20.)
- 165 626 SOLOMONSON, G. CLARKE, C. C., & WILSON, W. Electric motor controlling switch gear. (17/5/20.)
- 165 627 UREN, G. W. Protective fuses for electric circuits. (17/5/20.)
- 165 632 LEDWINKA, J. Duplex electric welding machines. (20/5/20.)
- 165 634 EDWINSON, J. Electric transformers. (20/5/20.)
- 165 655 SKINNINGROVE IRON Co., LTD., & SMITH, T. R. Electrostatic plant for depositing dust and particles from gases.
- 165 675 TAYLOR, A. R. Inductance or reactance coils. (15/4/20.)
- 165 686 CLARK, W., & CLARK'S ELECTRIC DEVICES, LTD. Electrical measuring instruments. (25/8/20.)
- 165 720 TYER & Co., LTD., & DOWNES, F. Electrical apparatus for railway signalling. (21/5/20.) Divided application on 162 553.
- APPLICATIONS FOR PATENTS.
- April 4, 1921.
- 9 844 INGLEY. Variable-speed squirrel cage induction motors and generators.
- 9 857 CAMPBELL & FARMER. Mechanical and electrical railway fog-signalling apparatus.
- 9 862 VERNON. Continuous flow apparatus for manufacture in solution of pure alkali, &c., by electrolysis.
- 9 874 CALLENDER'S CABLE & CONSTRUCTION Co., & WILSON. Switch and fuse contact.
- 9 877 KIRK. Electric burglar alarms.
- 9 881 SPAGNUS & Co. Mounting for trolley poles.
- 9 882 LAMBERT. Wind-driven electric-generating sets.
- 9 882 METROPOLITAN-VICKERS ELECTRICAL Co. Engine starting mechanisms. (2/4/20, U.S.)
- 9 909 ART-GES, BROWN, BOVERI ET CIE. Electrically heated muffler furnaces.
- 9 910 ART-GES, BROWN, BOVERI ET CIE. Apparatus for suppressing upper harmonic currents in metal vapour rectifiers. (10/4/20, Switzerland.)
- 9 911 ART-GES, BROWN, BOVERI ET CIE. Apparatus for suppressing upper waves in the d.c. circuit of metal vapour rectifiers. (15/5/20, Switzerland.)
- 9 913 MELLOR. Installation apparatus for wireless telegraphy.
- 9 919 B. T. H. Co. Electron discharging device. (22/10/20, U.S.)
- 9 920 B. T. H. Co. & TAYLOR. High resistance conductors.
- 9 921 B. T. H. Co. & MCCREADY. Current collecting devices for electric vehicles.
- 9 926 BERRY & PAINTON. Decorative electric devices.
- 9 933 OLDHAM. Galvanic batteries.
- 9 934 OLDHAM. Pocket electric lamps.
- 9 951 METALLURGISCHE ELEKTRIQUE. Cut-outs. (6/9/20, France.)
- 9 952 METALLURGISCHE ELEKTRIQUE. Automatic circuit breakers. (6/9/20, France.)
- 9 958 CHEVALIER & BOY-GARNIER. Electro-mechanical lamps.
- 9 959 CLARK. Ships' telegraphs, &c.
- April 5, 1921.
- 9 976 MARE. Sound-transmitting instruments.
- 9 984 ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEVOIX. Railway signalling devices. (3/1/21, Belgium.)
- 10 038 WESTERN ELECTRIC Co. High frequency duplex signalling system.
- 10 051 HALL & PERKINS. High frequency connections for electric circuits.
- 10 057 BARLOCHER. Liquid electric controlled.
- 10 065 SPERRY. Electric relays (13/11/14, U.S.)
- April 6, 1921.
- 10 005 HILL. Electric lamp for motor cars and cycles.
- 10 119 KILLAR. Short-circuiting electrical devices.
- 10 133 GUSLIN. Attachment for automobile dynamos for combining the action of lifting and starting.
- 10 140 SCOREY. Apparatus for magnetising steel for permanent magnets.
- 10 141 METROPOLITAN-VICKERS ELECTRICAL Co. Switchboards. (23/4/20, U.S.)
- 10 168 RICHTER, BRUNER & CLARK. Electro-fining glass furnace. (6/4/20, U.S.)
- 10 172 IGANIC ELECTRIC Co. (Cutler-Hammer Manufacturing Co.). Illuminating control systems.
- 10 173 BARLOCHER. Means for cooling electric machines.
- 10 181 GES-FÜR DRAHTLOSE TELEGRAPHIE. High-frequency telephone systems. (9/4/20, Germany.)
- 10 186 B. T. H. Co. (G. E. Co.). Insulated conductors.
- 10 183 NICKIG. Electric burglar alarm.
- 10 213 TELEGRAPHEN GES. Device for automatically making and breaking an electric circuit with commencement and cessation of speaking currents, &c. (24/8/20, Germany.)
- 10 217 TAYLOR. Regulation of h.t. cable systems.
- April 7, 1921.
- 10 249 MOTTERHEAD. Spring contact members for electric circuits on motor vehicles.
- 10 261 FLOW. Variable rheostats, &c.
- 10 265 FLOWER. Machine for undercutting commutator mica.
- 10 274 SIEMENS & LAIDLAW. Telephones.
- 10 281 ASSERSON & CARTER. Counting mechanism for telephones.
- 10 324 SOUND. Wireless telegraph and telephone systems.
- 10 325 BARNES & SONS. Twin audio and its applications.
- 10 326 MARCONI'S WIRELESS TELEGRAPH Co. Reception of radio signals. (14/4/20, U.S.)
- April 8, 1921.
- 10 332 NIBLETT. Electrolytic apparatus.
- 10 341 DEAN-OSGOOD. Holders for electric lamps, plugs, &c.
- 10 365 WEBB & WOOD. Tumbler switches.
- 10 372 KROGH. Electric and automatic device for egg testing.
- 10 394 METROPOLITAN-VICKERS ELECTRICAL Co. Control of a.c. motors. (17/6/20, U.S.)
- 10 396 HOLDEN-STONE. Electro-magnetic machines.
- 10 397 GOSWORTHY. Adjustable earthing clip.
- 10 399 MARKS. Siemens-Schuckertwerke. Apparatus for regulating phase compensation for a synchronous machine.
- 10 404 CALVELEY & HIGHFIELD. Commutators.
- 10 416 B. T. H. Co. (G. E. Co.). Electro-magnetic switches.
- 10 417 B. T. H. Co. & COCKSEDGE. Lighting fixture.
- 10 418 B. T. H. Co. & CLINKER. Electron discharge devices.
- April 9, 1921.
- 10 433 JOEL. Electric machinery.
- 10 441 & 10 442 TUCKER. Switches.
- 10 463 MORGAN. Electrical machines.
- 10 472 HIGHFIELD. Electric lighting systems.
- 10 473 SAUNDERS ELECTRICAL Co. Vent-plugs for accumulators, &c.
- 10 478 WILKINS. Voltage regulators.
- 10 483 HATCHER & ROOKE. Electric machines.
- 10 498 FROST & ESKINE-MURRAY. Electric conductors.
- 10 506 RIPPON. Cartons for storage, &c., of electric lamp bulbs, &c.
- April 11, 1921.
- 10 520 ROBINSON. Gas-filled incandescent lamps.
- 10 521 ROBINSON. Incandescent lamps.
- 10 526 BRAND & BROOKE. Portable electric sanding and planing machines.
- 10 550 WOODROW. Switch, fuse, &c., boxes.
- 10 561 HAEFELY (E.) ET CIE. Transformers for high voltages. 16/10/20, Switzerland.
- 10 585 MARKS. (Siemens-Schuckertwerke). Regulating asynchronous machines by means of commutator machine arranged behind.
- 10 591 ADAMS. Telephone exchange systems. (13/5/20, U.S.)
- 10 595 GES-FÜR DRAHTLOSE TELEGRAPHIE. Telephone systems. (12/4/20, Germany.)
- 10 597 Soc. INDUSTRIELLE DES TELEPHONES. Amplifiers for telephone currents. (18/11/20, France.)
- 10 599 STROGANT. Transformation of alternating to direct pressures and currents.
- 10 614 AUTOMATIC TELEPHONE MANUFACTURING Co. Telephone systems. (19/4/20, U.S.)
- April 12, 1921.
- 10 629 GOLDEN. Protective covering for electric refill batteries.
- 10 638 HUMPHRY. Cartridge fuse for electrical circuits.
- 10 643 HUMPHRY. Earth connection devices for pipes, cables, sheaths, &c., in electrical signalling, &c., apparatus for use in trains, factories, &c.
- 10 651 TOMS. Electrically illuminated hand mirror.
- 10 663 STONE. Electric lamp holders, &c.
- 10 671 HEWITT ELECTRICAL Co. Electric batteries. (15/4/20, France.)
- 10 700 METROPOLITAN-VICKERS ELECTRICAL Co. Control of a.c. motors. (30/7/20, U.S.)
- 10 701 METROPOLITAN-VICKERS ELECTRICAL Co. Control of a.c. motors. (19/7/20, U.S.)
- 10 702 B. T. H. Co. (G. E. Co.). Electro-magnetic switches.
- 10 705 IRELAND. Trolley pole safety appliance for electric tramcars, &c.
- 10 730 HURT (Dr. E. P.). Switch gear arrangements for sending and receiving low-frequency oscillations. (12/4/20, Germany.)
- April 13, 1921.
- 10 761 HOSSACK. Galvanic battery.
- 10 765 HINDE. Electric baling presses for loose materials.
- 10 770 STUDIGA GES-FÜR ELEKTRISSCHE BELEUCHTUNG. Illuminated signs.
- 10 776 STEWART, BROS. & STRAIN. Chronometric switches, &c.
- 10 795 HUMPHREY & HENFILL. Telephone receivers.
- 10 798 DEWURST. Electric machines.
- 10 799 BYRNE. Electrical apparatus.
- 10 802 DEXON. Contact-breakers for electrical ignition for automobile engines.
- 10 803 BARTHOLOMEW. Telautography.
- 10 822 ALMANN & SWENSSKA ELEKTRIKA. ARTIEBOLAGET & PETERSEN. Rotating device for relays.
- 10 823 ALMANN & SWENSSKA ELEKTRIKA. ARTIEBOLAGET & PETERSEN. Inverse time limit relays.
- 10 849 GELMAN. Telephones systems.
- April 14, 1921.
- 10 883 BOSCH (R.) ART-GES. Control devices for electric generators. (3/5/20, Germany.)
- 10 892 STEEL, PEECH & TOZER, LTD., & HOLME, BOWEN & BROOKE. Control of lifting magnets.
- 10 923 CROFT & RUSSELL. Transmitting, receiving, or reproducing sound.
- 10 935 Soc. ANON-POUR L'EXPLOITATION DES PROCÉDÉS M. LERLAIN-VICKERS. Three electrode bulbs or valves. (15/4/20, France.)
- 10 958 PRICE. Electric lighting for motor cycles, &c.
- 10 959 PRICE. Electric machines.

Tenders Invited and Accepted.

BOSNOR Council want tenders by Sept. 15 for wiring five houses and three flats. Particulars from the Council's Electrical Engineer.

SALFORD Corporation want tenders by Sept. 15 for tramway supplies for three or six months. Particulars from the Tramways Manager.

BERMONDSEY (London, Guardians want tenders by Sept. 23 for six months' supply of electric lamps, &c. Forms of tender, &c., from the Clerk, 285, Tooley-street, London, S.E. 1.

MANCHESTER Tramways Committee require tenders by Sept. 13 for motors, controllers, and trucks for tramcars. Specifications from Mr. J. M. McElroy, 55, Piccadilly, Manchester.

The Government of **MALTA** wants tenders by Sept. 15 for the supply of single phase meters. Forms of tender, &c., from the Crown Agents for the Colonies, 4, Millbank, London, S.W. 1.

Tenders are required by Sept. 14 for wiring the **GLAN ELY** Hospital, Fawcater, near Cardiff. Specifications, &c., from the Secretary, Welsh National Memorial Association, Westgate-street, Cardiff.

WESTMINSTER Guardians want tenders by Sept. 14 for supply of electric lamps and fittings, ironmongery, &c. Forms of tender from the Clerk, Prince's-row, Buckingham Palace-road, London, S.W. 1.

Buenos Aires State Railways invite tenders by October 21 for one year's supply of electrical stores. Specifications are expected to arrive at the Department of Overseas Trade at the end of September.

Tenders are invited by **DURBAN** Corporation for supply of two 500-kW rotary converters, switchgear, &c. Tenders to Town Clerk's Office, Durban, by Sept. 28. Specifications at the Department of Overseas Trade.

WALSALL Electric Supply Committee want tenders by Sept. 26 for the supply of 320 tons and the laying of 300 tons of c.i. pipes. Specification, &c., from Mr. E. M. Lacey, 12, Victoria-street, London, S.W. 1.

HAMPSHIRE BOROUGH COUNCIL invite tenders for the supply of oils for the Electricity Station for six months from Oct. 1. Particulars from the Town Clerk, at the Town Hall, to whom tenders by 4 p.m., Sept. 12.

Tenders are required by Sept. 12 for six months' supply of electrical fittings, etc., to the **BELFAST DISTRICT ASYLUM**, Purdyburn. Forms of tender from the Clerk, Purdyburn Asylum Committee, Sainfield-road, Belfast.

EASTBOURNE Corporation require tenders by Sept. 26 for a water-tube boiler, fan and chimney, feed pump and piping, and a 2 500-kW turbo-alternator, with condensing plant and pipework. Specifications from the Borough Electrical Engineer.

Tenders are invited by Oct. 5 for the supply of bronze wire (schedule 536) to the Postmaster-General's Dept., State of **QUEENSLAND**. Specifications, &c., from the office of the High Commissioner for Australia, Room E 5, Australia House, Strand, W.C. 2.

WELLINGTON (N.Z.) Corporation require tenders by Oct. 13 for two water-tube boilers, with feed-water heaters, etc., and a 5 000-kW turbo-alternator with condensing plant. Specifications from Messrs. Preece, Cardew and Rider, 8, Queen Anne's-gate, Westminster, S.W. 1.

The closing date for the receipt of tenders for the supply of 132 sets of accumulator cells required by the **VICTORIAN GOVERNMENT RAILWAYS** (contract No. 34 171) has been extended from Aug. 31 to Sept. 28. Specification at the Department of Overseas Trade.

The **VICTORIAN GOVERNMENT RAILWAYS** invite tenders by Sept. 28 for the supply and delivery of a lifting-magnet and generating set, with control apparatus and accessories (contract No. 34 241). Specifications may be inspected at the Department of Overseas Trade, 35, Old Queen-street, S.W. 1.

PETERBOROUGH CORPORATION ELECTRICITY DEPARTMENT invite tenders for the supply and delivery of a quantity of paper insulated, lead-covered cables, some for use on 6 500-V supply and some on 600-V. Particulars for the City Electrical Engineer, Albert-park, Peterborough.

The date for receiving tenders for the supply of electric light and power plant for **BULAWAYO** (Rhodesia) Municipality has been extended to Oct. 12 if tenders are referred to Messrs. Davis & Soper, 54, St. Mary-axe, London, E.C. 3, and to Nov. 15 if tenders are sent to the Town Clerk.

The **AUSTRALIAN POSTMASTER-GENERAL'S DEPARTMENT**, Adelaide (S. Australia), wants tenders by Oct. 12 for 2 750 yards of telephone cords, 120 hand sets, and 160 jacks. Specifications and conditions of tender can be seen at the Department of Overseas Trade, 35, Old Queen-street, S.W. 1.

The Standing Joint Committee of the Glamorgan Quarter Sessions and County Council require tenders by Sept. 10 for the electric lighting installations in **CWMGWARCH** Police Station (contract No. 6) and in **PENRHUYCEBIE** Police Station (contract No. 15). Specifications can be obtained at Glamorgan County Hall, Cardiff.

Tenders are also invited by Oct. 12 for the supply and delivery of galvanised iron and steel wire (schedule 537); and by Oct. 19 for the supply and delivery of insulated wire (schedule 538) to the Postmaster-General's Department, State of **QUEENSLAND**. Tender

forms, &c., from the office of the High Commissioner for Australia, Room E 5, Australia House, Strand, W.C. 2.

The **ELECTRICAL COMMITTEE** of the CORPORATION of **BRISTOL** invite tenders for the supply, delivery, and erection at their Feeder-road generating station, St. Philips, Bristol, of a 500 kW rotary converter, 6 600 V, a.c., three-phase, 50 periods, to 500 V d.c. Specifications and forms of tender from Mr. H. Faraday Proctor, The Exchange, Carn-street, Bristol, to whom tenders by 10 a.m., Sept. 16.

The **RAND WATER BOARD** invites tenders by Sept. 28 for supply and erection at the intake pumping station, Vereeniging, of two centrifugal pumps, direct-coupled to electric motors, one 10-ton travelling crane, and the supply and erection at the main pumping station site of two centrifugal pumps coupled to electric motors. Specifications of the Department of Overseas Trade, 35, Old Queen-street, S.W. 1.

Tenders are also invited, by 12 noon, Nov. 7, for the supply, delivery, and erection at the Board's Main Pumping Station, Vereeniging, of two steam-driven electrical generating sets of 350 kW capacity, each complete with switchboards and all accessories. Tenders to the Secretary, the Rand Water Board, Central House, P.O. Box 1703, Johannesburg.

The **URUGUAYAN BOARD OF STATE ELECTRICAL STATIONS** require tenders for four electrical generating sets, including one 300 to 325 kW, 3-ph., 50 cycle (2 000 V between phases), one 175 kW, 3-ph., 50 cycle (6 600 V between phases), one 125 kW and one 100 kW, d.c., three-wire 2x230 V; and four 4-stroke Diesel engines, one for each set. Particulars from the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1. Tenders by Sept. 19.

The Secretary of the **NEW ZEALAND PUBLIC WORKS TENDER BOARD** (Wellington) invites tenders by Nov. 1 for the supply and erection of new or secondhand auxiliary plant for the Rotorua electric supply as follows:—One oil engine (200 to 250 B.H.P.) and one three-phase 50-cycle alternator of 190 kW (power factor of 0.8), with exciter, &c.

The **NEW ZEALAND PUBLIC WORKS** Department also call for fresh tenders for the supply and erection of steel pipe lines and fittings required in connection with the Mangahao power plant. While the quantities, &c., are substantially the same as those specified in the original call for tenders, some of the conditions appear to have undergone modification. The closing date for the receipt of tenders in Wellington is Nov. 1, 1921. Specifications can be inspected at the Department of Overseas Trade.

H.M. Consul-General at **LOURA** Marques reports that tenders will shortly be invited by the DEPARTMENT OF POSTS AND TELEGRAPHS at **LOURA** Marques for the supply of 4 200 iron telegraph poles (approx. weight 177 lb. or 180 lb.), 15 000 g.-i. insulator stalks, 11 000 g.-i. insulator brackets, 15 000 porcelain insulators, 320 tons g.i. wire (4 mm.), and 90 tons hard-drawn copper wire (S.W.G. No. 14). Tenders (in Portuguese) by Sept. 30. Further particulars from Department of Overseas Trade.

The **VICTORIAN RAILWAY COMMISSIONERS** require tenders by Oct. 5 for double-wheel lathes for Jolimont Workshops (Contract No. 33 256), by Oct. 19 for d.c. arc welding plant for Jolimont Workshops (Contract No. 34 377) and armature winding machine with electric motor and starting gear (Contract No. 34 378), by Oct. 26 for 1 120 cwt. best steel boiler plates (Contract No. 34 342), and by Nov. 2 for storage battery with accessories and spares (Contract No. 34 229). Specifications and conditions can be seen at the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1.

The **ADMINISTRATION OF THE SOUTH AFRICAN RAILWAYS AND HARBOURS** invite tenders for the supply, for 12 months ending Dec. 31, 1922, of 85 560 incandescent train lighting lamps (tungsten filament) for 24 V, 8 to 10 c.p.; 8 125 engine head lamps, 150 W, 32 V (gas-filled 1/2 W type with concentrated filament); 50 472 incandescent lamps (tungsten filament); 5 545 incandescent lamps (carbon filament). Tenders by noon, Nov. 7, to the Secretary, Tender Board, South African Railway Headquarters Offices, Johannesburg. Specifications may be inspected at the Department of Overseas Trade, 35, Old Queen-street, S.W. 1.

The **NEW ZEALAND PUBLIC WORKS** Department invite tenders for the manufacture, supply, and delivery, ex ship's slings at Auckland, of six sets of three-phase air-brake switches suitable for operation upon 50 000 V circuits in connection with the Waikato Electric Power Scheme. Tenders to the Secretary, Public Works Tender Board, Wellington, by noon on Sept. 27. Telegraphic tenders also accepted. Specifications at the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1. A copy is also available for loan to firms established in the provinces.

The **PUBLIC WORKS DEPARTMENT** of **NEW ZEALAND** invite tenders for the supply of the following plant required in connection with the Mangahao electric power scheme: Section 12: Three water-wheels of 6 450 B.H.P., and two water-wheels of 3 225 B.H.P., complete with governors, couplings, and accessories; Section 13: Three 6 000 kVA and two 3 000 kVA alternating-current generators; Section 14: two three-unit exciter sets, each consisting of one 375 B.H.P. Pelton wheel, one 250 kW direct-current generator, and one 350 H.P. asynchronous motor; Section 15: seven 4 000 kVA single-phase transformers and accessories; Section 17: insulators for 110 000 V 50-cycle transmission lines; Section 18: lightning arresters for operation on two 110 000 V three-phase transmission lines; Section 19: switchboard, switches, and accessories. Tenders to the Secretary, Public Works Tender Board, Wellington, by noon, Nov. 29. Specifications at Department of Overseas Trade.

Miscellaneous.

An increased demand is reported from BIRMINGHAM for electric laundry irons, and vacuum cleaners operated by electricity.

A LICENCE OF RIGHT in the case of Patent 15498 13 has been granted to E. V. Hartford for "Improvements in and relating to power-operated brakes for vehicles."

THE CANADIAN DEPARTMENT OF CUSTOMS AND EXCISE have issued a memorandum containing Regulations regarding the method to be employed in marking or stamping imported goods.

The third Commercial Fair, the annual Samples Fair organised by the City of BRUSSELS, will be held next year from April 3 to 19, in the exhibition buildings in the Jardin du Cinquantenaire.

Inquiries relating to the SAFEGUARDING OF INDUSTRIES ACT should be addressed to the Assistant Secretary, Board of Trade (Industries and Manufactures Department), Great George-street, London, S.W. 1.

THE SHIPPING, ENGINEERING, AND MACHINERY EXHIBITION at Olympia, London, was formally opened on Wednesday, and will remain open until the 28th inst. A full account of the exhibits will be given in our next issue.

The first SCHOOL OF RADIOGRAPHY in the United Kingdom is to be opened for both sexes in the beginning of October at King's College Hospital, under the direction of Dr. Knox. The course of study will be for twelve months.

All goods sent for exhibition at the EASTERN SAMPLES FAIR, which is to be held at Lemberg from Sept. 25 to Oct. 5, will be allowed into Poland without licence and free of Custom duties, on condition that they are removed immediately after the fair.

LOUIS JOHN HUNT, electrical engineer, and SANDYCROFT, LTD., formerly known as the Sandycroft Foundry Company, Ltd., intend to apply for an EXTENSION OF LETTERS PATENT No. 6224/1906 for "alternating current machines" and No. 15711/1906 for "windings for a.c. dynamos."

Prof. H. Levy will deliver an address on "THE FUNCTION OF THE MAN OF SCIENCE IN ORGANISED RESEARCH," at 5.30 on Tuesday afternoon, September 13, in the new buildings of the Medical School, Edinburgh University. The address will be followed by a discussion to be opened by Prof. H. H. Turner.

THE ELECTRICIAN and other trade and technical journals, scientific and technical books, trade directories, &c., published by BENN BROTHERS, are on view on Stand No. 316 (in the gallery next to the band) at the Shipping, Engineering, and Machinery Exhibition, which opened at Olympia on Wednesday. Among the books on sale are "Automatic Telephone Systems," a manual in two volumes, by William Aitken, M.I.E.E., A.M.I.E.E., and the latest edition of the "Electrical Trades Directory."

The balance sheet of the RADIO CORPORATION OF AMERICA for the year ended December 31, 1920, shows total assets amounting to \$25 112 945, including \$8 901 675 for plant and equipment, and \$10 107 982 for patents, goodwill, contracts and franchises. Current liabilities amounted to \$1 883 227, the 7 per cent. preferred stock to \$13 525 870 and the common stock to \$9 611 392, with reserve at \$92 456. During the year the South American Radio Corporation was organised. It is jointly owned by the Radio Corporation and Marconi's Wireless Telegraph Company.

AN INQUEST was held at DEWSBURY on the 30th ult. into the death of Edward Braithwaite, an electrician of the Yorkshire Electric Power Company, who received a fatal electric shock while fixing up a lamp. In returning a verdict of "Death from shock, by being accidentally electrocuted while fixing an electric lamp," the Coroner commented on the fact that the lamp was a dangerous one. It was a lamp of the screw-cap variety with a one-hole switch in which the cap was alive with a voltage supply of from 220 to 230 a.c. It was a question for all concerned to see how far that danger of the live screw-cap could be obviated.

Under the auspices of the ELLIOTT SOCIAL ASSOCIATION the employees of Messrs. Elliott Brothers (London), Ltd., of Lewisham, held their fourth annual garden fête and sports on Saturday last, at the Colfe Grammar School Sports Ground, Eltham-road. The opening ceremony was performed by Mrs. W. O. Smith, wife of the chairman of the company. A long programme of events had been arranged, and some keen sport was witnessed by a large crowd. Especially interesting was the departmental tug-o'-war, all the teams being very evenly matched, and a great final saw the test room beat the tool room by two pulls to one. In addition to the sterner events, the lighter side was well catered for, and much amusement was caused by the various comic competitions, while a number of events were reserved for the children.

The prizes, which had been given by the directors, were presented to the various winners by Mrs. L. W. Smith, wife of one of the directors. At the close of the sports dancing was indulged in. The music being provided by the Lewisham Comrades Military Band under the baton of Mr. E. R. Jennings (late K.R.R.). The arrangements, which were admirably carried out, were in the hands of Messrs. W. J. Woodman, W. F. Beaden, E. J. Griffin, F. C. Hart, W. Nicolle, and A. S. Powell, while excellent work was done by the ladies' committee in providing light refreshments, &c.

Companies' Reports, &c.

The directors of DAVIS & TIMMONS, LTD., have declared an interim dividend of 6 per cent. per annum, tax free, on the ordinary shares for the past half year.

THE DIRECT SPANISH TELEGRAPH COMPANY announces an interim dividend at the rate of 8 per cent. per annum, tax free, on the ordinary shares for the half year ended June 30, in addition to a 10 per cent. dividend on the preference shares.

At the half-yearly meeting of the LANARKSHIRE TRAMWAYS, held in Motherwell last week, the chairman (Mr. R. A. Monks) said that the first three months' revenue of the present year showed an increase of £7 500 as compared with last year—an increase equal to about £30 000 per annum. The coal stoppage and its aftermath, however, had very seriously affected the revenue, and instead of their receipts showing an increase as they had anticipated of about £20 000, they were only £4 000 in excess of the takings for the corresponding period of last year. Questions were put in relation to the supposed negotiations by the County Council for the acquiring of the undertaking, and a shareholder asked what sum had been given by the Tramway Company as the price of the undertaking. The chairman said that the price had been put at £465 000. The County Council were told that to construct the system the cost of material alone would come to over a million of money. The company have recently paid a dividend for the half-year ended June 30 at the rate of 5 per cent.

In moving the adoption of the report and accounts at the half-yearly meeting of the TYNESIDE TRAMWAYS AND TRAMROADS COMPANY, Dr. J. P. Merz, who presided, said that the traffic receipts showed an increase of some £11 811, but that would have been more had it not been for the reduction in the holiday traffic. The reserve fund now stood at £38 898, which was less than the figures of twelve months ago. That was owing to their having taken out of reserve some £2 600 for the improvement of the permanent way. This improvement was a special welding process which they were now carrying out, and which would probably be finished this year so far as that part of the line between Newcastle and Wallsend was concerned. After that they would have to attack the North-road. Nearly £4 000 had had to be expended on their Bill, the purchase of a house for their secretary at Wallsend, and on car sheds. This was the largest aggregate outlay of the kind for many years. Interest was up by about £500, owing to the debentures now bearing a slightly larger rate of interest, but specially owing to their being paid free of income tax. The decrease in the amount available for dividend was £3 209. It was proposed to pay a dividend at the rate of 1½ per cent. for the half-year on the Ordinary shares. They would meet the decrease by carrying to reserve £1 000 less, carrying forward £870 less, and paying £1 359 less in dividend. The principal item they had to look at in their balance sheet was that the invested fund was, unfortunately, not equalled by the tangible reserves, owing to the fact that they had to absorb a certain amount of reserves to finish the tramway. On the other hand, their cash in bank and in hand was up by about £5 000. For the current half-year the prospects were uncertain. There was, however, some indication that things were improving. A dividend at the rate of 5 per cent. per annum (less tax) on the Preference Shares and 3 per cent. per annum (less tax) on the Ordinary Shares, payable Sept. 1, was declared.

Meetings of the holders of the First Mortgage Gold Bonds and of the Preference shares and Ordinary shares of COMPANIA DE ELECTRICIDAD DE LA PROVINCIA DE BUENOS AIRES, LTD., were held last week by order of the Court to consider a scheme of arrangement, prepared by Mr. B. H. Binder, the receiver and manager.

Mr. BINDER stated that he had been appointed receiver and manager on Jan. 16, 1920, and that the scheme had been prepared after conferences with the larger security holders. He submitted figures showing that the company had improved and extended its business, and increased both its gross and net earnings during the receivership. In order to maintain and continue this improvement it was necessary to incur further capital expenditure, but as it would be difficult, if not impossible, for the company to raise the required funds, it was proposed in the scheme that the capital expenditure recommended by the general manager to be carried out during the next three years should be provided for out of surplus earnings.

In explaining the scheme in detail, Mr. Binder pointed out that the arrears of interest to Dec. 31 last would be met by the issue of £174 044 of new Pre-Preference shares, and that a similar amount of shares would also be issued to the bondholders in respect of the reduction in the bonds of 20 per cent. This reduction was to be effected by reducing the nominal amount of each £20 bond to £16, the difference of £4 being the amount of Preference shares to be issued for each £20 bond. By this means the amount of bonds outstanding would be reduced to £696 176, and the annual interest charge would be reduced to £696 176, and the annual interest charge would be reduced to £34 800. It was also explained that the fixing of the sinking fund for redemption of Debentures at 2 per cent. of the reduced amount would make the annual sum required £13 924. This sinking fund was to commence only in 1924, and then to be dependent upon sufficient profits having been earned to provide it. When the scheme was passed and had been approved by the Court the reduced amount of bonds would rank for interest in cash as from Jan. 1, 1921, and the first payment of interest from that date to Oct. 1, 1921, the date of the next coupon, would be paid as soon as possible thereafter. The scheme was approved by both the shareholders and the bondholders.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Bankruptcy Information.

BARRACLOUGH, Frank, journeyman engineer, residing at 55, Wellington-road, Ewkes, Lancashire, formerly residing and carrying on business as an electrical and mechanical engineer at "Eastlife," Lightlife, near Halifax, and prior thereto at "The Gables," Lightlife Bridge, near Brighouse. Date of Receiving Order, Aug. 30. Debtor's petition.

Notice of Dividends.

GLADWIN, John William, 81, Burcot-road, Meersbrook, Sheffield, and 1a, Meersbrook Park-road, Sheffield, electrical engineer. Amount per £, 8d., first and final, payable Sept. 12, offices of Poppleton, Appleby and Turner, 155, Norfolk-street, Sheffield.

Notice of Intended Dividends.

DOUGHERTY, Samuel Horace, electrical engineer, 53, Warrin-road, Southport, carrying on business at 106, Kensington, Liverpool, and lately at 36, Renshaw-street, Liverpool, under the style or firm of The Mersey Electrical Company. Last day for receiving proofs, Sept. 21. Trustee, Herbert William Bowler, 30, North John-street, Liverpool.

PRIVATE MEETING.

[Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.]

SUTTON-IN-ASHFIELD MOTOR AND ELECTRICAL ENGINEERING CO., LTD., Sutton-in-Ashfield.—In pursuance of the provisions of the Companies (Consolidation) Act, a meeting of the creditors of the above was held recently at Nottingham. Mr. J. Keetley, C.A., of King John's Chambers, Bridlesmithgate, Nottingham, submitted a statement of affairs showing ranking liabilities of £5404. Of that amount £1668 was due to unsecured creditors, and £3736 represented an unsecured amount due on debentures. The assets were estimated to realise £15415, from which had to be deducted £61 for preferential claims and £7008 due to the first debenture holders. This left a balance of £3346 to meet the claims of the second debenture holders, which amounted to £12061. The balance was insufficient to fully discharge the claims of the second debenture holders, who were unsecured for £3736. The issued capital of the company was 5225 preferred Ordinary shares of £1 each and 525 deferred Ordinary shares of 1s. each, or a total of £5252 5s. As regarded the contributories, the deficiency was £10655. The company commenced trading in November, 1919, and had carried on business at a loss. About a month earlier the bank, who held the first debentures, objected to the overdraft being increased, and, as further moneys were not available, a receiver was appointed. The creditors decided to confirm the voluntary liquidation of the company, with Mr. Keetley as liquidator.

Benn Brothers' Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"Cabinet Maker"; "The Photographing of Furniture Window Displays"; "South Africa as a Market for Furniture"; "The Present State of Old English Furniture."

"The Chemical Age"; "Society of Chemical Industry; Notes on the Montreal Meeting"; "British Association: Sir T. Edward Thorpe's Address"; "The Laboratory of the Living Organism, by Dr. M. O. Forster."

"Farm and Home"; "Accounts of a Southdown Flock"; "Cattle Fattening"; "Why the Cheddar is Popular."

"The Fruit Grower" (Special Planting Season Issue); "Problem of Commercial Growing," by W. E. Bear; "Preparing the Land"; "Reviews of Leading Nurseries."

"Gardening Illustrated" (Special Autumn Bulb Issue); "Daffodils in the Grass" (illustrated); "Propagation of Hyacinths"; "Hyacinths in Bowls" (illustrated).

"The Gas World"; "The Gas Consumers' Commonest Complaint"; "Application of Scientific Methods to Increase the Efficiency of the Gas Industry"; "A New Pipe Joint."

"The Hardware Trade Journal"; "Gas Lighting Appliances"; "The Iron and Steel Institute Meeting at Paris"; and "The Art of Knotting."

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New Companies.

The following list is compiled from information supplied by Messrs. Jordan and Sons, Ltd., company registration agents, 116 and 117, Chancery Lane, London, W.C. 2.

JONES & PORDES, LTD. (176 414).—Reg. Aug. 22. 8, Crawford-passage, Farringdon-rd., E.C. 1. Manufacturers of electrical batteries and electric novelties of every kind. Nominal capital, £1000 in 1000 shares of £1 each. Directors, A. E. Jones and M. Pordes. Qualification of directors, £5.

E. GREENHALGH AND SON (Liverpool), Ltd. (176 528), Investment Buildings, 67, Lord Street, Liverpool. Registered August 30, electricians. Nominal capital £1000 in 1000 shares of £1 each. Directors: T. E. K. Greenhalgh and W. F. Brown. Qualification of directors: £100.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF RADIOLOGY AND PHYSIOTHERAPY (176 568). Registered Sept. 1. Every member to contribute a sum not exceeding £1 if necessary. Directors, R. Knox, 38, Harley Street, W.; F. Hernaman-Johnson, O. MacGregor, S. G. Scott, Sir A. D. Reid, S. Melville, and Agnes Saville.

ELECTROLUX, LTD. (176547). Registered August 31, 73, Newman Street, W. 1. To acquire from A. B. Electrolux, Stockholm, the trade mark "Electrolux" and the goodwill of the business carried on by them in England, and to carry on the business of electricians. Nominal capital £5000 in 5000 shares of £1 each. Directors: A. L. Venner-Gren (Chairman), J. Scrivener (managing-director).

TISBURY ELECTRIC SUPPLY COMPANY, LTD. (176 539), Town Mill, Salisbury, Wilts. Registered August 30. To generate and supply electric current for light, power, and any other purpose in or near Tisbury, Wilts. Nominal capital: £6000 in 6000 ordinary shares of £1 each. Minimum subscription: 90 per cent. Directors: A. J. Fippard, W. W. Kendall, A. B. Randall, E. D. Webb, F.S.A. Qualification of Directors: £25.

Forty Years Ago.

(THE ELECTRICIAN, SEPTEMBER 10, 1881)

ELECTRIC LIGHT AT SCARBOROUGH.—The Brush Light has been tried for some days now as a means of lighting the promenade at Scarborough.

ELECTRIC LIGHT AT NORWICH.—The Town Council has been so pleased with Mr. Crompton's lamps as erected in the market place, that they are about to extend them down the Prince of Wales's Road, which leads towards the station.

THE ELECTRICAL TRAMWAY AT PARIS.—Messrs. Siemens' electrical tramway, which runs right into the Exhibition, appears to be a great success, people being very anxious to be transported by means of the mysterious agency which our friends on the other side of the Channel have named the "Queen of the Nineteenth Century."

THE ELECTRIC LIGHT FOR RIVERS.—News from America says that amongst the latest uses to which it is proposed to put the electric light is the illumination of rivers to permit the rafting of logs at night. The Muskegon Boom Company will be the pioneer in this direction. In Baltimore experiments have been made with a view of illuminating water at night to a depth of 200 feet. Such a means of illumination, it is believed, would be of great service in searching for lost treasure and drowned persons, in raising wrecks, removing torpedoes, and in other subaqueous labours.

Prices of Metals, Chemicals, &c.

		Price.	TUESDAY, SEPT. 6.	
			Inc.	Dec.
Copper—	Best selected .. per ton	£70 0 0	£2 0 0	—
	Electro Wirebars ..	£75 0 0	£2 10 0	—
	H.C. wire, basis .. per lb.	0s. 11 ^p .d.	^p .d.	—
	Sheet ..	0s. 11 ^d .d.	^d .d.	—
	Phosphor Bronze Wire (Telephone)—			
	Phosphor-bronze wire, basis ..	1s. 3 ^p .d.	^p .d.	—
Brass 60/40—	Rod, basis ..	0s. 8d.	—	—
	Sheet, basis ..	0s. 10 ^d .d.	—	—
	Wire, basis ..	0s. 11 ^d .d.	—	—
	Pig Iron ..			
	Cleveland Warrants .. per ton	£6 15 0	—	—
	Galvanised steel wire, basis 8 S&W ..	£23 0 0	—	£2 0 0
Lead Pig—	Foreign ..	£24 5 0	—	—
	Foreign or Colonial ..	£23 5 0	—	£0 2 6
Tin—	Ingot ..	£150 10 0	£6 0 0	—
	Wire, basis .. per lb.	2s. 2 ^d .d.	^d .d.	—
	Sal ammoniac.—Per cwt. 65s. 40s.			
	Sulphur (Flowers).—Ton £13.			
	" (Roll-Brimstone).—Per ton			
	" £13.			
	Sulphuric Acid (Pyrites, 168°).—			
	Per ton, £9 17s. 6d.			
	Rubber.—Para fine, 1s. 0 ^d .; plantation 1st latex, 8 ^d .d. lb.			
	The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber prices by W. T. Henley's Telegraph Works, Co.			

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Notes of the Week.

Problems of Physics.

THE presidential address of SIR EDWARD THORPE to the British Association last week gave a fascinating picture of atomic structure, regarded mainly from the chemical standpoint, though he was careful to point out that the aim of new theories must be to provide an explanation satisfactory alike to chemists and physicists. PROF. RICHARDSON, in his address to the physics section, devoted himself mainly to physical phenomena. Einstein's theory he regards as an extraordinary triumph for pure mathematics. It has attracted much public attention, but it is really only one of a number of revolutionary changes. Amongst these the discoveries being made by SIR ERNEST RUTHERFORD at Cambridge, relating to the structure and properties of the nuclei of atoms, are of outstanding importance. The expulsion of hydrogen nuclei from such atoms as nitrogen and phosphorus on bombardment with high-velocity helium nuclei can be proved. Hence, not only the natural, but the artificial transmutation of chemical elements is an accomplished fact. After these preliminary remarks, PROF. RICHARDSON descended a little way from Mt. Olympus, and turned to the discussion of thermionic emission—apparently quite a complex problem. It is now accepted that these phenomena have not a purely chemical origin, but there are still many features, both of photo-electric and thermionic emission, that require elucidation. Contact electricity also appears to be closely related to thermionic emission. Here again experiment tends to disprove the chemical view. Yet another interesting speculation relates to the nature of Röntgen rays, which appear to be essentially similar to ordinary light of very high frequency. Thus the gaps in the spectrum are being all gradually accounted for, and there are now few regions where unknown qualities of radiation exist.

The Laboratory of the Living Organism.

HAVING discussed the intricacies of recent progress in physics and chemistry, we may turn to the address

delivered by DR. FORSTER on the living organism. Although dealing with a decidedly abstruse problem, DR. FORSTER contrived to invest the subject with the glamour of romance. In this material age there is perhaps justification for his condemnation of those who have been beguiled into studying chemistry under the impression that it is what is termed "a good thing." Every educated citizen, he suggests, should realise the intimate part that chemistry plays in daily life. To the average man breakfast is a hurried compromise between hunger and the newspaper. But to the chemist it is a daily miracle that gains rather than loses freshness as the years proceed. In the more technical part of his address, DR. FORSTER discusses the vegetable alkaloids, chlorophyll and hæmoglobin, and touches on what is surely a most poetical series of substances—the anthocyanins or pigments of blossoms and fruits. Finally, he has a few remarks to make on the importance of micro-biochemistry and photo-synthesis. DR. FORSTER naturally emphasises the part played by chemistry in physiology and plant life. We believe that in time to come the relation between electrical phenomena and human life, at present imperfectly understood, will be possibly regarded as an equally important field of knowledge.

True and False Economy.

WE yield to no one in the desire to see economy and economical methods practised in public and private life, but we wish to point out once more that not every item of capital outlay avoided or postponed is a real economy. The facts of each case must be considered on its merits, and if the circumstances justify it, then a progressive business man or public authority should not hesitate to incur expenditure if there is a likelihood of a good return on the monetary outlay. We are led to make these remarks by what transpired at the meeting of the Manchester Corporation last week. The Electricity Committee wanted permission to borrow a further sum of £1 466 743 for the new Barton power station, but at first there was a great outcry against the proposal, partly on account of the largeness of the sum required and partly on the ground that no

capital expenditure should be incurred at present. Fortunately, ALDERMAN DAGNALL, chairman of the Electricity Committee, is a good business man, and he was able to convince the members of the necessity for the expenditure, the proposal being ultimately adopted with only one or two dissentients. Already nearly £2 000 000 has been expended on the scheme, and, as the contracts are on a sliding scale, the Corporation will get the benefit of any reduction in wages or of a fall in raw materials in the shape of reduced contract prices. The contracts with the Metropolitan-Vickers Company represent about £1 500 000, and a stoppage at this stage would be disastrous for the future of the undertaking, and would also mean a claim for heavy damages for breach of contract. Moreover, the supply of electricity in the Manchester area is not adequate to the requirements, and any postponement would simply aggravate the situation. This line of argument was sufficient for the hard-headed business men of the Council, and the Electricity Committee has, therefore, been authorised to proceed with its scheme. There are, however, other local authorities in the country who do not take an equally sensible or long view of things, and to these we would point out that, though trade may be a little depressed at present and things may appear somewhat difficult, there are clear signs of an improvement, and, as a good and sufficient supply of electricity is essential for cheap production, it is a real national economy to be able to meet manufacturers' requirements when the trade boom comes, as we all hope it will very shortly.

The Olympia Exhibition.

THE varied and representative character of the exhibits at the Shipping, Engineering and Machinery Exhibition, which is being held at Olympia this month, is a striking proof of the optimism of the British engineering manufacturer, and of his faith in the future. It also affords a good illustration of the advance made since the last exhibition in 1919. On this occasion there is no Dutch section, but the British exhibits, over 300 in number, are more numerous and more truly representative of British industry. There are many fine displays of electrically-operated tools and transporting machinery, of electric welding plant, of electric, telegraphic and telephonic apparatus, &c., and a description of these will be found on another page. A special feature of the Exhibition is the number of engineering conferences and meetings at which papers will be read and lectures will be delivered. Great prominence appears to be given to the use of oil as a fuel, though this is, perhaps, not to be wondered at, in view of the high price of and difficulty in getting coal during the past few years. Apart from the commercial and business aspects, the Exhibition has also a distinct educational value, and all engineering students and others who take an interest in the welfare and progress of our greatest and most important national industry should pay a visit to Olympia this month.

More Production Essential.

In the course of an interesting speech at the opening luncheon, SIR TREVOR DAWSON pointed out that the many valuable inventions and machines shown at the Exhibition should assist in the cheapening of mass production. The lowering of the cost of production, coupled with the improvement of exchange, will alone enable us to compete successfully with the favourable economic conditions in other European countries. The crux of the problem is production and more production. Happily, there are

signs that the more progressive of the labour leaders already realise this, for MR. FRANK HODGES, who has recently been indulging in some candid talk to the Welsh miners, has told them that their salvation lies in increased output. Even though trade may be depressed at the moment, there can be no doubt of the future if labour co-operates in the development of industry. There are increasing signs that the traditional commonsense and foresight of the British working-man are beginning to assert themselves, and, if reasonably good relations are once established between capital and labour, the export trade, which is so important for the nation, will rapidly revive.

Welfare Work and Factory Lighting.

THOUGH the general public may not at first sight appreciate the connection between welfare work and the lighting of factories and workshops, our readers know that, as a matter of fact, lighting has an important bearing upon the health as well as the safety and efficiency of workers. In many of the large factories and works the owners, realising the advantages of an adequate and efficient lighting system, have remodelled and modernised their lighting arrangements, with most satisfactory results to themselves and to their workpeople. Much propaganda work, however, remains to be done, for in very many cases, more particularly in the smaller works, the lighting is still bad and inefficient. This is partly due to innate conservatism and partly to ignorance of the value of good illumination. Therefore, we gladly welcome the pamphlet on lighting in factories and workshops recently issued by the Welfare Department of the Home Office. Written in a clear and somewhat popular style, it sets out in a brief, though cogent manner the bad effects of defective lighting on workers and on their work, and gives the fundamental requisites of good lighting, the methods of artificial lighting, the illumination required for actual work, and other useful information. Extracts are included from the two reports of the Departmental Committee on Lighting of Factories, together with some appropriate illustrations of bad and good lighting. In our opinion, much good would be done by the distribution of this pamphlet among works managers, foremen, works committees, and others interested in the management or control of factories and workshops. At all events, it will give them a clear idea of the disadvantages and dangers of bad lighting, and once these are realised the progress of modern electric-lighting methods will be even more rapid than it has been.

A Telephone-Telegraph Submarine Cable.

RECENT political events, of which we know too much, have, as an insignificant sequel, necessitated an interesting electrical development in East Prussia, for as the new Polish "corridor" cuts off East Prussia from Pomerania a submarine cable, 170 km. long, has been laid in order to avoid any possibility of an interruption in communications between these two German possessions. This cable is to be used both for telephonic and telegraphic purposes, and contains six double-cores for the former and three single-cores for the latter. Single-core working for telegraph purposes was chosen partly on account of the limited space available, and partly to ensure due economy in copper. This choice was also largely influenced by the fact that it is now possible to reduce electrostatic and electromagnetic induction effects, and so avoid trouble from disturbances of this character. The submarine portion of the cable passes under the Baltic from Leba to Tenkitten, and is connected at the home end with Hamburg, Stettin, and

Berlin, and at the outer end with König-berg. The telephone cores consist of copper wire 1.45 mm. in diameter, and two copper strips, each 27 by 0.35 mm. The telegraphic cores consist of three copper wires, each 0.9 mm. in diameter. The telephonic core is wound with soft iron-wire 0.2 mm. in diameter in two layers and with three layers of paper, which bring the total diameter up to 4.4 mm. Each telegraphic core is wound with four thicknesses of paper, giving an overall external diameter per core of 5.2 mm. The cores themselves are covered with two lead coverings, which are separated from one another by a layer of compound. The thickness of the lead is 1.9 mm., and an interesting point is that no tin has been used in its composition. The whole cable is covered with a lead sheath, which is protected against water pressure by two steel spirals. At intervals of 2 km. insulated plugs are built into the core for localising any damage that may occur. The average diameter of the submarine cable, including the jute protecting coverings, is 52 mm. Laboratory experiments, which were conducted on the cable before laying, indicated that if the lead were of sufficient thickness and were hardened by the addition of a little tin the risk of any breakdown from water pressure would be reduced to a minimum, but, even as it is, experience shows that the cable will be fully able to hold its own. Apart from political reasons, it is, of course, the combination of telephone communication and telegraph communication on the same submarine cable that makes this installation interesting, and its operation under somewhat unusual conditions will therefore be watched with interest, especially now that increased telephone communication between this country and the Continent has become a vital necessity.

The Cost of Power Supply.

It is interesting to find that the views of American electrical engineers on future policy with regard to coal costs and their effects on tariffs correspond very closely with those which have recently been enunciated in this country, though in some ways they go further than even our greatest reformers are inclined to do. This is borne out in a paper read recently before the American Institute of Electrical Engineers by Mr. P. M. LINCOLN, who considered the question of the increasing cost of supplying electrical energy and put forward suggestions on how present rates should be revised to counteract increased production expenses. He pointed out for instance that increases which have taken place affect both the operating costs and the fixed charges. As an example, turbo-generators have increased in price by no less than 225 per cent. over 1914 rates, while motor generators, transformers, and switchgear are also very much more expensive. The result is that steam plant costs in cents per kWh are represented by a figure of 0.603 in 1914, and by a figure of 4.431 in 1920, while for hydro-electric plants the figures are 0.542 and 1.450 respectively.

The Necessity for a Coal Clause.

Mr. LINCOLN, therefore, considers that the increases in operating costs can logically and conveniently be recognised by increasing the energy rate at which power is sold and that this is most fairly done by the incorporation of a coal clause in the power contract. On the other hand, the necessity for increasing the demand portion of the power rate is not so immediately apparent as that for increasing the energy portion. Nevertheless, some upward movement will eventually be necessary here. The reason for this, of course, is that while the increased cost of the equipment is not without its effect on the running rate, it is both economically and commercially sound that the fixed charge

should be based on the actual cost of the plant which supplies the consumer, and not on the amount of equipment which he has himself installed. This necessitates the introduction of power factor into the fixed charge part of the tariff. In our opinion this is rather an extreme view, and though attractive enough at present will lose its glamour when prices begin to fall. Though not invariably economically sound to base the fixed charge on the plant installed, it is in general the method which has the most advantages.

Expensive Simplicity.

In a detached sort of way we have often drawn attention to the design and construction of the outdoor substations which are becoming an increasing feature of American electrical practice. We say detached, because we have pointed out more than once that though designs of this kind offer advantages in first cost, the climate and other conditions present in this country would cause any saving on the capital account to be very much more than outweighed by heavy items in the revenue portion of the balance-sheet. There is, however, yet another side to this question, as is well pointed out in a recent number of the "Elektrotechnische Zeitschrift," where attention is drawn to a tendency to elaborate the design of these substations, so that their fundamental property of simplicity is entirely lost in the process. This simplification the author further considers might well be extended to switchgear in general. He criticises adversely the four-storey type of switch construction, where disconnecting switches are placed on one floor, instruments on the next, switches on the third, and so on, and plumps for a two-storey erection with the bus-bars and disconnectors on the upper floor and everything else below. It is in some such simple way that the outdoor substation began its career, but in the course of its development it has become plastered over with all sorts of excrescences, so that the resulting arrangement is not really more economical than the substation built in accordance with the usual British practice. Whether American engineers will agree with this dictum is, of course, open to question. But there is this lesson to be learned from the arguments put forward: that while in this country safety is a necessity, elaboration is not, and that it may be possible, without increasing in any way the risks to human life, to design both generating and substation switchgear at a less cost but with as great an efficiency as many of the complicated arrangements which are at present employed. This is a thought for the designers of super-stations.

The Economies of Train Control.

THE Institution of Railway Signal Engineers is to be congratulated on its recent discussion of the technical side of automatic train-control. The whole subject is, indeed, one of great importance, for it is admitted that many of the railway accidents that have recently occurred would have been prevented had some method of communicating the position of the signals to the engine-driver other than by the usual visual means been employed. Unfortunately, though there are theoretically many excellent ways of doing this, most of them seem to fail in practice, and the experience of the Institution goes to prove that the more the subject is examined from the operating point of view the more difficult it becomes. In our view, some of this confusion and some of the complications which it induces arise from a very reasonable doubt in the minds of the signal engineers whether the cost that would be necessary to install any one of the possible systems would be worth the complications which would undoubtedly follow, or would

to justify the extra benefits to be obtained thereby. For instance, Mr. THORROWGOOD pointed out that of all the accidents reported on in 1920 only six would have been prevented by automatic train-control, and that the upkeep costs on the apparatus necessary to achieve this meagre result would probably have been in the region of £750 000 a year. He consolidated his arguments that everything is now almost as safe as it ever will be by pointing out that there was only one collision to every three million train-miles run. At first sight this argument is so strong as to be quite watertight. Nevertheless, we stick to the view we have always held that some further control over the engine-drivers' movements than is at present imposed is necessary, and we support this by calling attention to the recent unfortunate accident at Selby.

The Arc as a Factor in Chemical Analysis.

AN interesting account of the use that can be made of the electric arc in the chemical analysis of metals is given by Mr. W. ROY MORR, of the National Carbon Co., Ohio, in a recent issue of the "Transactions" of the American Electrochemical Society. Mr. MORR conducts his analysis by drilling a hole $\frac{3}{8}$ in. in diameter and depth into the positive carbon of an arc, ordinary high-grade, enclosed arc carbons about $\frac{1}{2}$ in. in diameter and not containing more than 0.1 per cent. of ash being employed. About $\frac{1}{2}$ gm. of the substance to be analysed is placed in this carbon cup, and an arc taking about 25 A at 50 V is started. The material in the cup is then devolatilised, only the most refractory residue remaining, the more volatile portions condensing on the lower and upper carbon in beads, mirrors or rings. These rings consist partly of exceedingly fine particles, with the least volatile close to the crater, and conclusions as to the volatility can be drawn by measuring the distance of the deposits from the carbon tips, or from distinct rings of iron which are first deposited. Mr. MORR has conducted a series of experiments in various other ways slightly modified from those just described, and has deduced from the results he has obtained a series of boiling points of the various refractory metals, together with such properties as odour, vapour, and flame coloration, which allow the various metals to be detected, even when such small quantities as 0.02 milligrammes are present. The method is both rapid and accurate, and appears to offer exceedingly good prospects for carrying out what has up to now been an extremely difficult problem.

Results from Hereford.

AS readers of THE ELECTRICIAN well know the Hereford Corporation Electricity undertaking possesses features of interest to electrical engineers on account of its enterprise in extending electricity supply into the adjoining rural areas. Unfortunately, this enterprise has not yet had its reward. For while the accounts of the department for the year ended March last, which have been audited by a firm of accountants, show a gross profit of £3 751, after paying interest and sinking fund charges, a deficit of £491 on the year was realised. This is partly due to the increase in the fuel cost per unit from 0.33d. to 0.47d., but, nevertheless, the present figure is still probably the lowest in the kingdom. This is due to the use of blast furnace coke oven dust as the sole fuel. Separate accounts are kept of the rural supply section of the undertaking, because the Treasury have guaranteed to make a contribution for interest and other charges, so that the results obtained from this work are easy to visualise. Of the increase of 147 358 in

the total units sold during the past year, the consumers on the rural mains took 87 505. Although supply has only been available for a short time there are already 49 consumers in the rural districts, and it is stated that current is being sent out to the rural mains at the rate of 10 000 units a week. Extensions of the mains are being made as required, and the main supply line to Lydbrook is in course of erection, so that the demand is likely to increase considerably. So far the capital outlay on this work amounts to £31 692, and though there was a deficit of £1 827 on the year's working, a sum of £1 612 will be obtained from the Treasury, making the actual loss relatively small, and next year's accounts should show a profit.

Electrical Testing in Canada.

SOME idea of the predominant position occupied by electricity as an illuminant and a power agent in Canada may be gained from the figures recently published by Mr. ORMOND HIGMAN, director of the Dominion Electricity and Gas Inspection Services and Laboratories. In the year 1896-7 the number of electricity meters and gas meters tested by the department was 5 762, and 16 987 respectively, but in the year ended March last the corresponding figures were 223 062 and 99 319. There are now nearly a hundred inspectors at work throughout the country, though complaint is made that central stations, and the electrical industry generally, are slow in taking advantage of the facilities offered for the standardisation of instruments. The main testing laboratory is at Ottawa, but two branch standardising laboratories have been established at Vancouver and Winnipeg, as it was found that delicate instruments were affected by vibration in rail transit. Mr. HIGMAN states that, after careful observation of the baneful effects of long distance travel on delicate electrical instruments, he was forced to the conclusion that accuracy could not be depended upon if an instrument was sent by express beyond a distance of 500 or 600 miles.

Water Power Problems.

IT is a matter for congratulation that so large a part of the proceedings of the Engineering Section of the British Association was devoted to addresses, papers, and discussions on water power development, and that special attention was paid to Prof. A. H. GIBSON's address, of which an account will be found on another page of this issue. Water power development is a subject upon which even engineers hold vague and often erroneous opinions, while the view of that wider circle of the public to whom the doings of the British Association are primarily intended to appeal may be succinctly summarised in the sentence that this country is far behind the whole world in hydro-electric practice. The cause of this time lag is, in accordance with personal predilection, due either to the Government, the trade unions, the landlords, the electrical manufacturers, or those responsible for managing electricity supply undertakings.

Two Important Factors.

In reality, however, the question can receive no such simple solution, and it is therefore worth while to spend a little time in discussing this slow development, if it be slow, and in discovering what are the obstacles to progress, if there are any. As Prof. GIBSON rightly says, the problems connected with the development of water power are partly technical and partly commercial. And while it is true that he sometimes forgets the importance of this dictum, it is these two factors which engineers concerned with the

employment of water power and those many classes of the community which are increasingly concerned with the use of power for industrial and domestic purposes must ever bear in mind. That general problem may, in fact, be stated thus: Cheap power is essential for every industrial process, cheap power in large quantities over long and continuous periods is required in certain electro-chemical processes, while the same sort of load, though less in quantity, is required for driving pumps in mines and at waterworks, and we hope will also shortly be required for certain phases of the domestic load. Can this cheap power be obtained better by developing what water power we possess, or by continuing to use our present fuel resources? If it can, in what proportion can it be so used, and how are we to set about using it as economically as possible?

Hydro-Electric Conditions in Great Britain.

If we envisage conditions in this country we find, as has often been pointed out before, that, while a fair amount of water power is available, that power is situated in the remote fastnesses of Scotland, Wales, and Dartmoor, and is then generally present only in small and, taken over the year, in varying quantities. As is equally well known, the industries of the country are based on the coalfields, and to utilise such water powers as we do possess without a re-orientation of these industries would require an expenditure on transmission lines of a magnitude which is not economically possible, at least at present. It would render the supply liable to constant interruption, and probably at the same time necessitate by reason of the uncertainty so caused the erection and use of extensive standby steam plant.

A Strong Economic Argument.

It is this economic argument which, much more than statistics of coal consumption or the financial advantages to be gained from the use of water power, will, we feel certain, prevent any wide departure from our present methods of working. That this is so is perhaps just as well, for even taking at its face value Prof. GIBSON's somewhat ingenuous statement that the water powers of the United Kingdom are capable of supplying about 27 per cent. of the present annual demand for power, it is obvious that this water power cannot do more than assist very slightly in providing the energy which our industries necessarily require and will continue to require in ever-growing quantities. It is as well that this fact should be emphasised, for there is no doubt a very considerable opinion exists that the solution of some of our present difficulties in the generation of electricity is to be found in the wider use of what water power we have at our command, and that engineers, electrical and otherwise, cannot be held blameless for their lack of enterprise in this respect.

An exception to this general rule in this country may be made in certain cases, which Prof. GIBSON very fairly details, where water power can be cheaply and easily developed for supplying adjacent communities or for feeding into larger networks, as has been done in the case of waste heat stations, and the load factor of a wide distribution system thereby improved. Many schemes of this character are being thought out in Scotland, and for both economic and technical reasons should be assured of success. These, however, are special cases, and are really no exception to the general rule we have detailed above.

The Water Power of the Empire.

The cold water which we have thrown on the opinions of certain enthusiasts need not, however, be sprinkled on

the very much wider development of hydro-electric resources which may before long be expected to take place in other parts of the Empire. As Prof. GIBSON shows, in nearly every dominion and colony large water powers are available, and in nearly every dominion and colony it should be possible to use these powers with economic success, either as an auxiliary to a steam station for supplying a town in conjunction with railway electrification, or on large electro-chemical developments. Under such conditions, especially where coal is scarce, water power is likely to become of ever-increasing importance, and to be required more and more as the resources of the country are developed.

Technical Problems.

So far we have dealt entirely with the economic side of the hydro-electric problems. It is undoubtedly the most pressing side, for until we are clear what our general and particular policy is to be, no real advance can be made. It is particularly important in this country, where the details are complicated and not easy to solve in general terms.

Nevertheless, the technical problems connected with hydro-electric development are more numerous than the economic, and just as urgently require solution. Prof. GIBSON is to be congratulated on making this clear and in laying down succinctly not only the advances that have been made in accordance with past experience, but the directions in which past experience shows advances must be made in the future. These problems include on the hydraulic side such matters as corrosion and erosion, bucket and draft tube design, methods of strengthening pipes, lining canals, and boring pressure tunnels, the effects of curvature in a canal tunnel, and the most efficient methods of constructing dams. On the more purely electrical side they include the combined operation of steam and water-power plants to give maximum all-round efficiency, the relative advantages of high voltage a.c. and d.c. generation and transmission, and the operation of automatic and semi-automatic generating stations. They also include an engineering and financial and, we might add, sober investigation into the various problems connected with the utilisation of tidal power.

The Need for the Expert.

It is axiomatic that all this work which is eminently necessary must be conducted by those with expert knowledge of the variety of problems connected with water power development. Unfortunately, in this country those experts are not available. Before, therefore, we can set about an economic utilisation of the water power of the Empire, unless we are to rely solely on outside help, we must train men in a knowledge of these subjects, and establish some organisation by which the many problems in connection with this question can be properly investigated. As Prof. GIBSON says: "What is required is a research laboratory, with facilities for experiments on the flow of water on a fairly large scale; for carrying out turbine tests on models of sufficient capacity to serve as a basis for design; and, if possible, working in conjunction with one or more of the hydro-electric stations already in existence at which certain large scale work might be carried out." We agree that it is only in this way that a corps of designers and operators, thoroughly acquainted with all phases of the work, can be recruited, for experience has amply shown that laboratories can be of the greatest assistance in the work of industrial development.

THE CIRCLE DIAGRAM FOR CLOSED SLOTS.

By H. K. WHITEHORN, B.Sc. (Lond.), A.M.I.E.E.

Judging from some comparatively recent patent specifications, it seems that there are instances where it is considered necessary to employ completely closed slots in induction motors, either for the stator or rotor, or both. The author has made some tests (extending over a considerable period) on three-phase motors* of 20 h.p. with closed slots, and in his search for papers or information on the subject found it mentioned only by Behrend† and Biedermann‡. It is the aim in this article to emphasise the difference between certain characteristics when completely-closed slots are used instead of semi-closed slots in three-phase induction motors.

In dealing with a.c. motor design the circle diagram is of very great importance to the designer. It is from test results of previous machines that the best material is obtained to serve as data for other designs, and a reliable short-circuit

and the short-circuit characteristic becomes a curve instead of the straight line represented by the formula. Therefore the short-circuit current at full voltage cannot be estimated correctly from test readings of the short-circuit current on



reading is essential, as it is impossible to get a trustworthy circle diagram from only the no-load and full-load test readings.

Importance of Short-Circuit Point.

The short-circuit point should represent, in phase and value, the actual current that would be taken by the stator if full voltage were applied to the motor terminals while the rotor circuit is short-circuited (or closed, just as for the full-load condition). Of course, in the case of squirrel-cage motors there is no possibility of altering the condition of the rotor windings. It is seldom possible to get the test-reading of short-circuit at full voltage (due to overheating), and all text-books and writers on this matter advise taking a test reading at a convenient lower voltage, say one-quarter of full voltage, and estimating from this the short-circuit point at full voltage, by the following formula:—

$$C = C_1 \frac{V}{V_1}$$

where V is full line voltage, V_1 is line voltage at which the short-circuit test is made, C_1 is the current reading in short-circuit test at voltage V_1 , and C is the short-circuit current at full voltage, required.

The formula is *only true* in the case of open or semi-closed

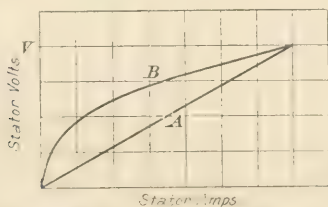


Fig. 4. SHORT CIRCUIT CURVE WITH LOCKED ROTOR.
A. With semi-closed slots (in stator and rotor).
B. With closed slots (in stator and rotor).

slots, as in Fig. 1 and Fig. 2 respectively. Previous writers have failed to point out this fact. There are instances where it is thought necessary to use completely-closed slots for some special reason of manufacture or other requirement.

The Effect of Closed Slots.

With closed slots (as in Fig. 3) having a complete bridge across the mouth of the slot, the above formula ceases to apply.

* With squirrel-cage rotors.
† The Induction Motor, by B. A. Behrend, Elec. World (New York), 1901.
‡ "The Estimation of the Dispersion Coefficient." E. A. Biedermann, ELECTRICIAN, Booklet.

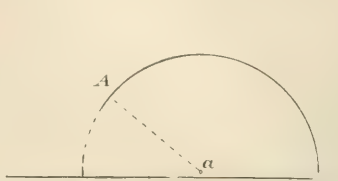


FIG. 5.—CIRCLE DIAGRAM, SEMI-CLOSED SLOTS.

lower voltages. Fig. 4 shows the difference between the short-circuit characteristics for semi-closed and closed slots, A and B respectively.

The most important effect of the complete bridge on the stator or rotor slot is the difference made in the circle diagram; and Fig. 5 indicates the standard diagram with semi-closed slot; whereas Fig. 6 shows the circle diagram with the closed slot—the slot having a bridge of the smallest practicable dimension. The effect is equivalent to a displacement of the centre of the circle below the base line by an amount depending on the thickness of the bridge. It would not be safe in practice to let the bridge be less than 0.03 or $\frac{1}{32}$ in. in case the bridge should break during assembly of the laminations. A reasonable thickness is 0.04 in. to 0.045 in., and

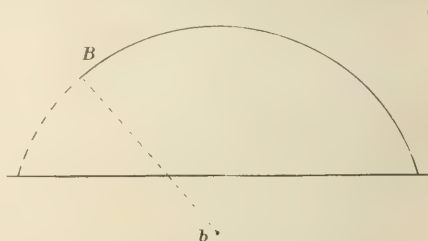


FIG. 6.—CIRCLE DIAGRAM, CLOSED SLOTS.

the bridge must certainly be of this thickness when the stator laminations are ground after assembly in the stator frame.

The comparison is better indicated in Fig. 7, where circles such as those in Figs. 5 and 6 are brought together, and the circles are for two motors of exactly similar design and dimensions, except that one, A, has semi-closed slots, while the other, B, has closed slots with a bridge thickness of 0.04 in., but the mechanical clearance in the air-gap is the same in both cases. The reluctance of the air-gap is naturally less in the case of the closed slot, which accounts for the lower value of the no-load current in this instance. It will be seen that the power factor at normal load is lower for the closed-slot design, since the angle VOQ is greater than the angle VOP.

TABLE I.—Showing differences of power factor in Fig. 7.

Percentage of full-load Amps.	Power Factor of	
	Circle A. Semi-closed slots.	Circle B. Closed slots.
125	0.84	0.80
100	0.85	0.81
75	0.86	0.8
50	0.80	0.80

The diameter of the closed-slot circle is much larger than that of the semi-closed design, which tends to equalise the power factor in the two cases. The power factors differ considerably, however, and an indication of their value is given in Table I.

Closed Stator and Semi-Closed Rotor Slots.

A further variation is brought into the comparison of Fig. 8 for the case of a machine with closed stator slots and semi-closed rotor slots. In Fig. 8 the three curves represented are: (A) Stator and rotor slots both semi-closed; (B) stator slots and rotor slots completely closed; (C) stator slots closed, rotor slots semi-closed. Therefore case (A) and case (B) are

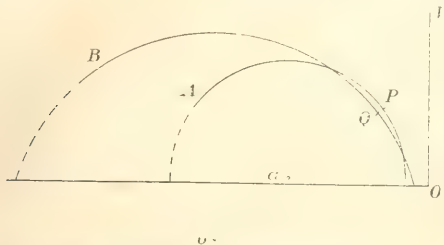


FIG. 7.—CIRCLE DIAGRAMS OF FIGS. 5 AND 6 FOR TWO MOTORS OF SAME TYPE, AIR-GAP, AND CORE SIZE.

- A. Semi-closed slots.
- B. Closed slots.

the same as the corresponding curves of Fig. 7. It is noticed that by making the rotor slots semi-closed as case (C), Fig. 8, the centre of the circle is raised considerably nearer the base line, and the diameter of the circle is reduced.

Relation Between Starting Torque and Current.

Another interesting comparison is the shape of the curve due to Dr. S. P. Smith* connecting starting torque and current when resistance is inserted between the line and the stator terminals, and the shape of the curve B of Fig. 4. This suggested a line of tests, in which measurements of the short-circuit current were to have been made at line voltage but with some resistance inserted between line and stator terminals. The aim was to determine the value of resistance required to bring the closed-slot circle in agreement with the semi-closed-slot circle on certain points. In this connection compare a paper by Mr. J. K. Catterson-Smith, on "Induction Motor Design."†

These tests were planned, when a most unfortunate occurrence destroyed the special machines, the measuring instruments and the records. It is regretted that for this reason

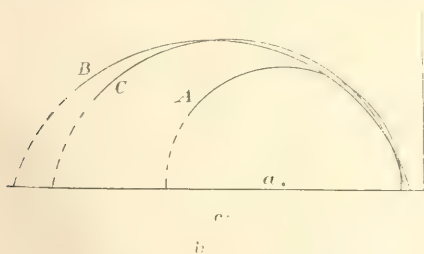


FIG. 8.—CIRCLE DIAGRAMS FOR THREE MOTORS OF SAME TYPE, AIR-GAP, AND CORE SIZE.

- A. All slots semi-closed.
- B. All slots closed.
- C. Stator closed, Rotor semi-closed.

the recorded figures cannot be reproduced in this article. The foregoing diagrams give the facts as clearly as possible from memory of the analysed results. Several tabulated values of the increased iron losses due to the bridge on closed slots, and comparisons with loss analysis on ordinary motors, were lost with the rest of the results, and they are not likely to be reproduced by the author. They bore full testimony

to Behrend's opinion that opening the slots has a decided tendency to diminish the load loss, and that he considered the seat of this waste of energy to be the bridges of the closed slot. The cases dealt with by Behrend, however, had a bridge thickness of too small a value for general manufacturing—0.01 in.—i.e., 10 mils.—so his losses proved less than in the case of 0.04 bridge.

The case of a very thick bridge—say, $\frac{1}{8}$ to $\frac{1}{4}$ in.—leads to very large stator leakage, low-power factor, and poor efficiency.

It is essential to make sure what a writer really means by "closed" slot, as Mr. B. F. Bailey, in "The Induction Motor,"* states (page 126): "When, therefore, closed slots are referred to, partially closed slots are meant . . ." And some comparisons that he makes later are liable to be misleading, in view of the facts brought out in the present article.

Large German Transformers.

A recent issue of the "Zeitschrift des Vereines Deutscher Ingenieure" contains an article by Dr. Walter Reichel on high-tension transformers and converting plant. In this the author states that there are several 60 000 kVA transformers in operation in Germany, and that an increase in size of three-phase transformers to 75,000 kVA is easily possible.

In the original article illustrations show the plan of a 60 000 kVA three-phase, 50-cycle, 110 kV transformer, together with a general arrangement of the huge cooling outfit. The complete weight is stated to be 150 tons, or 55 lb. per kVA, and the unit weight per kVA does not decrease appreciably for larger capacities. The cooling problem also is difficult, but the author says that it can be safely handled. The method employed for these large units is forced oil circulation, maintained by electrically driven pumps, with external cooling. The use of an oil "conservator," which excludes air from contact with the hot oil, is strongly advocated. The weight of a 75 000 kVA unit would probably be about 184 tons, or 54 lb. per kVA. It is said that many 30 000 kVA three-phase transformers have been built in Germany for 110 000 V. The weight of the 30 000 kVA unit is 80 tons, including oil, or about 5.88 lb. per kVA.

Regarding the present limit of conversion machines, the author says that there is no demand for very large sizes of any kind of converters, as only part of the generated energy will be transformed to direct current. A size of 10 000 kVA, although not reached as yet, seems to be the ultimate limit. As a typical example of the use of large motor-generator sets, Dr. Reichel gives details of an installation of several three-machine units—one motor and two d.c. dynamos. The synchronous three-phase motor is rated at 4 000 kVA, 5 200 V, 500 revs. per min. (50 cycles), delivering 3 800 kW (270 V and 14 000 A) from two d.c. generators with two commutators each. The unit weight amounts to 64 lb. per kW. With higher d.c. voltage the output could easily be increased to 6 000 kW at the same speed, or to 10 000 kW with increased speed. At 500 revs. per min. a d.c. output of 3 000 kW per generator seems to be the possible limit. Cascade converters have been built up to 4 000 kW (250 revs. per min., 510 V, d.c.), and an increase to 6 000 kW is regarded as the limit.

As to the maximum output of rotaries, this is said to be largely limited by the d.c. side. A d.c. voltage of 250 is about the lowest possible on account of insurmountable difficulties with the commutator and the collector rings. Several machines of 3 500 kW (250 V and 14 000 A) are in operation for chemical purposes. An upper limit of 5 000 kW, 520 V, at 214 revs. per min., has been reached successfully. The author also gives a schematic design for a converter of 10 000 kW (500 V, 20 000 A, 94 revs. per min.), with a probable unit weight of 29.8 lb. per kW in the original, and this is considered to be the limit which can be attained.

* "Papers on Design of Dynamo-Elec. Machinery," by Smith, Hawkins, and Neville. (Pitman.) 1918, p. 355, Fig. 10.
† J. Inst. Elec. Eng. Vol. 49 (1912), p. 635.

* "The Induction Motor," by B. F. Bailey. McGraw Hill (New York).

ELECTRIC TRACTION IN SWITZERLAND.

Oerlikon Locomotives for the Swiss Railways.

(Concluded from page 326.)

During recent years the Swiss State Railways have placed orders with the Oerlikon Company, in conjunction with la Société Suisse pour la Construction de Locomotives et de Machines, for a number of electric locomotives. Of these, two are intended for use for the express service between Lucerne and Chiasso, one being of the type 1-B+B-1, and the other of the smaller type 1-C-1. The length of the line is 225 km., and the locomotives can make three return journeys in the 24 hours, including 15 minutes turning time at each terminus, the load hauled being 425 tons. On gradients exceeding 21 in 1 000 an additional locomotive of the 1-C-1 type is used. This latter locomotive can haul a load of 215 tons up a gradient of 26 in 1 000, at a speed of 50 km. per hour, the more powerful locomotive being capable of hauling 300 tons under the same conditions. When starting up an incline of 26 in 1 000, the normal running speed of 50 km. per hour is reached in four minutes.

Goods Locomotive Details.

The other locomotives are of the 1-C+C-1 type, 23 in all being ordered, and delivery commenced in 1920. These locomotives are intended for the goods trains on the line Gothard Lucerne-Chiasso, and can traverse the section Goldau-Chiasso with a load of 860 tons twice in 28 hours, including a stop of 15 minutes at each of the termini. On gradients exceeding 1 in 100 two locomotives are coupled together. For a single locomotive on the section Chiasso-Bellinzona, the load hauled will not exceed 625 tons.

The locomotives must be able to haul a load of 430 tons at a speed of 35 km. per hour up an incline of 26 in 1 000, and a load of 300 tons at 50 km. per hour up a gradient of 26 in 1 000, and at 65 km. per hour up a gradient of 10 in 1 000. In addition, they must be capable of handling on a slope of 26 in 1 000, an overload of 20 per cent. for 15 minutes, the extra load being due either to an increased tractive effort, or to an increased speed, or to both. At starting, trains of 430 tons and 300 tons must be accelerated in 4 minutes to speeds of 35 and 50 km. per hour respectively up an incline of 26 in 1 000. The maximum speed of 65 km. per hour, which can be reached on an incline of 10 in 1 000 by these locomotives with a load of 300 tons, permits of their being used for passenger trains and for express trains on mountain lines. The power developed at a speed of 35 km. per hour (measured at the rim of the driving wheels) is 1 700 H.P. continuously, 2 200 H.P. for $\frac{1}{2}$ hours and 2 600 H.P. for $\frac{1}{4}$ hour,

the corresponding tractive effort being 13 100 kg., 17 000 kg., and continuously and for $\frac{1}{2}$ hours respectively. The tractive effort at starting is 22 000 to 24 000 kg.

The main dimensions of the three locomotives are given in tabular form below.

Supply System.—Single phase alternating current.

Voltage.—15 000-7 500 $\pm$ 5 per cent. or — 15 per cent.

Frequency.—16.67 $\pm$ 0.5 per sec.

Height of trolley wire.—4.8 to 7 metres above the rail.

Locomotive Characteristics.	1-C-1	1-B+B-1	1-C+C-1
Power developed for $\frac{1}{2}$ hrs. in H.P.	1 650	2 250	2 200
Tractive effort in kg.	8 900	12 000	17 000
Maximum tractive effort .	13 500	18 000	
Normal speed, km. per hr.	50	50	
Maximum speed	75	75	65
Length between buffers, m.	13.5	16.2	19.4
Total wheel base	10.0	13.2	16.5
Fixed wheel base	4.7	2.9	4.7
Diameter of driving wheels, in.	1.35	1.35	1.35
Diameter of pony wheels. .	0.93	0.93	0.93
Gear ratio	1 : 2.84	1 : 3.49	1 : 4.03
Weight of mechanical portion, tons	46.5	58.5	70.6
Weight of electrical equipment, tons	44.5	54.5	56.4
Total weight of locomotive tons	91	113	128
Load on axles, tons ... {	16.25	16.5	18.2
	+3 x 19.5	+4 x 20	+4 x 16.9
	+16.25	+16.5	+18.2
			+12
Adhesive weight, tons ..	58.5	80	104
Weight per metre run, tons	6.75	7	6.6
Coefficient of adhesion for tractive effort developed for $\frac{1}{2}$ hours	1 : 6.6	1 : 6.7	1 : 6.1
Ditto at starting	1 : 4.3	1 : 4.4	1 : 4.73 to 1 : 4.33

Express Locomotive 1-C-1.

The chassis of the express locomotive rests on three coupled axles and leading and trailing pony axles (Fig. 9.) These latter are of the Bissell radial type having a lateral play of 2 x 80 mm., being brought back to their mean position by means of laminated springs. The central axle has 2 x 25 mm. lateral play, to improve the action

shaft through spur wheels, the reduction ratio being 1 : 2.84, the wheels being driven through scotch yokes and coupling rods. The pinions are fitted to the motor shafts by means of flexible couplings.

The cab contains five compartments, including a driving cabin at each end, two transformer cabins, and the central cabin containing

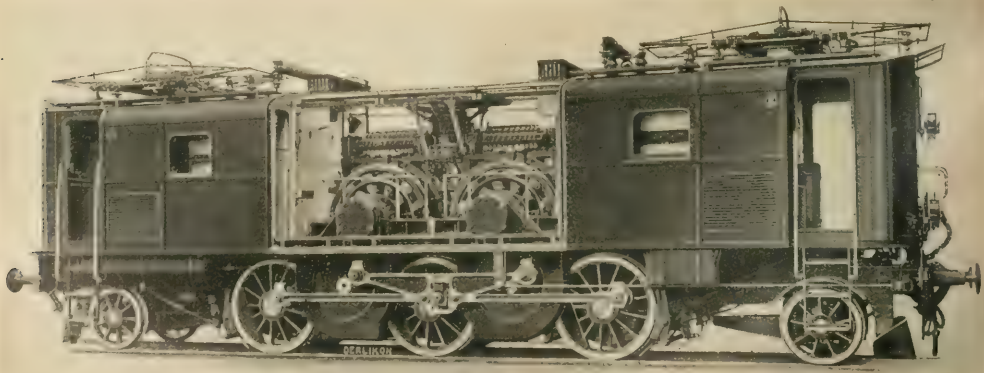


FIG. 9. VIEW OF OERLIKON 1-C-1 EXPRESS LOCOMOTIVE OF SWISS RAILWAYS.

on curves. As in the case of the Lötschberg locomotives two high-speed motors are used, placed back to back at the centre of the cab, with their shafts above the floor. The shaft of each motor carries a pinion at each end, making a total of four pinions driving the jack

the motors. Large movable panels are fitted in the roof and the sides to facilitate the dismantling of the transformers and motors. Braking of the locomotive is effected by 12 brake blocks acting on the coupled axles, and furnishing an effort equal to 80 per cent. of

the adhesive weight. There are two symmetrical parts to the brake system, each controlled independently by its own cylinder. For hand braking only four blocks acting on the two outside axles and two on the central axle are used.

Rhaetian locomotives for several years, and has been eminently satisfactory.

The motors are fed by two dry insulated air blast transformers, each transformer being connected to the corresponding motor by a



FIG. 10. VIEW OF 1-B-B-1 EXPRESS LOCOMOTIVE

Electrical Equipment.

The two motors each can develop continuously 675 H.P. at the rim of the driving wheels at a speed of 50 km. per hour, and 825 H.P. for $1\frac{1}{2}$ hours. They are of the compensated series type, 12 poles, and are provided with the Oerlikon patented method of obtaining the correct phase for the commutating field. The direction of rotation is reversed by reversing the connections of the exciting circuit by means of an electro-pneumatic reversing switch mounted above the motors.

The arrangement of the motor group at the centre of the locomotive determined by mechanical considerations, necessitates the employment of a double equipment in order to distribute the load equally between the axles. In addition, the use of this double equipment permits of a method of control in which the contactors are operated

contactor in series with a current transformer, feeding the overload release, and with a reactance coil. The contactor is mounted on the top of the transformer. In general the two low tension circuits, consisting each of one transformer and one motor, are joined in series to form a single closed circuit. In case of need, however, the following connections can be made by means of a special grouping switch:

1. Each transformer supplies its own motor, so that in the event of a breakdown of one of the motors, the motor-transformer group in question can be completely isolated. The locomotive can then continue to operate at full speed, developing, of course, one-half of normal tractive effort.

2. Either of the transformers supplies both motors. The locomotive then develops normal tractive effort at half-speed. The high

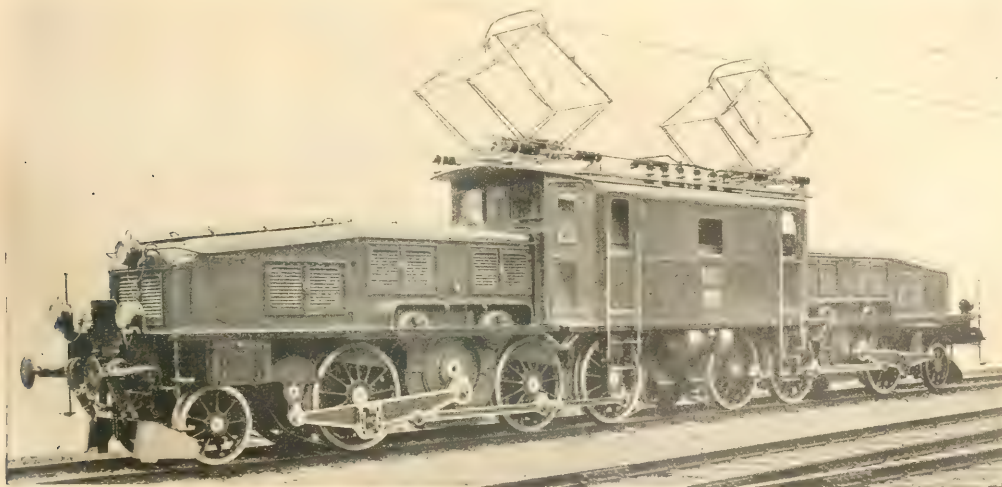


FIG. 11. VIEW OF 1-C-C-1 FREIGHT LOCOMOTIVE

alternately, so that by using two contactors and 12 tappings, 23 different speeds can be obtained. The control is effected electro-pneumatically, and can be worked by hand in case of need. A similar method of control has been in use on the Loetschberg and

tension circuit includes: Two pantographs, two reactance coils for protection against voltage surges, &c., two isolating switches, two high tension leading in insulators, two oil-immersed circuit breakers, the two primary windings of the static transformers, two current

transformers to operate the automatic overload releases, a potential transformer feeding the measuring instruments, and two earthing shoes. The pantographs are of the standard Oerlikon pattern and

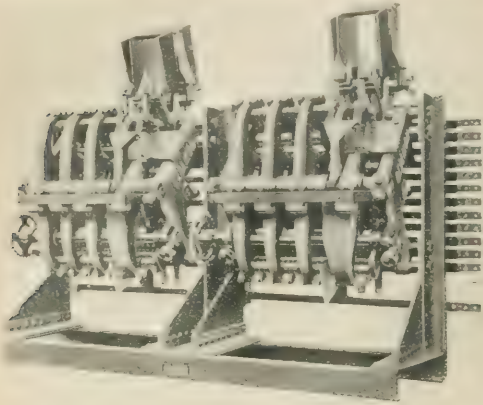


FIG. 12. HAND OPERATED "GRADUATOR" SWITCH

are designed to operate for a trolley wire at a height of from 4.8 to 7 metres. Equilibrium of the pantograph is maintained by a system of springs and an air damping device—an arrangement independent of temperature variations. The bow is operated pneumatically, a hand pump being used when the compressed air reservoirs are empty, as, for example, after a long stop. The isolating switches mounted on the roof serving to cut out a defective bow or one of the high tension groups can be operated from the inside of the locomotive by means of a key which is also used to open the lock closing the high tension compartment. These operations can only be carried out when the pantographs are lowered, and as soon as the safety lock is opened the high tension circuit is automatically connected to earth.

Control Arrangements.

The high tension oil-immersed circuit breakers are operated from either of the driving cabins, electro-pneumatically for closing and electro-magnetically for opening. If necessary, however, they can be operated by hand. They are fitted with automatic overload and no-voltage releases. A shock resistance having three studs protects the transformer and its circuit breaker from voltage surges on closing and opening the switch.

The equipment of the locomotive is completed by the following auxiliary apparatus: two electrically driven compressors, one or three electrically driven fans, and a motor generator connected to a storage battery. The auxiliary machines are all operated at 100 V, obtained at will from either of the transformers. The compressors supply the air necessary for the brakes and for the various pneumatic controls, and have an output of about 1 200 litres of air per minute

The 1—B + B—1 express locomotive consists of two bogies of the type 1—B, and a chassis covering the two bogies completely and carrying the cab of the locomotive (Fig. 10).

The Bissel axle is restored to its mean position by an arrangement of inclined planes, and not by springs as with the locomotive 1—C—1. Each bogie carries between the two driving axles two motors on which are mounted a reverser and a centrifugal fan for their ventilation. The shaft of each motor carries a pinion at each end, driven through a flexible coupling, making a total of four pinions driving the gear wheels fitted on a single jack shaft, the reduction ratio being 1:3.49. The turning moment is transmitted from the jack shaft to the driving wheels by means of two cranks at 90 degrees. The air for cooling the motors, &c., is taken in through Venetian shutters at the sides of the locomotive, the shutters being operated by compressed air. The brakes on each bogie are operated respectively by two cylinders. Hand braking only acts on the driving wheels of the bogie underneath the driving cabin that is being used, the braking-

at a pressure of from 5 to 7 atmos. They are controlled by a switch placed in the driver's cabin. An automatic air pressure regulator maintains the air pressure at the required value. A fan delivering 600 cm. of air per minute under a head of 15 mm. of water is fixed on the floor of the motor compartment and renews the air therein. Each transformer may be ventilated separately by a fan delivering 75 cm. per minute under a head of 70 mm. of water.

The motor generator consists of a single phase asynchronous motor driving a shunt wound d.c. generator connected in parallel with two storage batteries, for furnishing the current necessary for the various electrical controls and for lighting the locomotive. In addition to the two circuits of the main and auxiliary motors, the transformers feed a third circuit for electrically heating the train, the maximum current for this purpose being 400 A at 2 × 500 V.

The locomotive is fitted for multiple unit control so that it can be

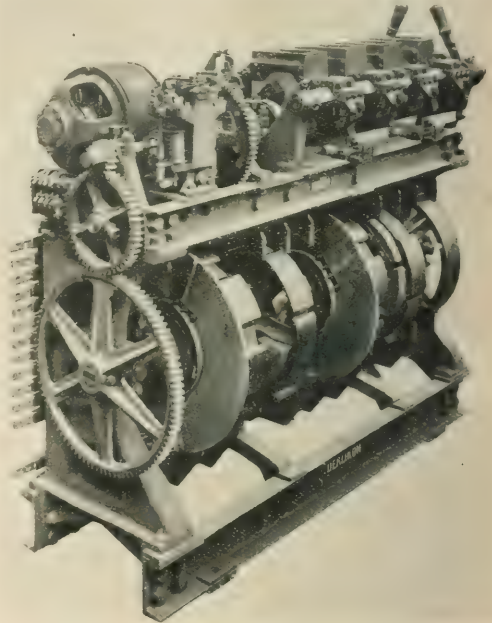


FIG. 13.—MECHANICALLY OPERATED "GRADUATOR" SWITCH.

coupled to another locomotive. In this case the control of the two locomotives can be carried out by a single driver in the leading locomotive. An ammeter fitted in the cabin enables him to follow the behaviour of the motors on the other locomotive.

effect thus developed being equal to approximately 40 per cent. of the adhesive weight.

Electrical Equipment.

The line voltage of 15 000 or 7 500 V is reduced to that necessary for the motors by means of a single oil-cooled transformer placed at the centre of the locomotive. The low tension winding is in two parts, each having 11 intermediate tapplings, which, by means of contactors, permit of 23 running speeds being obtained as with the 1—C—1 locomotive. The contactor-controllers are electrically operated. The motors are wound with 10 poles and can develop 450 h.p. continuously at the rim of the driving wheels at a speed of 50 km. per hour, and approximately 560 h.p. for 1½ hours. The general arrangement of the connections, &c., is the same as for the locomotive 1—C—1, but in addition the equipment is fitted for a regenerative method of electric braking (see description of the method of braking used for the freight locomotive 1—C + C—1).

Electric Freight Locomotives 1—C + C—1.

The mechanical construction of the 1—C + C—1 freight locomotives is much on the same lines as in the case of the type just described. There are three driving axles to each bogie, and the pony axles are brought back to their normal position, after passing

curves, by means of laminated springs. The two bogies are completely interchangeable and coupled together by an arrangement including a laminated spring and serving to transmit the tractive effort from one bogie to the other

The two motors on each bogie are mounted rigidly between the first and the second driving axles, and drive a jack shaft through pinions and gear wheels, the reduction being 1:4.03. The leading driving axle is driven from the jack shaft and the driving wheels coupled as shown in Fig. 11.

Using compressed air, a braking effect up to 80 per cent. of the adhesive weight of the locomotive can be obtained, and with hand braking, acting on a single bogie, up to 90 per cent. of the adhesive weight of the bogie. The body of the locomotive is in three parts. The two end portions are mounted directly on the bogies, whilst the cab rests upon both bogies. The portions of the electrical equipment housed in the two end portions are only covered with a low sheet iron protection (Fig. 9) whilst the portion provided for the cab, and containing chiefly the transformer and the control desks, remains free. This arrangement has the advantage that, owing to its reduced length, the cab can readily be lifted in spite of its substantial construction.

Electrical Equipment.

The arrangement of the electrical equipment is much on the same lines as that of the 1—B+B—1 locomotive. The transformer is designed for a primary voltage of 15 000 or 7 500 V at 16.67 periods per second. Variations of +5 per cent. and 15 per cent. from normal voltage may be compensated for by auxiliary windings on the low tension winding. During the early days of the electrification of the line steam locomotives will also be operating, and the line voltage will be maintained at about 7 500 V, and the primary winding of the transformer has been arranged in four sections. The connections between these sections are adjusted outside the transformer to suit the working voltage. There are two independent low tension windings, one for feeding the main and auxiliary

with windings for 1 000 and 800 V, to permit of the heating being regulated; the winding is designed for 400 kW at 1 000 V, and a maximum of 480 kW at 1 180 V.

The main switch is constructed in such a manner that its cover may be regarded as forming an integral part of the roof; a similar construction is used with the safety earthing switch generally mounted outside the main circuit breaker. As a result there is nothing inside the locomotive at the line voltage which can be touched in error or by negligence. Contrary to the case of locomotives previously constructed, there is no high tension chamber, so that the safety measures necessary to prevent accidental contact with the high tension circuit are reduced to a simple interlock making it impossible to lower the oil tank of the main circuit breaker unless the pantograph is lowered and the earthing switch closed.

The only device used on the locomotive to protect the equipment against voltage surges consists of a reactance coil fitted under the cover of the transformer. Previous experience has shown other protective devices mounted on the locomotive to be useless and that it is preferable to furnish each section of the line with its own protective devices.

The Main Motors.

The main motors are 12 pole compensated series motors, satisfactory commutation being obtained by the usual Oerlikon arrangement of adjusting the phase of the interpole flux. The connectors between the commutator and the armature conductors are liberally proportioned and not made of a high resistance. The twelve brush spindles each carry 5 brushes 40 mm. wide and 9 mm. thick. In order to eliminate high harmonics in the current or pressure waves, the stator slots are closed, and the semi-closed rotor slots are skewed through a slot pitch.

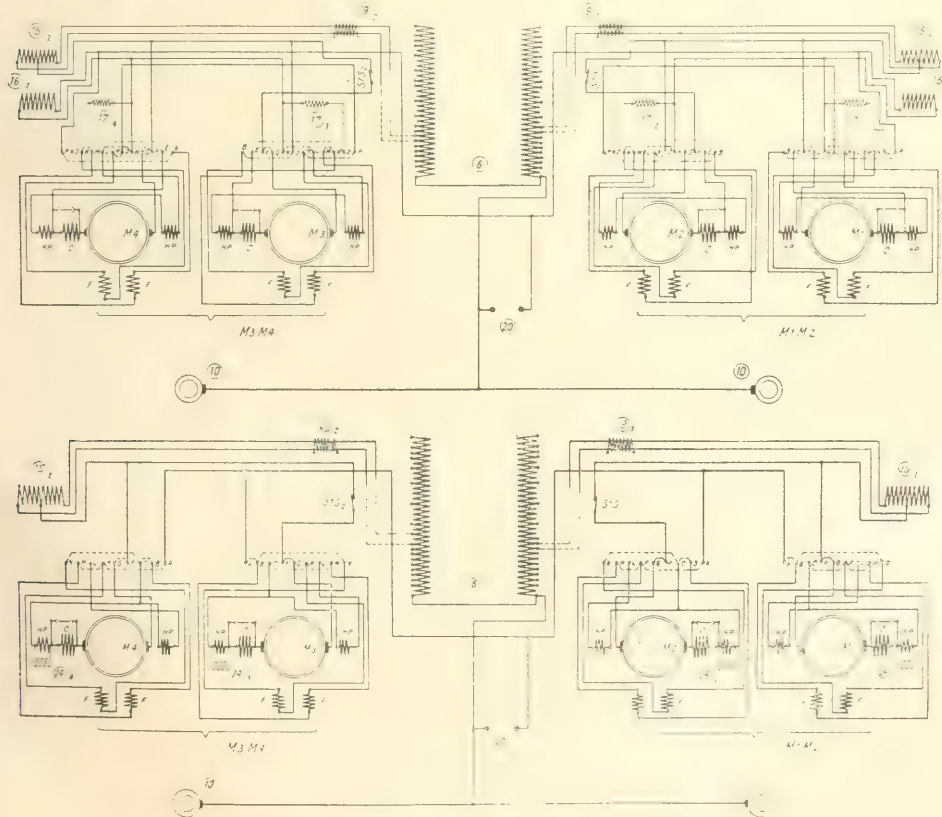


FIG. 11 - DIAGRAM OF BRAKING ARRANGEMENT

motors, and the other for the heating circuits of the train. The first winding is in two halves wound for a normal maximum voltage of 567 V, and provided with a number of windings, as with the 1—B+B—1 locomotive.

The winding for the heating circuit is for a maximum of 1 180 V

The motors are semi-enclosed, and with artificial ventilation can develop at the rim of the driving wheels an output of 550 h.p. at 400 V and 560 revs. per minute for 1½ hours, and 425 h.p. at 380 V continuously.

The speed regulation of the locomotive is effected by varying the

motor voltage by means of the "graduator" switch. For these locomotives two types of this controlling switch, differing in their mechanical construction, are being used. The one, Fig. 12, is mechanically operated by hand, and the other, Fig. 13, is operated

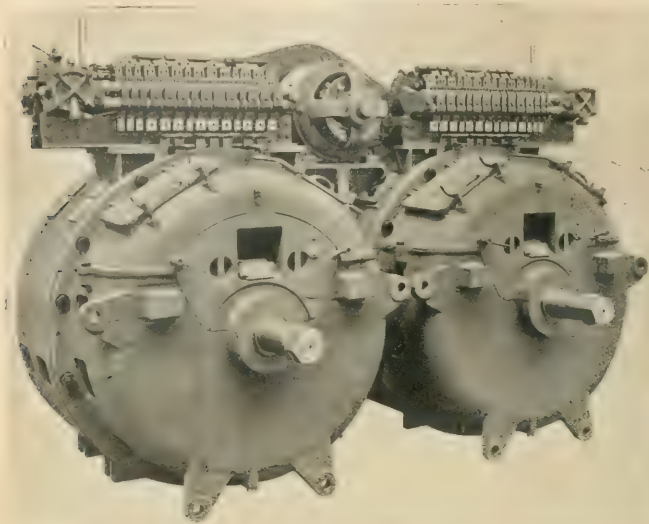


FIG. 15. VIEW OF REVERSERS

electrically. The latter is of the drum type similar to that used on the Loetschberg locomotives, with the exception that the two cylinders are arranged one above the other, and the servo motor does not run continuously, but only during the period of operating the graduator. The other type consists of a system of levers and cams, and has been designed especially with the object of reducing the effort usually required from the personnel; a central arc extinguishing device is used.

Regenerative Braking.

The locomotives 1—B+B—1, and 1—C+C—1, are arranged for electric braking and for regenerative control on down grades. Whatever form of electric braking may be employed, it has the advantage compared with mechanical braking that the wear of the brake blocks and the tyres with the consequent formation of metallic dust and the production of heat all disappear. The greater the weight, the greater is this advantage, and from the very beginning of electric traction one has aimed at the electric braking of the total weight of a train when descending an incline.

At first the single-phase system was thought to be at a disadvantage in this respect as compared with the direct current or the three-phase systems. The developments of recent years have caused opinion on this point to be modified in favour of the single-phase system. As may be seen from the diagram of connections, Fig. 14, the arrangement used on the locomotives is very simple, the electrical equipment of the locomotive for regenerative control only differing from that without regeneration in the addition of a main reactance coil, and an auxiliary reactance to ensure satisfactory commutation and connected in parallel with the commutating pole windings during braking. The operation of the brake is very simple, and it is regulated by the controller and graduator used for normal power working, the motors during braking being connected to any desired tapping on the low tension winding of the transformer.

The change from power working to braking is effected by means of the reversers designed to this end, and which are mounted on the motors, Fig. 15. At the beginning of braking the graduator controller is put to the zero position, and the reversers then put to the braking position; braking is then effected by means of the hand-wheel which is used for regulating the voltage at the terminals of the motors during normal power working. The braking effect on the lower notches is relatively weak, but increases as the voltage is raised. The driver regulates the speed at will, the control during braking being as fine as during normal power working since the number of voltage tapplings is the same for the two cases.

The arrangement permits of braking right up to standstill. The

braking reactance coil prevents the motor current from reaching an unsafe value. Braking can also take place at the highest speeds without giving rise to dangerous sparking at the commutators of the motors, or to excessive currents. When it is required to resume

normal power working, the controllers are set to the zero position again, and the reversers put back to the power position. The various interlocking devices for normal working as motors also operate during braking.

The characteristic* of this method of braking is that the braking torque is independent of the speed and depends solely upon the applied voltage. Any instability in the braking action is thus obviated, and for a given train load, by regulating the brake any desired speed may be obtained.

The extraordinary simplicity of these braking operations has been demonstrated on the Loetschberg locomotives, equipped as above described. According to calculations, the efficiency during regenerative braking reaches about 75 per cent. for normal working. The power factor of the regenerated energy varies normally between 0.6 and 0.7, deduction being made for the power absorbed in the auxiliary services—compressors, fans, &c. Taking this power into account, the power factor falls about 10 per cent. The Oerlikon method of regenerative braking with single-phase alternating currents is thus as advantageous as that obtained on the three-phase locomotives of the Italian State Railways.

The advantages of this method of braking are obtained without any inconvenience other than a slight increase in the weight of the locomotive due to the braking reactance coil. This increase represents but 3 or 4 per cent. of the weight of the locomotive when it is intended to brake a whole train, or about 7 to 9 per cent. of the weight of the electrical equipment.

Electric Power in Victoria.

The chairman of the Victorian Electricity Commission (Sir John Monash) in a recent address to the Victorian Chamber of Manufacturers, said by comparison with other parts of the world Victoria was under-industrialised and under-electrified. He pointed out hitherto they had been dependent upon New South Wales for coal, and consequently the supply of fuel for electric power had been frequently subjected to interferences through industrial disturbances in which Victoria or its citizens had had no part whatever. Those considerations were a sufficient ground-work for a scheme to liberate the State from such disabilities and to lay the foundations of great industrial development, progress, and prosperity in future. Victoria possessed resources of brown coal which were "fabulous" in extent—it would be possible to free the State from industrial disabilities. After investigation the Commission decided to utilise the extensive areas at Morwell (Gippsland) because it was close to the metropolis and favourably situated for the establishment of an electricity generating station. The extent of the field was 30 square miles, of which an area of one square mile had been selected, containing sufficient brown coal to last 100 years.

Kiewa Hydro-Electric Project.

Sir John told his hearers that the statement that hydro-electric power was necessarily the cheaper power was fallacious. Hydro-electric power depended upon special circumstances, including a reliable flow of water with a considerable fall, and the capital cost would be greater than that of a heat-power scheme. Water-power was only available in inaccessible and high lands a long distance from Melbourne. Brown coal would be produced at Morwell for about 3s. per ton, and it would be available at metropolitan railway sidings for about 9s. a ton. Briquettes would cost less than 20s. per ton, while electric energy in Melbourne would be obtainable at an average rate of something less than a halfpenny per unit. There was strong pressure on the part of some public men to rush precipitately into hydro-electric schemes, particularly the Kiewa scheme. A capital expenditure of £3 500 000 on the Kiewa scheme would be entirely unjustified, particularly as the Government and Parliament had definitely committed themselves to the Morwell scheme. It would take the country centres all their time to consume the 80 000 h.p. the Commission would be ready to give them in 1924. Kiewa would not be able to compete with Morwell, and it would lead to the irretrievable ruin of both schemes. It was sheer nonsense to suggest that it should be done.

* For a description of the theory, &c., of the method of braking, see THE ELECTRICIAN, Vol. LXXXI, p. 708, Dec. 20, 1918.

The British Association at Edinburgh.

Tuesday, Sept. 6th.

Members were arriving from all parts throughout the day, and from the crowded condition of the hotels, it was apparent that the meeting was going to be one of the largest of recent years. At the local headquarters in Parliament House it was reported that some 2 300 members had already signified their intention of being present. In place of the ordinary guide-book style of handbook, a small blue volume, of some 260 pages, was served out to members, entitled "Edinburgh's Place in Scientific Progress," specially prepared by a local editorial committee who had enlisted the services of twenty-five experts, each of whom had contributed a chapter outlining the influence celebrated citizens of the Scottish capital had exerted in promoting the chief branches of human knowledge. In it we are reminded that James Nasmyth, Macquorn Rankine, and Alexander Graham Bell were all born in Edinburgh and educated at the Royal High School; also, that James Clerk Maxwell and Peter Guthrie Tait were schoolboys at the Edinburgh Academy.

In the evening SIR OLIVER LODGE delivered the first of a series of citizens' lectures, his subject being "Speech Through the Ether." "We sometimes see in the papers," said Sir Oliver, "that Marconi thinks he has heard signals from Mars. I have nothing to say to that, for I don't know; but I think it possible other people have been trying to signal to us for a long time. Don't let us shut our minds to the infinite possibilities of existence."

Wednesday, Sept. 7th.

Many committees were held during the afternoon. After dinner a large and distinguished audience assembled in the Usher Hall to hear the President's inaugural address. It was not till the proceedings opened that the majority of those present learned that SIR EDWARD T. ORFE was indisposed. In his unavoidable absence, the address was read by SIR ALFRED EWING, Principal of Edinburgh University.

After recalling the circumstances under which the British Association was founded and the noteworthy character of the first meeting in Edinburgh in 1834, it was explained in Sir Edward's address that this—the fifth meeting held in the Scottish capital, would be marked by a greater degree of combination between the various sections than had hitherto been attained for the purpose of discussing common problems of general interest. Another change in procedure would be the introduction of discussions on the addresses of the presidents of sections. The progress of State-aided research was then traced, from the committee called by Lord Salisbury to report on the expediency of establishing a National Physical Laboratory down to the most recent activities of the Department of Scientific and Industrial Research. Then followed a rather technical discourse on the growth of modern views on the nature of matter which was keenly appreciated by the physicists and chemists, but must have verged on the incomprehensible to many. Contact with the masses of the audience was re-established when the theme changed to the use of poison gas in war. The tenor of Sir Edward's concluding appeal was to the effect that an educated public opinion would refuse to give credit to any body of scientific men who employed their talents in devising means to develop and perpetuate a mode of warfare which was abhorrent to the higher instincts of humanity.

Section A.

Thursday, Sept. 8th.

Section A had a very busy morning, a considerable amount of time being devoted to phenomena arising from the motion of electrons within the atom. Prof. J. C. McLENNAN, F.R.S., opened the proceedings with an account of experiments carried out at Toronto, to determine whether the spectrum of an ionised atom was similar to that of an atom with lower atomic number. In the case of potassium, the removal of the outermost electron would presumably produce a structure similar to that of argon. Prof. McLennan found that when potassium vapour was violently excited, a spectrum showing marked parallels to the spectrum of argon was obtained. He further described some interesting experiments on mercury vapour. When light of wave-length $2\,536\text{ \AA}$ falls upon mercury vapour it is absorbed. This absorption is imagined to take place on Bohr's theory by the removal of an electron from an inner to an outer orbit. The mercury atom exposed to light of this wave-length should therefore be in a different condition to that of the normal atom, and this difference in condition might be illustrated by the ability of the excited atom to absorb light of wave lengths which the normal atom is incapable of absorbing. It was found that when mercury vapour was continuously exposed to light of wave-length $2\,536\text{ \AA}$, it absorbed light of wave-length $4\,359\text{ \AA}$, whereas mercury vapour not so illuminated did not absorb the $4\,359\text{ \AA}$ line. Similarly, mercury vapour was found to absorb the $10\,140\text{ \AA}$ line only when illuminated with light of wave-length $1\,849\text{ \AA}$.

Discussion on all papers being very strictly limited, Prof. R. W.

WOOD (John Hopkins University) was the only further speaker on this subject, and he emphasised the importance of the phenomenon of the absorption of light of a certain wave-length when a substance was illuminated by light of another wave-length.

Prof. R. W. Wood then gave an interesting paper on fluorescence. If absorption of light by an atom takes place by the removal of an electron from an inner to an outer orbit, and the emission of fluorescent light by a reverse process, then it might be expected that this process would take time, so that if a substance was illuminated by an electric spark, there would be a brief interval between the cessation of the spark and the emission of the fluorescent light. Prof. Wood described experiments in which mercury vapour was illuminated by the instantaneous flash of an aluminium spark. It was found that the vapour remained non-luminous during the period of excitation, and for about $1/15\,000$ second after, when it suddenly burst into a flash of green fluorescent light. He pointed out that this appears to be the first observation of a fluorescent or phosphorescent body remaining dark during the period of illumination. Using a new type of phosphoscope, experiments were performed with other substances, but nothing analogous to mercury in its behaviour has yet been found, although the phosphoscope recorded the phenomena to $1\,400\,000$ second. Further experiments showed that only freshly formed mercury vapour exhibits the phenomenon of fluorescence, and then only when metallic mercury is present and liberating the mercury vapour. Prof. Wood expressed the opinion that the freshly formed particles of vapour are diatomic when they first leave the metal, and that they subsequently break up into monatomic particles. In some experiments on the fluorescence of solutions of fluorescence, Prof. Wood used jets, about the thickness of a fine sewing needle, projected with a velocity of about $1\,000\text{ ft. per second}$, and he referred to the pronounced cutting properties of these jets. They would easily cut through a strip of pine wood.

Prof. RICHARDSON and Dr. LANGMUIR took part in the discussion on the paper, the latter pointing out that fluorescence took place in two steps, and inquiring if light of other wave lengths was emitted in certain portions of the flash, owing to a time lag in the movement of the electrons to the different positions. Prof. Wood, in replying, admitted that the phenomenon might equally well be due to an electron change instead of the breaking up of diatomic molecules, and that, although the evidence was incomplete, other radiations such as affected a photographic plate were not emitted.

In a further paper Prof. Wood dealt with the extension of the hydrogen spectrum from twelve to twenty lines by the employment of vacuum tubes of unusual length. The phenomena observed in these tubes are very remarkable and were described in as much detail as time would permit. He was of opinion that the effect of a condenser on the discharge was merely to increase the current density in the tube, and that many complicated phenomena, formerly ascribed to the oscillatory nature of the discharge, were due to this increase. He described experiments in support of this view, and calculated that in one case the instantaneous current in the tube was of the order of $3\,000$ amperes. The source of this increase of current was unknown, as there was apparently no increase in the primary current of the transformer.

Mr. A. A. CAMPBELL SWINTON, F.R.S., read an interesting paper on the reception of wireless signals on a shielded frame aerial. It had been suggested that something of the nature of a wireless telescope with improved direction finding properties might be made by placing a frame aerial in a large metal tube or wire spiral, open at both ends. The Eiffel Tower spark signals were received on a small frame aerial placed inside a tube of wire network with open ends. It was found, however, that while the presence of the tube weakened the signals, altering its direction did not affect them, and the signals were not further weakened by closing the ends of the tube by wire grids. The tube was then replaced by a box of sheet copper with one end open. In this was placed, not only the frame, but also the amplifier and all the other apparatus, the telephone being listened to through a rubber pipe. The amplifier was a 5 valve resistance amplifier connected to a 3 valve transformer—coupled note magnifier. Signals were heard of equal strength with the open end of the box pointing towards or directly away from Paris, but ceased when the box was turned so that the open end faced at right angles to Paris, the frame still pointing to Paris; or when the open end was completely closed with a copper or tinfoil cover. In the latter case the signals were still audible unless the copper actually touched the box on all sides. For other positions of the box with the end open, signals could only be heard when the relative positions of the box and frame were such that a prolongation of the plane of the frame towards or away from Paris, no matter which, came out of the open end clear of the copper sides of the box.

SIR OLIVER LODGE expressed himself very much surprised by the smallness of Mr. Campbell Swinton's apparatus, the receiving frame being only one foot in diameter. In his own early experiments he

had used a hat-shaped copper box and he found that everything had to be placed inside the box. He found that even a wire passing through a small hole in the box seemed to coax the waves in, and Mr. Campbell Swinton had got over that difficulty successfully.

Demonstrations.

In the afternoon various demonstrations were given. Mr. J. J. DOWLING exhibited his recording ultramicrometer and some of its applications. The ultramicrometer consists of an oscillating valve circuit and an arrangement for measuring the changes of the plate current. If the capacity in the oscillating valve circuit is changed, then the plate current is affected and the changes in plate current may be recorded by the galvanometer. Extremely small changes in the distance apart of the condenser plates, of the order of 10^{-8} cms., are quite detectable. The curve showing increase of plate current with distance apart of the condenser plates shows that the sensitivity of the arrangement is independent of the condenser plate distance over large ranges of the order of 1 mm. Moreover, the apparatus is stable and gives consistent results. Among its applications exhibited were: as a micrometer arrangement for demonstration purposes, as applied to a seismograph, as a micro-pressure manometer sensitive to $1/10,000$ atmosphere, as a sensitive balance with rapid action and for recording plant growth. The use of the apparatus as an extensometer was shown by clamping the two condenser plates, insulated, of course, to a metal bar and observing the change of plate current when the bar was stretched. Thus Young's modulus for the bar could be found. In the micromanometer, the moveable plate of the condenser was attached to a stretched rubber membrane forming one side of a closed box. The gradual motion of the membrane, due to the fall of pressure resulting from the approach of a cyclonic depression towards Edinburgh, was easily observable on the galvanometer whilst the demonstrator was speaking. As a recorder of plant growth the instrument showed itself capable of demonstrating, not merely the general phenomenon of growth, but pulsations of growth such as have been previously described by Sir Ramachander Bose, using a complicated lever magnifying system. The general principle is not new, being similar to that described by Prof. Whiddington at the Cardiff meeting last year. Whiddington's arrangement was much more sensitive and he used heterodyne reception, but the new arrangement possesses greater stability, is more easy to demonstrate and is sufficiently sensitive for most purposes.

DR. DAWSON TURNER and MR. D. CROMBIE demonstrated the behaviour of an electrified pith ball in an ionized atmosphere. If a charged Leyden jar is placed in an ionized atmosphere the ions are directed towards the jar. A pith ball connected to, and insulated from, the knob of the jar by a blob of shellac, will, if it happens to lie on the line joining the centre rod of the jar and the source of ionization, be alternately charged and discharged by contact with the knob and the stream of ionization respectively, so that it will oscillate. This simple instrument may be used to demonstrate the ionization of a gas by various agencies.

MR. W. L. BALLS gave a demonstration of a simple harmonic analyser and peridoscope. The movements of a set of equidistant strings, under equal tension radiating from a flexible yoke, are observed by an optical lever. The angle of divergence of the strings being small, they may be considered as parallel. The curve under investigation is made into a template which is pushed under the strings at a point corresponding to the interval which is suspected to be the length of the period. The resulting movement of all the strings is averaged out and communicated to the optical lever, the movement of a spot of light permitting the fairly accurate determination of the length and amplitude of the period. The device is simple and gives rapid results once the template has been prepared.

Friday, Sept. 9th.

SIR OLIVER LODGE, in proposing a vote of thanks to the President, referred to the controversy on the seat of the contact difference of potential in which he had played an important part in the latter part of last century, and he welcomed the study of thermionic emission in extreme vacuo, which was throwing so much light upon this important subject.

SIR DAVID CLERK, in seconding the vote of thanks, gave an interesting historical summary of a certain portion of thermo-dynamics.

The section then proceeded to the rooms of section B, where a joint meeting of sections A and B was held to discuss the structure of molecules. The meeting was opened by DR. LANGMUIR, who gave a very clear account of his theory of atomic and molecular structure.

PROF. W. L. BRAGG, F.R.S., and PROF. A. O. RANKINE took part in the discussion. The former dealt with the light which the examination of crystal structure by the reflection and diffraction of X-Rays threw upon the structure of atoms and molecules. He showed that X-Ray examination of compounds proved that the molecules might be represented by definite arrangements of atoms and that each atom possessed a definite spherical volume in these arrangements. The mathematical theory of reflection of X-Rays by the electrons in the atom had been worked out, and experimental

results showed that there certainly was no octet arrangement as required by Dr. Langmuir's theory, but there was a dense arrangement of electrons much nearer the nucleus. He pointed out that this in no wise detracted from the beauty of Langmuir's conception as a useful working approximation for the chemist.

PROF. RANKINE dealt with the evidence which his experiments on the viscosity of gases lent to Dr. Langmuir's theory. If one removed the outer electron from an atom of rubidium one would presumably obtain an arrangement like that of krypton; similarly, by removing an electron from the molecule of ammonia one would obtain a structure similar to that of a molecule of marsh gas. Now rubidium and ammonium form isomorphous salts and crystal measurements show that rubidium and ammonium occupy the same volume. Now the atomic diameters, as deduced from viscosity measurements for krypton and marsh gas, are respectively 3.10×10^{-8} and 3.13×10^{-8} cms., so that the experimental evidence supported the Langmuir view of electron shells.

Section G.

Thursday, Sept. 8th.

The papers taken in section G. this morning were:—(1) Prof. T. Hudson Beare—An Inquiry into the Suitability of Scottish-Grown Timber for Aeroplanes and Pit Props. (2) Prof. Alex. R. Horne, O.B.E.—Experiments on the Mechanical Properties of Scottish Pine. (3) Dr. B. C. Laws—Stresses in Ship's Plating Due to Fluid Pressure. (4) Dr. E. M. Horsburgh—The Fracture of Wire in Steel Ropes. (5) Prof. T. Hudson Beare and Mr. W. Gordon—The Influence of the Width of the Specimen upon the results of Tensile Tests of Mild Steel and Rolled Copper.

The time available for discussion on these papers was very limited, but sufficed to disclose that the war had stimulated widespread interest in the possibilities of home-grown timber. Laboratory tests appeared to show that specially selected specimens of Scottish-grown timber compared favourably with imported woods; but, due to poor cultivation, the home-grown product was generally speaking inferior as regards straightness and freedom from knots.

In the afternoon a visit was paid to Messrs. Ramage and Ferguson, Leith, including the Leith Docks. Another party visited the works of Messrs. Bruce Peebles and Co., where a large number of Peebles-La Cour motor converters were seen passing through the shops, having outputs varying from 100 to 2,000 kW.

After dinner, a civic reception was given in the Royal Scottish Museum, at which some 2,500 ladies and gentlemen were received by Lord Provost and Mrs. Hutchison. Large though the gathering was, there was ample room within the spacious building. Amongst the many objects of interest, the fine collection of working models in the machinery section attracted attention.

Friday, Sept. 9th.

The first hour was purposely kept open in Section G. so that members should be free to attend Section A, where Prof. O. W. RICHARDSON, F.R.S., delivered his presidential address on Problems of Physics. The result was a very crowded meeting.

At 11 a.m. Prof. A. H. Gibson read his presidential address on Water Power to the Engineering Section. Many visitors were attracted, and the lecture theatre was crowded.

The papers following were:—Prof. F. G. Bailey—The Linking up of the Smaller Water-Powers in Scotland, and Prof. F. C. Lea—The Utilisation of Tidal Power, with special reference to the Severn Estuary.

The intention had been to allow time for a general discussion on water power; but it was already 1 p.m. before Prof. Lea finished speaking. This circumstance was much to be regretted, as there were electrical engineers present anxious to challenge the feasibility of Prof. Bailey's scheme of generation by over-driven induction motors in large numbers of small scattered units, and there were geologists interested in water power developments whose views would have been valuable to hear.

A feature of Prof. Gibson's address was an appeal for the endowment of one large well-equipped central laboratory where the problems surrounding hydro-electric developments could be investigated on a commercial scale. Opportunity of reiterating this need was taken by Prof. T. Hudson Beare, in moving a vote of thanks to the president.

In the afternoon, a party of fifty or so visited the wire works of Messrs. Brunton, Musselburgh, where the works, processes and the magnificently appointed research laboratories were seen to advantage. Here Prof. Haigh gave an interesting demonstration of his patent alternating stress testing machine. In this machine alternating stresses exceeding 1 ton are applied with a stress frequency of 2,000 cycles per minute by means of an armature oscillating between magnets excited by two-phase current. Ingenious arrangements were shown for accurately calibrating the machine and for examining the wave form of the induced stresses. With the machine properly adjusted a very smooth and regular sine curve is obtained, but if there is looseness sufficient to produce audible rattle the wave becomes irregular.

At 8.30 p.m. Prof. C. E. INGLIS, O.B.E., M.A., delivered an

evening discourse on "A Comparison of the Forth and Quebec Bridges, showing the Evolution of Cantilever Bridge Construction during the past Thirty Years," which was widely attended and enthusiastically received. Sir Alfred Ewing, who occupied the chair, when introducing the lecturer, mentioned that if there had been no armistice in November, 1918, the British Army would have crossed the Rhine on portable bridges made to Prof. Inglis' design. A novel feature in an address of this kind was the introduction of a brief interval between the first part of the lecture, which dealt with the Forth Bridge, and the second part devoted to an account of the vicissitudes which culminated in the successful completion of the Quebec Bridge. Prof. Inglis traced the main differences in designs between the two bridges to the changed economic conditions. It might be said that the Forth Bridge was made by hand, while the Quebec Bridge was machine made. Both bridges were of the same species, but their construction differed widely, the new fashion in bridge design being dictated by cheapness, durability, &c.

Saturday, Sept. 10th.

By common consent no meetings were held, the whole day being reserved for excursions, of which the chief were:—(1) Loch Lomond, Loch Katrine and The Trossachs, *via* Stirling, Bridge of Allan and Callander, by motor char-a-banc and boat. (2) The Scott country, Melrose, Dryburgh, Abbotsford, and the Valley of the Tweed by motor coach. (3) Valley of the Forth, Queensferry, Alloa, Stirling, Linlithgow, by char-a-banc.

Monday, Sept. 12.

The proceedings started with a lantern slide lecture by Squadron-Leader A. J. Miley on Seaplanes.

The rest of the morning was occupied by a joint discussion with section C (Geology) on the Mid-Scotland Canal, presided over by Dr. Flett.

In the afternoon a visit was paid to the laboratories of the Heriot-Watt College, and a small party were enabled to avail themselves of a special permit to inspect the Forth Bridge.

Tuesday, Sept. 13.

It was reported that the committee on gaseous explosions would be discontinued as investigations similar to those with which the committee has concerned itself are now being prosecuted by the Air Ministry, the Admiralty and the Department of Scientific and Industrial Research. On the other hand, the Committee on Complex Stresses was re-appointed. The report of the Committee was presented to section G. Of the eight papers contained in this report the following were read in abstract:—Dr. G. COOK, Distribution of Stress in a Flanged Pipe; Prof. B. P. HAIGH, The Strain Energy-Function and the Elastic Limit; Dr. W. MASON and Mr.

W. J. DELANEY, Alternating Combined Stress Experiments; Mr. R. V. SOUTHWELL, On some problems relating to the Design of High-speed Discs. This investigation appears to have been suggested by the practical problem of vibration in turbine discs.

At the absence, through illness, of Mr. SYDNEY B. DONKIN, his paper on the New Electricity Supply Station of the Corporation of Edinburgh was accepted as read.

DR. S. PARKER SMITH was then called on to read his paper on Large Electric Units. He illustrated his remarks with a fine selection of modern examples of large turbo-generators, water-wheel alternators, slow speed alternators, rotary and motor converters, mercury rectifiers, &c. Many of these had been made from drawings specially prepared for the occasion by leading British, Continental, and American firms.

Then followed:—MR. JOHN SCOTT-TAGGART's paper on "The Negatron; A New Negative Resistance Device particularly for Use in Wireless Telegraphy." This was accompanied by a successful demonstration of the oscillating property of the Negatron, a new negative resistance valve. A "Negatron oscillator" (made by the Radio Communication Company) was used to receive incoming continuous wave signals. The following message was received from the Admiralty C.W. Station at Aberdeen: "This message conveying greetings is being sent from the Admiralty Wireless Station at Aberdeen to the Engineering Section of the British Association on the occasion of a demonstration at Edinburgh of a new method of producing wireless waves." A message was also received from Paris which read: "French scientists send through the wireless station at Eiffel Tower, Paris, their cordial greetings to colleagues of the British Association at present assembled at Edinburgh." Both messages could be clearly heard throughout the room and were written on a blackboard as received.

DR. T. F. WALL then read his paper on Long-distance Transmission of Electrical Energy Generated by Means of Tidal Power.

In the course of a brief discussion which followed Dr. A. E. Kennelly remarked that as far as he was aware that was the first serious proposal to transmit considerable quantities of electric energy at telephonic frequency. It would be easy to suggest difficulties which might arise, but he did not wish to do that as in his opinion the suggestion deserved trial.

Wednesday, Sept. 14.

The papers taken by Section G on this last morning were:—DR. S. F. BARCLAY, Modern High-speed Centrifugal Pumps; DR. J. S. OWENS, Experiments on Air-Lift Pumping; PROF. TIMOSHENKO, Impulsive Stresses in Rails and Girders; DR. DAVID ELLIS, Iron Bacteria in Relation to the Incrustation of Pipes; MR. WATSON, (Birmingham) Sewage Gas for Power Production.

Water Power Development.*

By Prof. A. H. GIBSON, D.Sc.

The reasons for the revival of interest in the development of water power are partly technical and partly economic, while the urgent demand for energy to supply the abnormal requirements of the war period, combined with the world shortage of fuel, has been responsible for an unprecedented rate of development in most countries with available water power resources, and especially in those countries normally dependent on imported fuel.

World's Available Water Power.

During the past few years much attention has been paid to statistics of available and developed water powers. Estimates of potential power are always to be accepted with considerable reserve. In order to make a reasonably accurate estimate, the run off from the catchment area and the variation in this run off from month to month and from year to year, must be known, and it is only in comparatively rare cases that this information is as yet available. Moreover, there is as yet no standard basis on which potential power is computed. In the table opposite the potential water power is estimated on the basis of the maximum flow as just defined, and in terms of continuous twenty-four-hour power.

The Water Power of the British Empire.

With the noteworthy exceptions of Canada and New Zealand, practically nothing has been done, prior to 1915, by any part of the British Empire, to develop or even systematically to investigate the possibilities of developing its water powers. Since then, however, there has been a general tendency to initiate such investigations, and at the present time these are being carried out with varying degrees of thoroughness in India, Ceylon, Australia, South and East Africa, and British Guiana.

Of the developed power in the Empire about 80 per cent. is in Canada. Throughout the remainder of its territories only about 700 000 H.P. is as yet developed, or only a little over 1 per cent. of the power available, a figure which compares with about 24 per cent. for the whole of Europe, and 21 per cent. for North America,

including Canada and the U.S.A. These figures sufficiently indicate the relatively large scope for future development.

Power Available in Great Britain.

According to the Water Power Resources Committee, the aggregate output of the various large Scottish schemes of the Committee is, roughly, 270 000 continuous horse-power. In

The Water Power of the World in Millions of Horse Power.

	Available	Developed
Great Britain	0.9	0.2
British Empire	23.0	3.28†
Canada		
Australia		
Africa (East)		
„ (South)		
„ (West)	30.9 to	0.7
British Guiana	50.0	
India and Ceylon		
New Zealand		
Papua		
Austria	0.5	0.57
Brazil	2.0	0.32
Dutch East Indies	5.5	
France	5.6	1.6
Germany	1.5	0.75
Iceland	4.0	1.0†
Italy	4.0	1.25
Japan	8.0	1.5
Norway	7.5	1.25
Russia	20.0	1.0
Spain	5.0	0.88
Sweden	6.2	1.2
Switzerland	4.0	1.1
United States of America	128.0	28

* Including projected extensions to plants now in operation.

† Projected but not yet constructed.

* Abstract of the President's Address to Section G of the British Association.

In addition to these there are a very large number of other small schemes which have not yet been investigated, and it is probably well within the mark to say that there are waterpower sites in the country capable of developing the equivalent of 400 000 continuous horse-power, or 1 500 000 H.P. over a normal working week, at least as cheaply as from a coal-fired installation. A number of attractive schemes are also available in North Wales, though these are, in general, more extensive than those in Scotland. Owing to the general flatness of the gradients, there are, except possibly around Dartmoor, no schemes of any large individual magnitude in England, but there are a large number of powers ranging from 100 to 1 000 H.P. which might be developed from river flow uncontrolled by storage. Investigations on a few typical watersheds throughout England and Wales appear to show that the possible output averages approximately 8 continuous horse-power per square mile of catchment area, which would be equivalent to an aggregate of about 450 000 H.P. Although much of this potential output is not commercially feasible, it would give the equivalent of 500 000 H.P. over a normal working week if only 30 per cent. of it were fully utilised.

Some Irish Figures.

■ In the report recently issued by the Irish Sub-Committee of the Board of Trade Water Power Committee, it is estimated that approximately 500 000 continuous 24 hour horse-power is commercially available in Ireland, and that if utilised over a 48 hour working week, its capacity would be at least seven times as great as that of the engine power at present installed in the country for industrial purposes.

It appears then that, although the water power possibilities of the United Kingdom are small in comparison with those of some more favoured countries, they are by no means so negligible as is commonly supposed, even in comparison with the present industrial steam power resources of the country. In fact the inland water power resources of the United Kingdom are capable of supplying about 27 per cent. of this, a proportion which, in such an industrial country as our own, is surprisingly large. ■

Some Reasons for Development.

Many of the small powers would be well adapted for linking up, as automatic or semi-automatic stations, into a general network of electricity supply, or for augmenting the output of municipal supply works, as has been done so successfully at Chester, Worcester, and Salisbury. The development of the many small schemes available in the Scottish Highlands would probably have a great effect on the social life of the community. It would go far towards reviving and extending those small local industries which should form an essential feature of the ideal rural township. Commercially such undertakings may appear to be of small importance, but as a factor in promoting the welfare of the State, economical and political, their influence can hardly be over-estimated. Some of the larger schemes in Scotland would lend themselves admirably to transmissions to its industrial districts, while others, in close vicinity to the sea-board, would appear to be well adapted for supplying chemical, or electro-physical, or metallurgical processes.

While this is admittedly an inopportune moment to suggest anything in the nature of State co-operation in such developments, it may be pointed out that many of the Scottish powers in particular occur in sparsely populated districts, and that, although they would ultimately become remunerative, the difficulty of raising the capital necessary for their development is great. In view of their direct and indirect advantage to the community it would appear not unreasonable to advocate that financial assistance should be granted by the State in the earlier stages of such developments. If such assistance, say in the form of a loan maturing after a period of ten or fifteen years, could be granted, it would certainly give an immediate impetus to the development of water power in this country.

Conservation.

The importance of water power development from the point of view of conservation of natural resources requires no emphasis. The consumption of coal in the best modern steam plant of large size, giving continuous output, would be about 9 tons per horse-power year, and on this basis the world's available water power if utilised would be equivalent to some 1 800 000 000 tons of coal per annum. The world's output of coal in 1913 was approximately 1 200 000 000 tons, of which about 500 000 000 tons were used for industrial power purposes, so that on this basis 55 000 000 continuous water horse-power would be equivalent to the world's industrial energy at that date. Not only does the use of water power lead to a direct conservation of fuel resources, but it also serves to a notable degree to conserve man power.

Modern Tendencies in Water Power Development.

The large amount of attention which has been concentrated on the various aspects of water power development during the past ten years has been responsible for great modifications and improve-

ments in the design, arrangement, and construction of the plant. Broadly speaking, these have been in the direction of increasing the size, capacity, reliability, and efficiency of individual units; of improving the design of the turbine setting and of the head and tail works; of increasing the rotative speed of low head turbines; of detailed modifications in the reaction type of turbine to enable it to operate under higher heads than have hitherto been considered feasible; and of increasing the voltage utilised in transmission.

The capacity of individual units has been increased; rapidly during recent years, and at the present time units having a maximum capacity of 55 000 H.P. under a head of 305 ft. are being installed in the Queenston-Chippewa project at Niagara, while units of 100 000 H.P. are projected for an extension of the same plant. These modern high-power turbines are usually of the vertical shaft, single runner type, with the weight of the shaft, runner, and generator carried from a single thrust Michell bearing. This arrangement lends itself to a simple and efficient form of setting, while the friction losses in the turbine are extremely low. As a result of careful overall design it has been found possible to build units of this type having an efficiency of approximately 93 per cent.

Drawback of the Low Head Turbine.

One of the great drawbacks of the low head turbine in the past has been its relatively slow speed of rotation, which necessitated either a slow speed, and consequently costly generator, or expensive gearing. As a result of experiment it has, however, been possible so to modify the form of the runner as greatly to increase the speed of rotation under a given head without seriously reducing the efficiency. Investigations in this direction are still in progress and promise to give rise to important results. At the present time, however, turbines are in existence which are capable of working efficiently at speeds at least five times as great as would have been thought feasible ten years ago.

Pipe Line Difficulties.

The non-provision of a suitable pipe line has, until recent years, tended to retard the development of plants for very high heads. Under such heads the necessary wall thickness, even with a moderate pipe diameter, becomes too great to permit of the use of riveted joints. Recent developments in electric welding and oxy-acetylene welding have, however, rendered it possible to construct suitable welded pipes, and by their aid, and by the use of solid drawn steel pipes in extreme cases, it has been found possible to harness some very high falls. The highest as yet utilised is at the Fully installation in Switzerland. Here the working head is 5 412 ft., corresponding to a working pressure of 2 360 lb. sq. in. The pipe line is 19·7 in. in diameter and 1½ in. thick at its lower end, and each of the three Pelton wheels in the power house develops 3 000 H.P., with an efficiency of 82 per cent.

The great increase in all constructional costs since 1914 has increased the cost of the average hydro-electric plant by something of the order of 150 per cent., and since the cost of energy produced by such a plant is mainly due to fixed charges on the capital expenditure, this cost has gone up in an even greater proportion owing to the higher interest charges now demanded. It is true that the same increased cost applies within narrow limits to the output from every steam plant erected since the war, and the relative position of the two types of power plant with coal at about 25s. per ton is much the same as before the war.

Modern Modifications in Design.

The fact remains, however, that a newly constructed hydro-electric plant has often to compete in the market with a steam plant built in pre-war days whose standing charges are comparatively low, and in order to enable it to do so with success the constructional cost must often be reduced to a minimum compatible with safe and efficient operation. With this in view many modifications in design and construction have been introduced in recent plants, but there would still appear to be ample scope for investigation into the possibility of reducing the first cost by modifying many of the details of design and methods of construction now in common use.

Among recent modifications in this direction may be mentioned:—The elimination of the dam in storage schemes in which natural lochs or reservoirs are utilised, this water level being drawn down in times of drought instead of being raised in times of flood. This reduces the cost of construction appreciably in favourable circumstances, and eliminates the necessity for paying compensation for flooding of the land surrounding the reservoir; the substitution, where feasible, of rockfill dams for those of masonry or monolithic concrete; the introduction of outdoor installations with the minimum of power house construction; and the simplification of the power plant.

Research in Hydro-Electric Problems.

There are few branches of engineering in which research is more urgently required and in which it might be more directly useful.

Among the many questions still requiring investigation on the civil and mechanical side may be mentioned:—

Turbines.—Investigation of turbine corrosion as effected by the material and shape of the vanes, effect of erosion due to sand and silt, resistance to erosion offered by different materials and coatings, bucket design in low head high-speed turbines, draft tube design, investigation of the directions and velocities of flow in modern types of high-speed turbines, and investigation of the degree of guidance as affected by the number of guide and runner vanes.

Conduits and Pressure Tunnels.—The design of large pipe lines under low heads with the view of reducing the weight of metal, the investigation of anti-corrosive coatings so as to reduce the necessity for additional wall thickness to allow for corrosion, methods of strengthening large thin-walled pipes against bending and against external pressures, methods of lining open canals and of boring and lining pressure tunnels, and effects of curvature in a canal or tunnel.

Dams.—Most efficient methods of construction and best form of section especially for rockfill and earthen dams, and best methods of producing water tightness.

Run-off data.—Since the possibility of designing an installation to develop the available power efficiently and economically depends in many cases essentially on the accuracy of the run-off data available, the possession of accurate data extending over a long series of years is of great value.

Among other questions which are ripe for investigation may be mentioned:—The combined operation of steam and water power plants to give maximum all-round efficiency, the relative advantages of high voltage d.c. and a.c. generation and transmission for short distances, and the operation of automatic and semi-automatic generating stations.

The Pros and Cons of Tidal Power.

The question of tidal power has received much attention during the last few years. The tidal rise and fall around our coasts represents an enormous amount of energy, as may be exemplified by the fact that the power obtainable from the suggested Severn installation alone, for a period of eight hours daily throughout the year, would be of the order of 450 000 h.p. Many suggestions for utilising the tides by the use of current motors, float-operated air compressors, and the like have been made, but the only practicable means of utilising tidal energy on any large scale would appear to involve the provision of one or more dams, impounding the water in tidal basins, and the use of the impounded water to drive turbines. The energy thus rendered available is, however, intermittent; the average working head is low and varies daily within very wide limits, while the maximum daily output varies widely as between spring and neap tides.

If some electro-chemical or electro-physical process were available, capable of utilising an intermittent energy supply subject to variations of this kind, the value of tidal power would be greatly increased. At the moment, however, no such process is commercially available, and in order to utilise any isolated tidal scheme for normal industrial application it is necessary to provide means for converting the valuable output into a continuous supply constant throughout the normal working period.

Some Suggested Means of Utilisation.

Various schemes have been suggested for obtaining a continuous output by the co-ordinated operation of two or more tidal basins separated from each other and from the sea by dams with appropriate sluice gates. This method, however, can only get over the difficulty of equalising the outputs of spring and neap tides if it be arranged that the maximum rate of output is that governed by the working head at the lowest neap tide, in which case only a small fraction of the available energy is utilised.

When a single tidal basin is used it is necessary to provide some storage system to absorb a portion of the energy during the daily and fortnightly periods of maximum output, and for this purpose the most promising method at the moment appears to involve the use of an auxiliary high level reservoir into which water is pumped when excess energy is available, to be used to drive secondary turbines as required. It is, however, possible that better methods may be devised. Storage by the use of electrically heated boilers has been suggested, and the whole field of storage is one which would probably well repay investigation. If a sufficiently extensive network were available, linking up a number of large steam and inland water power stations, a tidal power scheme might readily be connected into such a network without any storage being necessary, and this would appear to be a possibility which should not be overlooked in the case of our own country.

Investigation Necessary.

A tidal power project on any large scale involves a number of special problems for the satisfactory solution of which our present

data is inadequate. Many of the hydraulic, mechanical, and electrical problems involved are comparatively new, and there is little practical experience to serve as a basis of their solution. Among these may be mentioned:—The most advantageous cycle of operations as regards working periods, mean head, and variations of head; the methods of control and of sluice gate operation; effect of changes of level due to wind or waves; the best form of turbine and setting and the most economical turbine capacity; the possibilities of undue corrosion of turbine parts in salt water; the best method of operation; constant or variable speed; whether the generators shall be geared or direct driven; and whether generation shall be by direct or alternating current. The questions of interference with navigation and with fisheries; of utilising the dam for rail or road transport across the estuary; and, above all, economic questions connected with the cost of production, and the disposal of the output of such an installation, also require the most careful consideration before a scheme of any magnitude can be embarked upon with assurance of success.

In view of the magnitude of the interests involved, and of the fact that rough preliminary estimates indicate that to-day current even for an ordinary industrial load could be supplied from such an installation at a price lower than from a steam generating station giving the same output with coal at its present price, it would appear desirable that these problems should receive adequate investigation at an early date.

Facilities for Research in Hydraulic Problems.

In view of the considerations already outlined, and especially in view of the large part which British engineering will probably play in future water power developments, the provision on an adequate scale at some institution in this country of facilities for research on hydraulic and cognate problems connected with the development of water power is worthy of serious attention. At present the subject is treated in the curriculum of the engineering schools of one or two of our universities, but in no case is the laboratory equipment really adequate for the purpose in question.

What is required is a research laboratory with facilities for experiments on the flow of water on a fairly large scale; for carrying out turbine tests on models of sufficient capacity to serve as a basis for design; and, if possible, working in conjunction with one or more of the hydro-electric stations already in existence, or to be installed in the country, at which certain large scale work might be carried out. The provision of such a laboratory is at the moment under consideration in the United States, and in view of the rapidity with which the designs of hydraulic prime movers and their accessories are being improved at the moment, it would appear most desirable that the British designer, in order that the deservedly high status of his products should be maintained and enhanced, should at least have access to equal facilities, and should, if necessary, be able to submit any outstanding problems to investigation by a specially trained staff.

Import Trade in British India.

Although the report of H.M. Senior Trade Commissioner at Calcutta shows that total imports on private account into INDIA for the first quarter of 1921 have decreased by nearly $\frac{1}{2}$ crores, as compared with the year 1920, the imports of machinery, railway plant, and rolling stock, electrical apparatus, &c., have considerably increased.

The imports of iron and steel were on the whole fairly well maintained, and while shipments from the United Kingdom were reduced in most cases, Belgian shipments advanced. In beams, plates, girders, and bridge work there was an advance of 22 lakhs, and the United Kingdom increased her share from 30 to 35.5 lakhs. In wrought tubes, pipes, and fittings there was an increase from 38.5 lakhs to 105.6 lakhs. British shipments increased only slightly from 24 to 27 lakhs, but American supplies advanced from 14.4 lakhs to 75 lakhs.

Practically all types of machinery contributed to the general increase, but the most notable advances were in cotton and jute textile machinery, boilers, machine tools, rice and flour milling machinery, oil crushing and refining machinery, sugar machinery, metal working machinery, mining machinery, saw milling and paper mill machinery. Imports of electrical machinery show a great advance from 23 lakhs to 112 lakhs, and of the latter figure the United Kingdom supplied 71 lakhs and the United States of America 36 lakhs.

The total trade in electrical appliances and apparatus increased from 46 lakhs to 159 lakhs. The United Kingdom increased its share from 34 to 111 lakhs, and the United States of America from 7 to 35 lakhs. The principal increases were in cables, electric lamps, lighting accessories and fittings, and unenumerated apparatus.

Glass and glassware imports fell from 89.5 to 66 lakhs. The decrease was almost entirely borne by Japan. British shipments increased from 12 to 15 lakhs, and German supplies from a negligible quantity to 8.25 lakhs.

Imports of belting and machinery advanced from 25 lakhs.

Linking-up the Small Water-Powers in Scotland.*

By Prof. F. G. BAILLY, M.A.

SCOTLAND is full of streams and rivers, the average height of the country is considerable, and the rainfall generous. The theoretical water power calculated from these runs into many millions. But, for the most part, the rivers have too gradual a fall, and the streams of the steeper ground too little water, to permit of any great concentration of water power at any one place. Hence most of the power runs to waste, only a few favourable areas affording both volume of water and rapid fall from any considerable height. A scheme is proposed to utilise the rapid streams and waterfalls of the high uplands, and the rivers of the long, gently sloping valleys, by numerous small hydro-electric stations, so that the rainfall will pass through a succession of turbines in its passage from the gathering ground to the sea, and yield up a fair proportion of its total energy. For this purpose the stations must be small, probably from 50 to 300 h.p., in order to avoid the costly work of large dams and long lades and pipe lines; they must work automatically, to reduce cost of superintendence; and they must be simple and robust.

Turbine Details.

The turbines will generally be of the reaction type, their properties being well suited to the work, and will drive an induction generator, which is an over-run squirrel-cage three-phase induction motor. The generator is the special feature of the scheme. With a small variation in speed, it varies the load over a large range, so that up to the full power of the turbine all the water power is converted. Above this power the turbine slows down, and no overloads are possible with normal head of water. Extra head produces some overload, flooding of tail reduces the load, and shortage of water, by lowering the head, also brings down the load. It may be desirable to control the gate for short-water conditions for the sake of better efficiency, but that is easily done automatically by the water level. The generator will supply to the line all power given to it without any regulation and without regard to shaft speed, for the frequency of the current is controlled entirely by the generators in the central station, to which all the hydro-electric plants are connected. The equipment is simple, being a main switch and fuses, with a speed indicator for starting up. The starting process is merely the raising of the speed to approximately the proper value and the closing of the main switch, while, by putting a free-wheel device between turbine and dynamo, the latter runs light on the mains as a motor, and picks up the load when the turbine comes on again. Hence automatic control or remote control from the central station may easily be arranged, shutting down and restarting any unit or group of units.

General Layout of Installation.

The general arrangement consists in a set of overhead mains running out from the central station of the large town in the district and following the course of the main river, branching along its tributaries until the distance and the smallness of the streams render further extension uneconomical. At all suitable points the small stations are erected, merely a hut with turbine and dynamo, or perhaps two of them, one being cut off when water is low, and the whole set feeding into the mains. The steeper parts will be dealt with by short pipe lines and lades, but in the valleys a succession of small dams will be built, each operating a turbine. The dams also serve for storage during a drought by the shutting down of the turbines during the night.

Superintendence may be reduced to periodic visits round the area, as there is little more than cleaning of the intake screens and examination of the automatic apparatus. Wear and tear of the machinery is small, for the only rubbing surfaces in either turbine or dynamo are the bearings of the shaft.

The Influence of the Central Station.

The central station is an important part of the system, and will require some special treatment. As it makes up all the irregularities of the load and supplies the magnetising current of all the small dynamos, its design will differ somewhat from the usual pattern. Fortunately the condition of shortage of water comes on slowly with ample warning. It is the lightning of its load by plentiful water that will occur abruptly at times, but that is harmless. The magnetising current may more conveniently be supplied at some point nearer to the small stations, and the regulation of these may be arranged at the same place, so that the main station will only operate for the actual demands for power and for receiving the power for redistribution in its neighbourhood. In some districts not a great deal of the power from the small stations will ever reach the central station, for the collecting mains also act as distributors to the whole countryside, which will thus be supplied with light and power. The district will be beneficially opened up for the factories and small industries, and the mains will not only

serve the double purpose, but the total power distributed will be large in proportion to their size, since both supply stations and points of demand are intermingled. The excess or deficiency passes to the central station.

The Possibilities of the Scheme.

While the scheme has possibilities of great magnitude, it may be commenced on a small scale in a single watershed, the mains being gradually extended, and more water power brought into action, as is found economical. Each little station is independent of the other and is not affected by additions. Hence there is small financial risk. The economic gain is in coal consumption, balanced against the extra cost of the water power plant over the same power put into the central station, though the complete balance sheet contains other items on both sides.

Speech Through the Ether.

By Sir OLIVER LODGE.

THE first of the citizens' lectures in connection with the British Association meeting at Edinburgh was given by SIR OLIVER LODGE, whose subject was "Speech Through the Ether; or, the Scientific Principles Underlying Wireless Telegraphy."

SIR OLIVER LODGE said that to him ether was the most real thing in the material universe. It was not matter, but it seemed to be the stuff of which matter was made. It held the atoms together, and it welded the cosmos into a coherent whole. It penetrated the pores of matter, even into the innermost recesses of atomic structure, and it extended to the furthest confines of visible space. By its aid they saw and analysed the nebulae, at distances too vast for anything but mind. Through it, too, they did more prosaic things. They telegraphed, and they ran electric motors, even tramscars, guiding the energy by a wire, itself inert. Briefly summarised, the ether was responsible for cohesion, for chemical affinity, for electric and magnetic forces, for light, and, as they learned from Einstein, for gravitation too. Was there anything the ether did not do? Yes, it did not convey sound. Sound was a vibration in matter, not in ether; while light was a tremor in ether, not matter. They saw through the ether, they did not talk through it. But his subject was "Speech through the ether," speech by means of what they called empty space. How could that be? How could they utilise the ether for conveyance of sound? It could only be done by transmutation. The ether had long been used to convey heat, yet heat was a property of matter. Heat from the sun reached the earth, but it did not travel as heat. At the sun the quiver of the particles was transmitted to the ether, it spread out as radiation and where that fell it could excite a similar quiver. The heat disappeared in one place, to reappear in another. It travelled continuously as energy, but not as heat. So it was with sound also. The sound vibrations must be transmuted, must be delivered up to the ether to travel as radiation, and at the distant station it must be received by something which could transmute the energy back to sound again.

Transmutation of Heat from Matter.

The transmutation of heat from matter into ethereal energy was effected by the atoms themselves, by mechanism only partially known to us. Through all the geological ages—literally from time immemorial—it had been going on. It was not so with sound. No trace of sound reached us from an exploding star. We saw the flash; we heard nothing. To transmute sound into an ethereal tremor, and to change it back again into sound at a distant station, required human agency. It needed discovery and invention. Discovery and invention were rife among us, though handicapped in their early stages by poverty and lack of opportunity. Only when some practical result was forthcoming did that difficulty begin to disappear. Great achievements were not due to one man, but to a succession of workers, each passing on the torch to the next. It was well to remember great names of recent times. Kelvin, Maxwell, FitzGerald, Hertz, the pioneers on one line; and on another, Crookes, J. J. Thomson, and others who were working hard to-day. The first line dealt with the ether and its properties; the second line discovered the nature of electricity. It was only with scientific principles that he was dealing, not with the technical details of application. Methods of application were protean; many an amateur was acquainted with them, and the subject was advancing so quickly that devices a few years old might hiss the speaker. But the fundamental principles remained, and one of these was the nature of electricity.

The Docile Electron.

It had turned out to be corporeal, atomic, or rather electronic. The discovery which closed the nineteenth century was the isolation of the natural unit or electricity. Small almost beyond conception, mobile and active to an extraordinary degree, the electron was becoming our most docile servant. The skill of man had harnessed electrons; by their aid sound vibrations could be transmitted

* Abstract of a Paper read before Section G of the British Association.

to the ether, and after transit across great vasts of space could be transmuted back again. In an empty Crookes tube they could be driven off from matter. From a hot wire they evaporated, and they could be deflected and guided as we wished. Their obedience was absolute and instantaneous; they had next to no inertia or sluggishness of their own; and they obeyed the slightest force. If faced with a positive plate, they rushed to it; if the plate was negative, they retired discouraged. Their journey was itself an electric current, and thus they got an electric current varying and responding to every fluctuating control. Electric oscillations were known; we owed them to Kelvin and Fitzgerald. They were of extraordinary frequency, millions of vibrations per second, and, they generated waves in the ether, as was shown by Maxwell and Hertz. Let them arrange a microphone—an ordinary telephone transmitter to which they could talk in the ordinary way—and let the slow sound vibrations, a few hundred per second, be applied to strengthen or weaken electric oscillations of a few million per second. Thousands of oscillations occurred during the time that every sound wave lasted, and by letting them control a crowd of electrons in an exhausted vessel or vacuum tube their intensity could be controlled by every ripple, every rustle, every shock, and every sibilant which went to constitute human speech. And the radiation emanating from the electric oscillations would then be graduated in intensity, so that the waves which travelled in the ether should be strong or weak exactly as the stimulus required. If they received the electric waves and conveyed them to another empty bulb containing again a hot wire giving off electrons, the crowd of particles would respond, another current would be generated, carved into fluctuations of corresponding strength, and these variations of current when employed to actuate a telephone could accurately reproduce the tones of the distant voice. Roughly and generally that was the plan, and the ingenious devices by which the feat was carried out were astonishing. He was not specially astonished by the wireless transmission of coarse signals, like the dot and dash of ordinary telegraphy. It was no more difficult to send impulses across space than to guide them by wires. What Mr. Marconi had made practical as "wireless" might have come in first, and then wires might have been regarded as an improvement, like speaking through a tube instead of shouting into the open air. Any mechanical sending key, and many a mechanical relay, could accomplish that. But no mechanical relay could follow the variations of quality in human voice; no agency short of the electron would be quick and docile enough. But with their aid the feat was accomplished, and the electric waves which acted as the intermediary could travel a thousand miles or more before being received and once again transmuted.

One more principle must be emphasised. How could the human

ear or any instrument follow vibrations of millions a second? It could not. Only the electron could do that. But let them suppose that in addition to the oscillations coming from a distant station they set up home oscillations, in a small subsidiary vacuum tube, of nearly the same frequency. Let the incoming waves vibrate a million times, for instance, while their local arrangement vibrated a million plus 500, what would happen? They would "beat." They would give 500 beats a second, and that was a musical note. To that they could listen, and upon that the variations of intensity could be superposed. This was not the first plan adopted. The first plan was the utilisation of crystals and other detectors, such as the Fleming valve, to rectify the oscillation—to check all the negative pulses and utilise all the positive—to let only one sign through. Thus they got the vacuum valve. But soon this was improved by Lee Forest into a magnifier, so that an original impulse, exceedingly weak, could be strengthened a hundred or even a thousand times by using the electrons as relays, and putting a number of relays in series. So, also, for transmitting, the magnifying glass was available. The electric impulses from the first valve, the one directly actuated by the microphone—these need not be given to the ether; they could be used to stimulate another valve, so as to increase their intensity until the waves generated were powerful enough to be allowed to rush across the Atlantic. This they were able to do in a fraction of a second. And then, though what arrived was only a feeble residue, since they had spread far and wide by that time, they still preserved all their peculiarities intact; every pulse of the speech was retained, and could be reproduced, and by adequate magnification could be made easily audible. Distance was no deterrent, it only enfeebled; it did not confuse and spoil, as it did with a wire embedded in the ocean. The properties of the ether were perfect, and all the fluctuations were accurately conveyed. All that they required was a magnifier to get a convenient intensity; and that the ingenuity of man had supplied.

Communication with other Worlds.

We have learned how to transmit speech through empty space, said Sir Oliver Lodge in conclusion. Empty space separates the worlds. Are beings other than human beings able to communicate with us? We sometimes see in the papers that Marconi thinks he has heard signals from Mars. I have nothing to say to that, for I don't know. I don't assume we are the only beings in the universe. I don't assume we know more about ether and electricity than any other people in the universe. I think it possible other people may have been trying to signal to us for a long time. I don't know whether they are on another planet, or where they are. All I say is—don't let us shut our minds to the infinite possibilities of existence. (Applause.)

The Olympia Engineering Exhibition.

In the absence of the president, the HON. SIR CHARLES PARSONS, K.C.B., F.R.S., the Shipping, Engineering and Machinery Exhibition was formally opened on the 7th inst. by CAPT. H. RIALI SANKEY.

An interesting speech was made by COMMANDER SIR TREVOR DAWSON at the inaugural luncheon concerning industrial conditions in Germany and their possible effect on this country. Sir Trevor had just returned from a visit to Germany, during which he had investigated the labour position in one large electrical works and in one of the largest steel and engineering works. He said he found that both works were hives of industry, and that labour was working harmoniously with the management, the result being that output was very high. He had ascertained that the management of the electrical works had been permitted to write down the value of their shops and machinery during the war period until they stood on their books at the price of one mark, and that during the same period there were no taxes corresponding to our munitions levy or excess profits duty. Consequently, during the war period industrial firms had been able to collect working capital, which placed them in a strong position when peace was declared. German manufacturers were, therefore, in a sound economic position to compete successfully in world markets.

The most important commercial question to be settled at present was undoubtedly that of exchange, and our existing condition could be largely attributed to adverse foreign exchanges. The many valuable inventions and machines exhibited at the exhibition should in the future considerably assist in cheapening production on massed production lines. Exhibitions such as this brought together the combined results of the brain power of our inventors and workpeople, and they could not fail (Sir Trevor concluded) to assist in furthering the interests and the welfare of the workers by ensuring to them employment and the means of livelihood.

In the two years that have passed since the last Shipping,

Engineering, and Machinery Exhibition was held there has been seen a marked change in trade conditions. Although we have been experiencing the effects of a trade slump, there are clear signs of an improvement, but whatever may be the state of trade, the opportunity should be taken of making a visit to Olympia. To be up-to-date is essential to progress, and the progressive man will at least accept the opportunity of seeing, even if at the moment he cannot place orders. This year some three hundred leading firms have taken stands, and the exhibition may be said to be as truly representative of the industries as far as the space available at Olympia permits. In addition to the attractions of the exhibits themselves, there are to be a number of special lectures on various subjects, and it is to be noticed that "oil" comes in for a large amount of attention, three conferences being exclusively devoted to the discussion of the use of oil as a fuel.

The exhibition will remain open daily from 11 a.m. to 9 p.m. until September 28th.

Notes on Exhibits.

British Thomson-Houston Co., Ltd.

The manufactures of this company are so wide in character that it must have been as difficult for them to decide what to leave out as it is for us to describe adequately their exhibit in the space at our disposal. The apparatus shown comprised crane controllers, rivet heaters, motors, wireless appliances, "Mazda" lamps, fittings, &c.

A portable master controller for cranes, demonstrated in operation, enables all operations of the crane to be controlled from the deck or dockside, where full view of the load is obtained during all stages of cargo loading or discharging. Only one man is required, and the necessity of a second man to signal to the crane-driver is obviated. The man carries the controller by means of shoulder-straps, and moves to the most suitable position from which he can control the load. The

controller is connected only by a light trailing cable to contactors mounted on a panel. These contactors are operated by the portable master controller, and govern the main current to the crane motors. In addition to the labour economy, this system enables the charging and discharging speeds to be increased, with less risk of damage to the cargo.

The B.T.H. portable wireless receiver is remarkable in being a complete unit, weighing only 20 lb., in a case measuring 13 in. by 14 in. by 5 in., and it does not require an external aerial or other wires. All that is necessary is to stand the box on a pivot on the detachable cover, connect the telephones, and by simple adjustment "tune" the apparatus to the vibrations of the passing wave. The signals are sufficiently loud to enable messages to be taken from stations in France and Germany, and the direction of origin of the signals is indicated by the instrument. The case contains a receiving coil, adjustable condenser, two receiving "valves" or vacuum bulbs, accumulator for heating the valve filaments, dry cell for the telephone circuits, two small transformers, and a hinged frame which carries a second coil. The accumulator for heating the

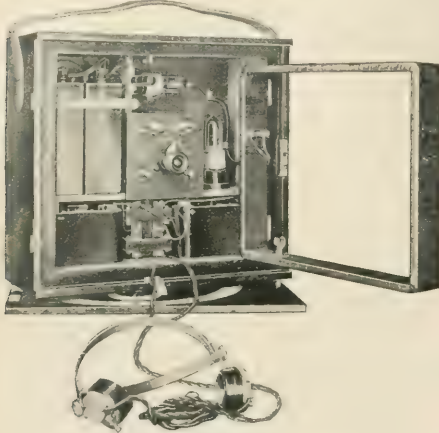


FIG. 1.—PORTABLE WIRELESS RECEIVER.

valve filaments is of the "unspillable" type, and only requires recharging after running with the bulbs for about seven hours. The receiver is shown in Fig. 1.

The B.T.H. floodlight projector, originally of naval origin, has now become a popular aid to commerce in lighting factory or railway yards, and it is also of considerable use for illuminating advertisement hoardings and the façades of public buildings. These projectors, which were recently illustrated in *THE ELECTRICIAN*, are intended for outdoor use, and are thoroughly weatherproof. A marine type of projector for use on ships was also exhibited. This projector can be supplied with mountings suitable for attachment either to the rail of the ship or to the rail of the navigating bridge, and its value in connection with docking or the loading or unloading of cargoes at night is obvious.

Coventry Chain Company.

The neatness and compactness of chain gearing was vividly indicated at this company's stand, which comprised an exhibit

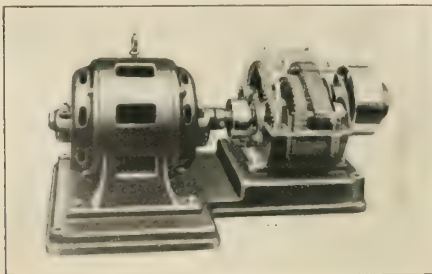


FIG. 2.—CHAIN REDUCTION GEAR BOX.

of various types of chain drives. A typical chain reduction gear-box is illustrated in Fig. 2, and it will be noted how

compact the apparatus is. As examples of accurate and precise workmanship the sample chains left nothing to be desired.

Relay Automatic Telephone Company.

A special feature of the "Relay" system which will attract the attention of most visitors is the fact that there are no

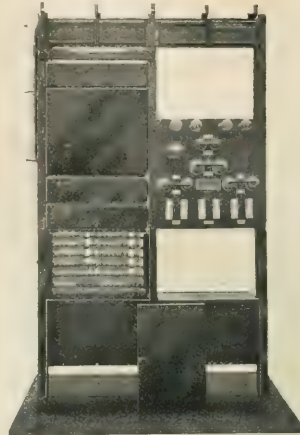


FIG. 3.—STANDARD 50-LINE SWITCHBOARD.

working parts as generally understood. There is an entire absence of all electro-mechanical switches, and the great advantages obtainable by the use of the system include absolute

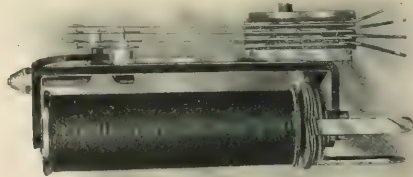


FIG. 4.—SINGLE RELAY.

secrecy, instantaneous connection or disconnection, and high speed of operation. A further important feature is that only two wires are needed from the switchboard to each telephone. Figs. 3 and 4 show a standard 50-line switchboard, and a single Relay.

The Cambridge and Paul Instrument Co., Ltd.

The particular items of interest here were the electrical CO instruments, draught and pressure gauges, and pyrometers. These instruments are particularly accurate and sensitive and purely electrical, requiring no chemical absorbent and no delicate glass work. The CO meter itself contains two identical spirals of platinum wire enclosed in two separate cells in a metal block, one cell containing air saturated with water vapour the other being open to the flue gases. The platinum spirals form two arms of a Wheatstone bridge circuit. When a current flows in this circuit the two spirals become heated and lose heat to the walls of the cells, their temperatures, and consequently their resistances, depending on the thermal conductivities of the gases surrounding them. Changes in the percentage of carbon dioxide in the flue gas surrounding the one spiral cause changes in the conductivity of the gas and a consequent change in the galvanometer deflection. The indicating or recording galvanometer, which is connected to the CO₂ meter, can therefore be calibrated to give direct readings in percentage of carbon dioxide.

A new optical pyrometer of the disappearing filament type was shown for the first time. This is a convenient and very portable instrument for the measurement of high temperatures. The pyrometer contains a small electric lamp, and temperatures are measured by looking through the eyepiece at the hot body and adjusting the current through the lamp by means of a rheostat until the tip of the filament is of the same brightness as the hot body. The temperatures are read on a small moving-coil ammeter calibrated in temperature, which forms an integral part of the pyrometer. An aluminium diaphragm separates the movement from the lamp.

Electrical Utilities, Ltd.

In addition to current limiting devices and excess current indicators, there is to be seen at this stand a "Dim-Bright" adaptor fitting, an electric fitting intended for use with the new "Neon-Gas" electric discharge lamps. It consists of a polished brass globe fitted with an adaptor (to fit any electric

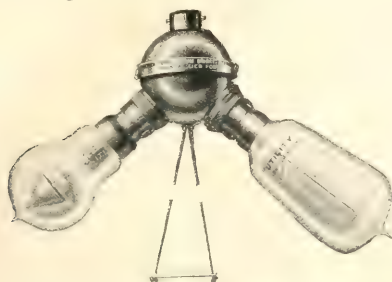


FIG. 5. "DIM-BRIGHT" ADAPTOR FITTING.

lamp-holder) at the top, and two lamp-holders at the foot controlled by cord-operated switch which puts one or other lamp in circuit. For large halls, hotels, cinemas, hospitals, &c., the fitting is used with one "Neon" lamp and one bright lamp inserted. The dim lamp can be alight continuously, consuming little current, but the bright light is instantly available on pulling the cord. This fitting is illustrated in Fig. 5.

Power Plant Company.

Helical gearing must always be of interest to the electrical engineer who is called upon to deliver power by means of motors, as in nine cases out of ten the motor speed is too high for industrial requirements and, therefore, means of speed reduction have to be applied. For this reason electrical engineers should inspect the exhibit of this company, where they will see examples of gearing representing the latest developments and all of a very high degree of accuracy and finish. Flexible couplings will be seen attached to the various units and to the 1 500 H.P. magnetic brake and coupling.

Metropolitan-Vickers Electrical Co., Ltd.

A feature of this exhibit is a specially designed welding generator, known as the Metropolitan-Vickers' single operator type welding generator. The wasteful series resistance used in the ordinary way to obtain stability of the welding arc has been eliminated, and the stabilising of the arc is secured by special

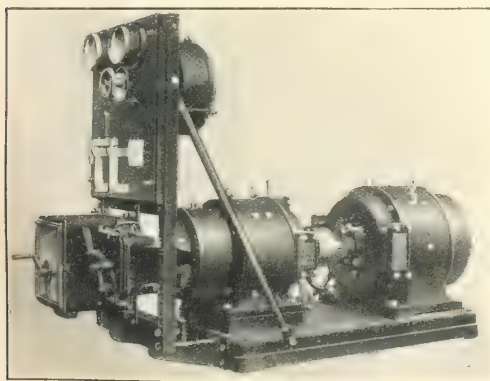


FIG. 6.—SELF-STABILISING ARC WELDING SET.

windings embodied in the machine. A noteworthy feature of this generator is the absence of an external reactance or choking coil. The design has been so perfected that nothing need be interposed between the terminals of the generator and the welding apparatus. The set exhibited, which is illustrated in Fig. 6, is designed for metallic electrode welding to a maximum capacity of 175 A. It is arranged in the form of a motor generator set, the motor starting gear and the generator control panel being mounted on iron brackets attached to the bedplate. Thus the set is an entirely self-contained and complete unit.

(To be continued.)

A Rugby Church Installation.

In connection with the artificial lighting of churches, probably nothing finer has ever been accomplished than the installation at St. Marie's Roman Catholic Church, Rugby. The building is a Gothic structure; the walls are a very light stone color, relieved by a decorative design around and between the pointed arches, and the roof timbering is blue with painted silver stars.

Formerly the church was lighted by means of gas standards, but the lighting was extremely unsatisfactory. The illumination was insufficient and unevenly distributed, and there was also a great deal of glare. The standards interrupted the line of sight between almost any part of the nave and the chancel. Another serious objection to the gas lighting was that at night the ceiling and upper parts of the walls were left in darkness; whereas, from the architectural point of view, the whole interior design of a building of this character and period is based upon top lighting.

The present installation at St. Marie's Church consists of Mirolux trough reflectors, containing 40 and 60 W. Mazda vacuum lamps. The nave is lighted by fourteen troughs. These reflector units are fixed on the East side of the arched roof beams, between the clerestory windows. Several advantages arise from this disposition of the light units. For instance, neither the lamps nor reflectors are



CHANCEL LIGHTING.

visible to the congregation; the light comes from the same level as the windows, and, like daylight, illuminates the entire nave, from floor to ceiling; there is ample illumination at pew height, and the congregation are able to read with ease and to look towards the chancel without any discomfort. The chancel is lighted by means of six Mirolux troughs. Owing to the general Eastward direction of all the lighting and the greater wattage employed, the chancel, and especially the Rood Cross, are more intensely illuminated than the body of the church.

The photograph, illustrating the lighting of the chancel, was taken at night, solely by the light of the Mazda installation, and has not been retouched. To Mr. Shenton, engineer of the Rugby Urban Council Electricity Supply department must be accorded much of the credit for the installation. The wiring, which is on the surface, is carried out on the Henley wiring system, with twin lead-covered cables, painted to match their surroundings. This system, owing to the small section and flexibility of the wires is very suitable for such an installation as this. The wiring is practically invisible, and control of all points is centralised in a distribution box placed in the vestry. The whole of the work was carried out by Mr. Shenton's department under his personal direction. As our readers know, Mirolux trough reflectors and Mazda lamps are manufactured by the British Thomson-Houston Company, Ltd.

THE INQUEST ON FRANK E. PLUM, electrician, who was killed at a Walker sub-station on the 1st inst., was concluded last week, when a verdict of death by electric shock was returned, but the coroner emphasised the value of artificial respiration in these cases. The sub-station was in Messrs. Armstrong, Whitworth & Company's naval yard, and deceased, who was a very capable and efficient man, had been responsible for the maintenance of all electrically-driven plant at the south end of the yard. He had been instructed to cut away certain loose cables, which were "dead." Subsequent to the accident, plier marks were discovered on a live conductor, indicating that deceased had attempted to cut it in error. On testing, the voltage of the current flowing from that conductor to earth was about 255. So far as is known, artificial respiration was not tried. Of the fifteen cables to be cut, deceased had cut nine.

Bradford Electricity Charges.

During the week several sensational but very misleading statements have appeared in some of the provincial and London papers regarding the financial position of the Bradford Municipal Electricity undertaking. It is interesting to trace the source of these reports, so that our readers may be able to judge for themselves how readily trivial things get magnified by local reporters, and, therefore, we set below a history of the incident on which the sensational reports were evolved, and we also present the true state of affairs.

Genesis of Rumour.

It appears that recently Mr. THOMAS ROLES, the city electrical engineer, found it necessary to make certain recommendations to his committee regarding the revision of the charges to power consumers. About this time last year the committee gave consideration to the charges made to all consumers charged under rates in connection with which there was no provision in the contracts for variation in accordance with the price of coal, and these rates were all standardized at an advance of practically 75 per cent. above pre-war rates. A considerable number of the power consumers (those in connection with whose supply the load factor is low) have not yet paid to the extent of 50 per cent. above pre-war rates, and, prior to the last half-year, not more than about 35 per cent. above these rates. The long-hour consumers have, however, owing to the incidence of the coal clause, been called upon to pay in many cases well over 100 per cent. above pre-war rates, and the recommendations of Mr. Roles were to the effect that the power rates should be revised, so that all consumers should, as nearly as possible, be charged on a basis of 75 per cent. above that paid in 1914.

At this stage it appears that a youthful reporter of one of the local evening newspapers, which attempts to specialise in "stunts," heard that these matters were being considered by the Electricity Committee. He approached the Chairman, who informed him that the matter was not ripe for placing before the public, and that, if he had any regard to his wishes, he should not make any reference to it until the committee's decision was reported at the next Council meeting. In spite of this the reporter made enquiries of other members of the committee, until at last, apparently, he found one unwary enough to give him some particulars. The result was, that on the remarks of a layman the reporter concocted an alarmist article calculated to depress further the power consumers, who are for the most part badly hit by the slump in trade. The article in question has been copied by other newspapers, or information has been given to them by the same correspondent. The statements vary to some extent, but, as usual, the "Daily Mail" adds the final touch of veracity by stating: "There is a deficiency of about £30,000 to £40,000 on the accounts of the electricity department."

It might be added that the department, like all undertakings whose chief source of revenue is from the supply of electricity to power consumers, has been badly hit by the reduction in output due to the coal strike, and also due to the slump in trade, which has affected the Bradford industry severely. There is, however, no intention on the part of the committee to endeavour to make the consumers who have used electricity during the period of the strike bear the loss sustained by the department by making an abnormal increase in the charges for power, as is insinuated in the article. As a matter of fact, the accounts of many consumers for the first quarter in which the new charges are operative will be considerably less than their accounts for the same consumption of electricity in each of the first three quarters of this year, by reason of the fact that the department will be buying coal at much cheaper prices, and, therefore, far less will be paid by such consumers under the terms of the coal clause than the additional charge to be paid by reason of the increase in the basic rate.

The present charges to power consumers are based on a standing charge of £3 kW per annum, plus 4d. per unit, so that the new charge represents an increase of £2 per annum on the standing charge. At present the maximum price payable is 2d. per unit, plus an additional charge of .015d. for each 6d. rise in the price of coal above 8s. per ton. The new maximum charge is 34d. per unit, inclusive of any charge which may be made under the coal clause.

The Electricity Committee are very incensed, and at a Council meeting Ald. W. Turner made the following statement:

Ald. Turner's Statement:

At the request of the Electricity Committee I desire to make the following statement: The committee, at their meeting on Friday last, having had submitted to them extracts from a section of the local Press, together with extracts from a section of the London Press, from which it would appear that the electricity department has, in fact, lost very considerable sums of money during the current year, desires to express its complete condemnation of such misleading statements, the effect of which is not merely mischievous, but calculated to be damaging to the department and to the credit of the city.

The truth is, that some months ago the rates charged to a certain section of consumers of electricity were revised. It is now recommended by the committee that the rates charged to another section of consumers should undergo revision; these altered rates will come into effect on October 1, subject to the approval of the Council, and will only have the effect of raising the charges some 75 per cent. above pre-war charges. It is obvious that the enforced curtailment of consumption during the coal dispute operated adversely upon the department during the current year, but to state or suggest that there is a deficiency of £30,000 to £40,000 in the accounts is a grotesque exaggeration.

Key Industries.

It is provided in sec. 1 (5) of the SAFEGUARDING OF INDUSTRIES ACT, 1921, that for the purpose of preventing disputes arising as to whether any goods are or are not any goods chargeable with duty under Part I. of the Act, the Board of Trade may from time to time issue lists defining the articles which are to be taken as falling under any of the general descriptions set out in the schedule to the Act, and where any list is so issued defining the articles which are to be taken as falling under any such general description, the said schedule shall have effect as if the articles comprised in the list were therein substituted for that general description.

In pursuance of this provision the Board of Trade have prepared lists defining the articles which are to be taken as falling under the following general descriptions set out in the schedule, viz.:-

Optical glass and optical elements whether finished or not.

Optical instruments.

Scientific glassware.

Laboratory porcelain.

Scientific instruments.

Gauges and measuring instruments of precision of the types used in engineering machine shops and viewing rooms.

Compounds (not including ores or minerals) of thorium, cerium, and the other rare earth metals.

Synthetic organic chemicals (other than synthetic organic dyestuffs, colours, and colouring matters imported for use as such, and organic intermediate products imported for their manufacture) analytical reagents, all other fine chemicals and chemicals manufactured by fermentation processes.

Articles included in any of the lists and articles falling under any of the following general descriptions will, subject to the provisions of the Act, be chargeable with duty under Part I. on or after Oct. 1 next:-

Lamp-blown ware; wireless valves and similar rectifiers and vacuum tubes; ignition magnets and permanent magnets; arc-lamp carbons; metallic tungsten, ferro-tungsten, and manufactured products of metallic tungsten.

The Trades Union Congress.

The Trades Union Congress, the Labour Parliament, has met and discussed almost every subject on earth, except labour. We have had another demonstration of the thoroughly political character of the labour movement, and the distance which it has travelled since the days when the great Trade Unions were first established. We know what Labour means about Ireland, the Washington Conference, the Peace Treaty, disarmament, education, local government, national taxation, and a host of other questions which many of us still find it difficult to associate with Labour. We have no doubt that the Wesleyan Conference, the Institution of Electrical Engineers, the Police Union, and a lot of other worthy bodies have views about Ireland, but we are glad to know that they have so far refrained from expressing them in their corporate capacities. We are still optimistic enough to look forward to the day when the Unions will meet as Trade Unions and discuss trade questions. When that day arrives, such matters as "ca-canny" limitation, restriction, demarcation of functions, and similar topics, may receive the attention of those "brains" which have joined with the "hands" to form the modern labour movement. The brains have no doubt worked hard enough to devise these innumerable means of handicapping industry, but they are wise enough when they appear in public at the annual Trades Union Congress to confine the discussion to extraneous matters of current politics.

As a race the English are supposed to be rather fond of self-depreciation. When we meet we love nothing better than to discuss our faults. Our trade and professional associations are chiefly occupied in debating ways by which recognised weaknesses can be removed. From this point of view, the labour movement is to some extent un-English, or it is, perhaps, the exception which proves the rule. A verbatim report of the proceedings of the Trades Union Congress does not in any line or sentence even so much as suggest that any English labourer is lacking in efficiency or fails to reach the high peak of perfection. None of these delegates seem worried to know whether it is possible that any of the men they represent could by taking thought become more useful members of society. They are all apparently content to know that the labourer is all that he could or should be, and that everybody else is wrong. It is, unfortunately, perfectly true that the economic pressure of unemployment has given a totally different tone to these discussions between labour experts. They are not so bombastic as they were, but they still fail to recognise the possibility that some of the troubles which have come upon them may be due to their own shortcomings. All this is thoroughly un-English. It is in essence Prussian, and for that reason we can take comfort, knowing full well that it cannot last in our country. The time must come again when the Trade Unions will recognise their true function as business organisations, and devote their thoughts and discussions to business matters. They will then turn their attention to construction instead of destruction, and British industry will once again lead the world.

At the Central Criminal Court ERNEST M. WALKER, engineer, has been sentenced to EIGHT MONTHS' IMPRISONMENT in the second division for converting to his own use £555, the subscriptions of fellow employees of the Metropolitan District Railway Company at Ealing Common for an outing fund, of which the prisoner was treasurer.

Municipal Electricity Accounts.

The gross working profit on the **BIRKENHEAD** Electricity undertaking for the year amounted to £22 577, as compared with £24 502 in 1919-20—decrease of £1 925. The total income amounted to £99 352, an increase of £19 903. The sale of tramways current was up by £3 892, and for all other purposes by £15 577. On the other hand, the total working expenditure amounted to £76 674, an increase of £21 328. Of this increase generation expenses accounted for £16 191 (mainly due to fuel and wages), distribution charges for £22 605, and other expenses for £3 031. Counsel's fees in connection with the Electricity Enquiry amounted to £1 375. The outstanding debt on the undertaking was £139 151 at the close of the year, against which was set a balance of the sinking fund and stock redemption fund of £18 199.

For the year ended March 31 the accounts of **PETERBOROUGH** Electricity Works show gross revenue to be £25 452, against £18 382 in the previous year. Total working expenses (less maintenance of public lamps) amounted to £22 057 (£13 185) and capital charges £6 158 (£5 254), making the net result, before charging capital expenditure out of revenue, &c., a deficit of £3 580 (£6 688). Total capital expended amounts to £118 215; capital repaid on the sinking fund, £43 278; loans outstanding, less sinking fund, £90 383. Units sold numbered 1 280 563, against 1 113 005 in 1920; number of consumers, 825 (720); total connections, 2 283 kW (2 017 kW); maximum demand, 876 kW (825 kW); load factor, 16.69 (15.40). The net deficits for the last two financial years, amounting to £4 268, have been charged to the district fund account for the year ended March 31, 1921, but these deficits have been only partly provided for in the general district rates which have been levied. The last financial year (ending March 31, 1921) marks the close of a definite period in the history of the undertaking, being the last year of the exclusive use of the electrical system, both in "generation" and "distribution," which has been in operation since the opening of the works twenty years ago. The adverse financial result is, to a great extent, attributable to conditions which are unavoidable during the transitional phase of the development of the undertaking.

REDDITCH Urban Council electric lighting accounts for the year ending March 31 show gross revenue to be £34 638, against £31 152 in the previous year, an increase of £3 486. Total expenditure amounted to £28 980, leaving a net revenue of £5 657. Repayment of principal, however, required £2 437 and interest £4 424, which made a deficit of £1 203. The total units sold numbered 2 574 378, against 2 762 033; the average price obtained per unit was 3.2d., against 2.7d., an increase of .5d. on the previous year. On Oct. 1, owing to the heavy increase in wages and the cost of coal supplies, the following revised scale of charges becomes operative:—Lighting: Factories, 7d. per unit; theatres, picture palaces, 6d. per unit; all other classes of consumers, 8d. per unit. Power, cooking, and heating: Except in the case of a large consumer taking a supply on the high-tension side, the charge for all current (except lighting) will be 2½d. per unit, subject to an increase or decrease of 2s. 6d. per 1 000 units for every 1s. or part of a 1s. variation from the standard price of coal delivered to the electricity works; namely, 19s. per ton. Meter rents: The charges for meter rents will be 2s. to 10s. per meter per quarter, depending on the size of the meter installed. No prepayment meters will be installed. The minimum payment for current will be at the rate of £1 per annum for each meter installed. A discount of 2½ per cent. will be allowed off all accounts paid at the Council House within thirty days of their being sent out.

The accounts of **SHEFFIELD** Corporation Electric Supply Department for the year ending March 31 last show that the capital expenditure on the undertaking to March 25, 1920, was £5 021 086. During the year £419 345 was expended on capital account, making the total to March 31 £5 440 431. The revenue account shows that the income from electric supply was £982 456, and from installation and motors £99 479, making a total of £1 082 025, and the expenditure £705 406, leaving a balance of £376 618. Interest, sinking fund, and income tax take up £260 288, leaving £116 329. To this is added £15 493 balance to March 25, 1920, and £61 144 balance after settlement of income tax account to March, 1919, and these bring the total balance up to £192 968. The sum of £1 000 has been transferred to the motors and cookers fund; £100 000 to the renewals and special expenditure fund, £73 356 10s. to the reserve, and £18 611 to depreciation of stocks. These total up to £192 968, and balance the account. The amount paid to sinking fund, with accumulation, for reduction of debts to March 31, 1921, is £1 048 072. The total number of consumers is 12 428, an increase of 2 526 during the year, or 25 per cent., and the total connections amount to 180 233 kW, an increase of 24 971 kW, or 15 per cent. The department has been responsible for the installation of 7 810 H.P. of motors, out of a total horse power of 19 056 connected during the year. The number of units sold during the year was 9 182 951 more than the previous year, an increase of nearly 7 per cent., and but for the coal strike and trade depression this increase would have been very much greater. The average prices obtained were 3.88d. for light and heat and 1.41d. for power, giving a total average for 1921 of 1.65d. In 1917, for light and heat 2.22d. was paid, for power .74d., with a total average price of 85d. In 1917 194 100 tons of coal were consumed at 15s. 5d. per ton, and in 1921 this had risen to 223 728 tons at 36s. per ton. The number of staff and workpeople is now 1 052, and the total amount paid in salaries and wages amounted to £226 442 for the year.

Electric Traction.

STOCKPORT Council has decided to have the tramway track in Warren-road reconstructed at an estimated cost of £1 200.

At **BOURNEMOUTH**, where a good deal of track repair work and the relaying of lines is in progress, a number of new tramcars have recently been added, thus facilitating the dealing with the holiday traffic.

The **GLASGOW** Tramways Committee has decided to obtain powers in a Provisional Order to run several omnibus routes, to be confined, with one exception, to an area whose radius is ten miles from the centre of the city. The Committee have rejected the proposal to revert to the halfpenny fare.

The total receipts of **ST. ANNES** Tramways for July amounted to £7 836, to which £4 326 must be added for Lytham-road route, owned by Blackpool Corporation. The receipts for the full period up to July 31 were £20 392 net, compared with £19 165.

MANCHESTER tramwaymen have rejected the proposal of Mr. McElroy, general manager of the Tramways Department, by which the car cleaners as a body would work shorter hours, and thus avoid the dismissal of thirty cleaners who, for reasons of economy, have been given notice.

Work is rapidly proceeding on the construction of the track for the express tramway service from Harehills to Oakwood or Roundhay, LEEDS, and a considerable number of unemployed have been engaged. The track will be laid on a special route, with a foot-path on each side.

In view of the fact that the **TRAMWAYS (TEMPORARY INCREASE OF CHARGES) Act** will expire in 1923, the Municipal Tramways Association has been informed by several municipal tramway undertakings that they are in favour of the general scheme of the Act being made permanent, and the Ministry of Transport will therefore endeavour to get the necessary legislation passed next year.

It was previously announced that certain **UNDERGROUND STATIONS** were to be re-opened last Sunday. It is pointed out that the date should have been given as Sunday, Oct. 9, on which day and following Sundays it is intended to re-open all stations on the Underground system for the whole day, with the following four exceptions: Cannon-street, Covent Garden, York-road, and Aldwych.

The Ministry of Transport has extended by one year from Sept. 6, 1921, the periods limited by the **BIRMINGHAM CORPORATION LIGHT RAILWAY ORDER (1912)**, as extended by an Order of the Board of Trade dated July 28, 1915, for the completion of the works, and the period limited by the **BIRMINGHAM CORPORATION (QUINTON) LIGHT RAILWAY ORDER, 1913**, for the purchase of lands and the completion of works.

The **LIVERPOOL** Tramway Committee has authorised the City Engineer to proceed with tramway reconstruction work at an estimated cost of £50 000. Mr. P. Priestley, the tramways general manager, has recently introduced various improvements in about twenty of the Corporation tramcars. The plough-shaped wooden life-guard, which completely encircled the truck, has been superseded by the Tidswell side and end life-guards and a wire guard running the full length of the car body. The number of obstructions inside the car and the roof cover have been reduced, with a view to greater facility in cleaning; an efficient system of ventilation has been provided, and also an inside destination indicator, while the decoration of the interior of the cars has been improved.

Commenting upon the reversion to the use of COAL AS FUEL by the RAILWAY COMPANIES, our contemporary, the "Daily Express," says: "We cannot but feel dismay, however, at the prospect of returning to the old régime for good. Half the smoke and foulness in the air, half the blackening of our lungs in towns is due to the steady outpouring of coal smoke from the railways. There is one means by which our towns and cities could be made cleaner and healthier, viz., the use of electricity. Coal-burning engines are forbidden in the precincts of New York and other American cities, and trains are run in and out of the great termini by electrically driven engines." It concludes by pertinently asking: "How long will it be before British railways catch up with the spirit of the age?"

The annual report of the **BIRKENHEAD** Tramways and Motor Department for the year ending March 31 shows that the total income of the Tramways amounted to £152 304, against £148 179 in the previous year; working expenses were £116 060 (£100 476), leaving a gross profit of £36 244 (£47 703). After providing for Interest, Sinking Fund, and Income Tax, £232 211 (£31 599), a net profit of £4 033 (£16 104) remains, which has been allocated as follows: In aid of rates, £3 021; contribution to Capital Account, £81; Renewals Fund, £930. The Renewals Fund now stands at £17 417. Of £14 935 in the Reserve, £13 253 has been utilised for the purchase of "buses, which amount, together with interest, is to be repaid by the "buses in eight annual instalments. Passengers carried numbered 2 218 239 (22 836 034); car miles run, 1 286 921 (1 275 022); number of units used, 2 885 442 (2 864 650); number of units used per car mile, 2.242 (2.246); percentage of working expenses to receipts, 76.20 per cent. (67.79 per cent.); average traffic revenue per car mile, 27.57d. (27.37d.); average total revenue per car mile, 28.46d. (27.89d.); average working expenses per car mile, including power cost, 21.65d. (18.91d.); average total cost per passenger, 1.255d. (1.099d.); average number of passengers per car mile, 17.23 (17.91); profit per car mile, 816d. (3.033d.).

Electricity Supply.

BIRKENHEAD Electricity Committee has received sanction to borrow £15 000 for mains and £5 000 for services.

DOVER Town Council will in future supply electricity to the Western Heights Barracks, which have hitherto been lighted by gas.

Owing to the present condition of trade, **OLDHAM** Town Council has decided not to advance the charges for electricity for the time being.

MOTHERWELL Town Council has decided to reduce the charge for electricity for public lighting in the WISHAW area from 5d. to 3½d. per unit.

It is hoped that electricity charges at **SWINDON** will shortly be reduced. The undertaking made a profit of £6 600 during the past year.

GUILDFORD Corporation will take over the undertaking of the Guildford Electricity Company on the 29th inst. The purchase price has already been fixed at £55 000.

WINCHESTER City Council has decided to borrow for the electricity department £11 000 at 6½ per cent. per annum, to be repaid by equal instalments in fifteen years.

Among the mechanical appliances recently installed by the **MANCHESTER** Gas Committee are a dictograph telephone installation and a comptometer.

BISHOP'S CASTLE Town Council have consented to the Electric Light Company increasing the charge for electricity from 9d. to 1s per unit for a period of six months.

WORKSOP Urban Council has decided to take up a loan of £25 000 at 6½ per cent. per annum for extensions of its electric supply undertaking.

The Electricity Commissioners have given their formal consent to the extension of the generating plant at the **PERTH** Electricity Works. The extensions are estimated to cost about £15 000.

LLANDUDNO Council made a loss of £1 136 during the last year on power supplied to the Light Railway Company. A flat rate of 3d. per unit is therefore to be charged for the next twelve months.

STRETFORD Urban Council are purchasing from Salford Corporation a rotary converter, installed at the Broughton Copper Company's works, for £1 750, plus alteration and removal costs, estimated at £365.

In regard to the application of the **NORTHWICH ELECTRIC SUPPLY COMPANY, LTD.**, to the Electricity Commissioners for a special Order, the date for sending in objections has been extended to Sept. 30, 1921. The Urban Council has instructed the Clerk to report fully upon the matter to the General Purposes Committee.

KEIGHLEY Corporation has received sanction to borrow £27 374 for extensions of the electric supply undertaking, but the Electricity Commissioners have reserved their decision as to a further sum of £26 252.

WREXHAM Town Council has decided to alter the discount allowed to consumers from 2½ per cent. to 5 per cent. for a period of six months, and to apply for authority to increase the maximum charge for electricity from 8d. to 9d. per unit.

The charges for electricity at **NELSON** have been increased by ½d. per unit for lighting purposes and ½d. for power. This has been necessitated by the excessive prices of fuel during the coal dispute, the estimates having been exceeded by £2 118.

The **Honourable Lich. Society** have consented to allow **COLERAINE** Urban Council to use, at a nominal rent, the water power at the Salmon Leap on the Bann for generating electricity for the Council's electric power and lighting scheme.

WALTON-ON-NAZE Urban Council have deferred applying for a loan of £3 000 for extensions to the electricity plant and works pending consideration of a scheme put forward by Mr. C. F. J. Barker, who states that there is a possibility of obtaining electricity by means of power from the mill pond at 2d. per unit.

After discussing the future supply of electricity in **MID-LANCA-SHIRE** for eighteen months, a recent conference of local authorities was unable to devise a scheme satisfactory to all parties, and the conference has been adjourned *sine die*. The Electricity Commissioners have now asked for schemes to be prepared.

The **MONAGHAN LIGHTING COMPANY** offer to light the town with sixty electric lamps, at 10½d. per unit, on a guarantee that the Council will continue to take the light for seven years. The Council, however, are unable to give the guarantee, as they go out of office in 1923. There the matter stands for the present.

The **REGBY** Guardians have asked their Building Committee to reconsider the recommendation to postpone the wiring of the board-room, offices, &c. Decorations are being carried out, and it is therefore considered advisable to do the wiring work now, more particularly as the cost of the electric light will be less than that of gas.

Increased charges of ½d. per unit for power and heating, and 1d. per unit for domestic supplies to kitchen houses in **DENDALE**, which were to have taken effect from Oct. 1, have been postponed. Members of the Council have raised objection on the ground that

the cost of production is coming down, and the matter has been referred back to the Electricity Committee for reconsideration.

The Electricity Commissioners have refused to sanction the application of **ACCRINGTON** Corporation for borrowing powers for £126 850 for electricity extensions. A deputation from the Corporation, sent to London to place further arguments before the authorities, was given a favourable hearing, but no alteration of the decision has yet been announced.

As there have been several failures of the electric supply mains laid on the solid system, the **HORSHAM** Urban Council has authorised extensive renewals to be made so as to get rid of weak portions before the winter months. Tenders for alterations to the electricity works have been accepted, and an application has been made to raise the necessary loan.

West Lancashire Rural District Council will raise no objection to **Southport Corporation** supplying electricity to residents in that portion of the Kew district within the West Lancashire rural district. Application is, therefore, to be made to the Electricity Commissioners for a licence to supply electricity to the residents in the district referred to.

The borough treasurer of **SWANSEA** has informed the Electricity Committee that he regards the annual report of the undertaking as extremely gratifying. The amount hitherto provided towards repayment of capital is about 34 per cent., or one-third of the whole. Certain suggestions have been made by the borough treasurer as to the provision of working capital for the undertaking.

Electric current is now available in the village of **LAMBERHURST** (Kent) for public and private lighting. Hydro-electric plant has been installed at the Old Mill by Col. Delamain, and there is also a battery of accumulators. A charge of 1s. is made for fifty hours' use of a 16 c.p. lamp, or 1s. a unit where meters are installed.

Councillor J. Winterbottom, chairman of the **SOUTHPORT** Electricity undertaking, speaking as to the future policy of the committee, states that it is hoped to have the whole of the township of Ainsdale electrically lighted for the winter. It is hoped that the cables will be laid and the sub-station completed by the end of the month. Last year there was a profit on the undertaking notwithstanding the many difficulties which had to be contended with. The Borough Electrical Engineer has reported to the Council concerning a site for the erection of an electricity sub-station on the Ainsdale housing site.

A report circulated by the **NEWCASTLE** Watch Committee states that the 60 per cent. lighting from Aug. 6 to Sept. 30, and 100 per cent. lighting from Oct. 1 to Dec. 31 inclusive, which had been agreed to, will cost £11 708; this being an excess of £6 646 over the estimates approved by the Council. It is anticipated, however, that savings on salaries, wages, and electricity will amount to £1 798, and it is proposed to apply that sum in reduction of the proposed excess expenditure, reducing the latter to £4 848. The City Council is requested to approve of the additional expenditure.

The effect of high rates and the demand for public economy are manifesting themselves in an increased interest taken in municipal administration. At **KINGSTON-ON-THAMES** on Monday a resident asked the county magistrates to grant a summons against the Town Council for allowing "a scandalous waste of electricity and gas in the street lamps of the district." He alleged that the lamps were lighted at least an hour before it was necessary. The chairman said the county magistrates had no control over the street lighting in Kingston, and the applicant must apply to the borough magistrates; neither had they any control over Surbiton.

The position of **WALSALL** Electricity Department was considered at a meeting of the Town Council on Monday, and various opinions were expressed. Mr. G. W. Warner referred to a sum of £4 000 which was being paid for expert advice, and declared that a financial loss of £4 000 or £5 000 had been made during the last quarter on electricity, and that they were "up to their necks in debt" if the matter were investigated. The Mayor said that no doubt investigations ought to take place at the electricity station. He wished Walsall had followed the example of Wednesbury and sold the electricity station. Mr. Talbot, on the other hand, pointed out that they lost £5 000 on the first quarter of last year, yet they finished the year with £7 000 profit. During the quarter under review the number of customers had increased from 1432 to 1735. The committee's report was approved.

SKEGNESS Council have received a letter from the Electricity Commissioners stating that they cannot see their way clear to recommend the Minister of Transport to grant a further extension of time asked for by the Council for inaugurating a public supply of electricity. They propose to recommend the Minister to revoke the powers of the Council to supply electricity under their Act of 1914, but, before doing so, they have offered to consider any further observations which the Council may desire to offer. The Council have decided to interview a prominent local electrician, and hear his views and suggestions in the matter. In their application to the Commissioners, the Council stated that the outstanding loans, exclusively of housing, were £102 570, and the assessable value of the district was only £26 330; and further, that the gas undertaking is being carried on at a considerable loss, and they desired to protect it from competition. A number of tradesmen of the town have installed electricity, and are giving a supply to their neighbours.

WALSALL Corporation proposes to ask the Electricity Commissioners to authorise the supply of current at Sheffield and Daw End-lane, Rushall.

DOVER Town Council has received sanction for the borrowing of loans of £3 000 for mains and services, and £250 for transformers. Application is to be made for a loan of £8 000.

In order to meet the increased demands upon the electricity station, **CARLISLE** City Council have agreed to the installation of a 3 000 kW turbo-alternator in the existing works, at a cost of £40 000.

Application is to be made to the Ministry of Transport by **DOUGCASTER** Town Council for sanction to the construction of a light railway connecting the tramway in Frenchgate to the tramway in St. Sepulchregate, along Trafford-street and Factory-lane. The estimated cost is £10 001.

SOUTH SHIELDS charges for electricity are to be revised and reduced from Oct. 1 as follows:—For lighting (a) on m.d. system, by abolishing the addition of $8\frac{1}{2}$ per cent. on the low-priced units, and (b) by reducing the flat and special rates for theatres from $8\frac{1}{2}$ per cent. to 75 per cent. The industrial and domestic power and heating charges are also to be reduced from $8\frac{1}{2}$ to 75 per cent., and tramway supply from 2½d. to 2d. per unit.

At Tuesday's meeting of the **CARPHEILLY** Council the question of electric lighting was further discussed, when the Clerk stated that the Council had no power to take debenture shares in the South Wales Power Company. Mr. E. D. Budge warned the Council against generating their own electricity, on the ground that their charges would be prohibitive. The matter was deferred to allow of further negotiations with the parties concerned.

Preliminary steps have been taken in connection with the promotion of a Provisional Order by **AYR** Corporation for the utilisation of the water-power of Loch Doon for electricity supply. The report of the consulting engineer has been submitted to the Electricity Commissioners. In a reply the secretary states that the Commissioners will give their favourable consideration to a water-power scheme which is likely to be of economic benefit to the burgh of Ayr; but they are unable to comment on the details of the report, having regard to their position in respect of the proposed Parliamentary Bill upon which in due course it will be their duty to advise the Minister when making his report on the Bill. It is proposed that the area of supply should be the portion of Ayrshire south of the Kilmarnock lighting area.

At the monthly meeting of **STAFFORD** Town Council the Mayor submitted a report of the Electricity Committee introducing a new method of charge and scale of tariffs recommended by Mr. Ellis, the consulting engineer, for the supply of electricity. He said it was an earnest endeavour to improve and extend the business of the electricity undertaking, and it was only by doing more business that they could keep it off the rates. Although it was a complete change from the old system of payment, there would be no increase in the prices charged, but there would be an inducement for consumers to use more electricity. Alderman Bostock pointed out that the charge per unit to churches was 8d. and to places of amusement 4d., and proposed that the rate for the former should also be 4d. This was agreed to, together with the proposal put forward by the Mayor.

Forty Years Ago.

(THE ELECTRICIAN, SEPTEMBER 17, 1881.)

A SEXTUPLE SYSTEM.—It is reported from America that patents will shortly be taken out for a sextuple system of telegraphy.

SWAN'S LAMPS IN A THEATRE.—We hear that **MESSRS. SIEMENS** will light Mr D'Oyley Carte's new theatre in the Strand with 600 Swan lamps.

TELEGRAMS FOR THE GREEK ISLANDS.—Telegraphic communication has now been established with the Greek Island of Kythira (Cerigo), and telegrams can be forwarded to that island at the rates in force for the island of Spezzia.

ELECTRIC LIGHTING EXHIBITION AT BRIGHTON.—At a largely-attended and influential meeting recently held at Brighton, under the presidency of the Mayor, it was unanimously agreed that it was desirable to hold a Domestic, Sanitary, and Scientific Exhibition in the town during the week commencing the 17th of December next. A competitive exhibition of electric lighting is contemplated in connection with the exhibition.

ELECTRICAL RECTIFICATION OF ALCOHOL.—Electricity is being employed in the rectification of inferior alcohol in distilling by a process due to the late M. Naudin, and now in successful operation on a large scale at the distillery of Bapaume-Ses-Rouen. The process consists in passing currents of electricity through the inferior alcohols, so as to disengage the superfluous hydrogen from them by electrolysis. The electricity is provided in part by a voltaic battery and in part by the Gramme dynamo-electric machine. The most important result of the new method, in a public sense, is that by its means beetroot alcohol, which is ordinarily poor, can be prepared so as to be of high quality. The common beet spirits can, it is said, be made to yield 80 per cent. of alcohol, equal in quality to that from the best malt, and the process is much simpler and cheaper than the manufacture of alcohol from either malt or potato.

Overseas Notes.

Public electric lighting was inaugurated recently in **HOMEBUSH** (Sydney).

The **VICTORIAN RAILWAY COMMISSIONERS** have indicated their intention to use **ELECTRIC LOCOMOTIVES** for suburban goods trains and for shunting in Melbourne.

H.M. Commercial Agent for EGYPT calls attention to the fact that contracts for the supply of goods to the Egyptian Government have been lost through the failure on the part of British firms to comply with the conditions of tender.

EXTENSIONS of the Western Australian Government **PERTH TRAMWAY SYSTEM** in the suburbs are urgently required, but the authorities have been hampered by lack of funds. A loan of £2 000 000 is being raised, a portion of which may be devoted to tramway extensions.

Sydney Council has offered to supply electrical energy to the municipality of **PROSPECT AND SHERWOOD (N.S.W.)** at £4 18s. per kVA of maximum demand, plus 0.9d. per unit (to be increased if coal exceeds 25s. per ton), and 14 per cent. per annum on the capital cost of cable.

Mr. A. Abbott, H.B.M. Consul at SAO PAULO, is now on leave in this country, and will interview British firms interested in trade with the State of Sao Paulo. Applications for interviews should be addressed to the Department of Overseas Trade (Latin-America Section), 35, Old Queen-street, S.W. 1.

A Colonial Office report states that in the colony of **GRENADA** the telephone service is under Government control, and is efficiently run at a very moderate cost, a payment of 12s. per month, entitling the subscriber to an unlimited service throughout the entire island without payment for trunk calls. There are six telephone exchanges, 159 miles of direct wire, and 938 miles of wire connecting subscribers and exchanges.

The chairman of the Melbourne and Metropolitan Tramways Board recently stated that the increase in **CONSTRUCTION AND OPERATING COSTS OF TRAMWAYS** would not warrant the construction of new electric tramways unless an income of 1s. per car mile in excess of the receipts on the most profitable of the existing lines was assured. Therefore, any scheme for the general extension of the Melbourne tramway system must be deferred. The cost of the existing double-track tramways was £25 700 a mile, but the estimated present cost of similar tramways was £57 900 a mile. Operating costs were now 24.45d., compared with 14.32d. in 1916. The "Industrial Australian and Mining Standard" suggests that motorbus services should be established for connecting up suburban districts, and remarks that the necessary good roads would benefit all classes of transport, but we fear the roads would not be good long after motor-buses commenced to run on them.

There will be an **INTERNATIONAL ELECTRICAL EXHIBITION** at Amsterdam from Nov. 25 to Dec. 26 next.

A strike of electricians in **BERLIN** cut off the supply of electricity for lighting and power. There was no tramcar service and the newspapers suspended publication. The men returned to work on Tuesday, when the supply was restored.

More than 4 000 firms applied for space at the **PRAGUE FAIR**, which was opened on the 1st inst. In future the exhibition buildings will cover 150 000 square yards, compared with about 20 000 square yards at present available.

It has been announced that a private British company has secured for fifteen years the exclusive use of the output of radium from the celebrated **Joachimsthal** mines, in Bohemia, which now forms part of **CZECHO-SLOVAKIA**.

ITALY'S ELECTRIC POWER RESOURCES, which in 1915 amounted to 2 500 million kWh, are to-day stated to be over 4 000 million kWh. The capital of the electric companies has advanced during the same period from 600 000 000 lire to 1 500 000 000 lire (£60 000 000 at par).

It is announced that a society has been formed in **SPAIN** to charter a liner for the purposes of a floating trade exhibition. It is intended that the trade ship, carrying a staff of expert salesmen, shall make periodical visits to all the important ports of the world, especially those of America.

A commission agent in **COPENHAGEN** wishes to obtain the representation of United Kingdom manufacturers of electro-technical goods, such as electric light fittings, armatures, motors, dynamos, &c., for the Danish market. (Reference No. 201.) Particulars from the Department of Overseas Trade.

It is stated that **THE NORWEGIAN HYDRO-ELECTRIC NITROGEN COMPANY** and its subsidiary hydro-electric works, the **A/S Rjukanfoss**, have concluded a loan for 50 million kroner with a syndicate of Scandinavian and French banks. At present the plant in operation represents 345 000 h.p., and a further 100 000 h.p. is available for future use. The proceeds of the loan are for the purpose of increasing the working capital.

According to **Reuter**, **Signor Barricelli** has placed in the **ACCADÉMIA DEI LINCEI, ROME**, "in order to protect his rights, sealed papers containing a report on a scientific discovery with regard to 'Universal gravitation.'" It is added that **Signor Barricelli's** researches "modify very remarkably the theory of Newton and Laplace respecting gravitation and demonstrate the nature of electric universal gravitation."

Institution Notes.

The offices of the WOMEN'S ENGINEERING SOCIETY have been removed to 26, George-street, Hanover-square, W. (Telephone, Mayfair 4654.)

The students' section of the MANCHESTER ASSOCIATION OF ENGINEERS have issued the syllabus of meetings which it is proposed to hold during the ensuing session. The section exists for the purpose of enabling engineering trade apprentices and students to extend their general knowledge of engineering and to provide them with opportunities to read papers and take part in debates. The session begins in October, and the meetings will be held generally on the first and third Thursday evenings at the Manchester Municipal College of Technology.

A Paper dealing with the electric supply stations in Canada was read on Saturday by Mr. N. Deykin at a meeting of the BIRMINGHAM AND DISTRICT ELECTRIC CLUB at the Grand Hotel. The author referred to the immense advance which has been made in electrical equipment of all kinds in Canada during recent years, and described the various systems in operation for the generating and transmission of electricity. Lantern views were shown of the great Niagara power-house, demonstrating the industrial and commercial benefits obtainable by the harnessing of the rapids.

Members of the YORKSHIRE BRANCH of the ASSOCIATION of MINING ELECTRICAL ENGINEERS met at Wakefield last Saturday. Mr. F. W. Harbottle (Allerton-Bywater), in his presidential address, said the mining electrical engineer's advice and technical knowledge should be taken more fully into consideration by colliery management than they were at the present time. The electrical engineer's position should be made more secure; he was too often dominated by men of inferior knowledge with regard to electricity. Such a state of affairs tended to stop the progress of electrical development in mines.

A general discussion on Catalysis, with special reference to newer theories of chemical action, will be held under the auspices of the Faraday Society on Wednesday, Sept. 22, at the INSTITUTE of ELECTRICAL ENGINEERS, Victoria Embankment, W.C. 2. The discussion will be divided into two parts: Part 1, beginning at 4.30 p.m., will deal with the Radiation Theory of Chemical Action, and will be opened by Prof. J. Perrin, of Paris. Part 2 will deal with Heterogeneous Reactions, and will be opened by Prof. Irving Langmuir, Chief Research Chemist to the General Electric Company, U.S.A. It is expected that Prof. Arrhenius and Prof. Victor Henri will also be present, and among others who will contribute to the discussion are Prof. E. C. C. Baly, Prof. F. G. Donnan, Prof. W. C. McC. Lewis, Prof. A. Lindemann, Prof. A. W. Porter, and Dr. E. K. Rideal.

The annual general meeting of the FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION was held on the 5th inst., the president (Prof. G. T. Morgan, O.B.E., D.Sc., F.R.S.) in the chair. A report was read of the progress made since the association was resuscitated in the early part of 1920, and, although space does not permit mention of all its activities, we must refer to the great success of the dinner and smoking concert held last season. The fact that the college is being kept open, due in no small measure to the individual and collective efforts of the old students, should impress on all old students the necessity of the association and should ensure a steady influx of new members. Students who have recently completed their course are advised to apply for membership at once if they have not already done so. The annual dinner this year has been arranged for Saturday, Nov. 12, and the smoking concert for Friday, Jan. 27, 1922. Both these functions are to be held at the newly-opened Engineers' Club. The first number of a Bulletin, which it is proposed to issue quarterly, is in preparation, and old students are requested to forward immediately an account of what they are now doing for inclusion in same. Application forms for membership and all particulars of the association may be obtained from the Hon. Secretary, Mr. H. P. Guy, 209, Northumberland-park, Tottenham, N. 17.

Business Items, &c.

THE JACKSON ELECTRIC STOVE COMPANY, LTD., announce that the address of their Scottish agent, Mr. Kirby Johnson, is 68, Gordon-street, Glasgow, not 68, Gordon-road.

MESSRS. HARLAND AND WOLFE have decided to establish riveting and other engineering workshops on the Thames side. The firm have taken over the whole of the maintenance work of the Port of London Authority, which has granted leases of sites and given other facilities for such repair and construction work as may be required.

With the approach of the dark evenings the question of lighting becomes a matter of great importance to industrial undertakings. In this connection Messrs. the BENJAMIN ELECTRIC LTD., of Tottenham, offer to supply a copy of the recent Welfare pamphlet on INDUSTRIAL LIGHTING in FACTORIES and WORKSHOPS to those of our readers who may be interested in the subject.

Z. ELECTRIC LAMP AND SUPPLIES COMPANY, LTD., 73, Newmarket-street, W. 1, announce that in order to make way for their new season's model of "Electrolux" Portable Cleaning Apparatus, they are offering to the trade their stocks of the present model at £13 (25.30 V 15s. extra). These machines will be sold only on the understanding that their list price of £15 to consumers is strictly maintained.

At the invitation of the BRITISH INSULATED AND HELSBY CABLE Co., the Chester Society of Natural Science, Literature, and Art recently paid a visit of inspection to the Helsby Works. Messrs. Sproule (works manager) and Bayles, Talbot, and Roberts, acted as guides, and the tour of the works, which cover 15 acres of ground, took over two hours. Time did not admit of a more detailed study of the processes of manufacture.

In reference to the PRIORY DISTRIBUTION BOARD, described in our last issue, we are informed that, in addition to the case of the board being made in sheet steel, the company have branched off into another line, and are having same now cast in aluminium, with a coat of paint to protect it from atmospheric conditions. This has been found to make the board exceptionally light and strong, showing a decided saving where export orders are concerned. The board is made up to any number of ways, from two to twenty-four.

We are informed that the PAPER TESTING DEVICE described in our issue of the 2nd inst. is now made in London by Mr. Renold Marx, 9, Clifton-street, E.C. 2, who has acquired the exclusive European rights for this instrument. In our description the titles of the blocks got accidentally reversed; the description of Fig. 1 applies to Fig. 2, and vice versa. The British patent number of this invention is Elmdorf-Marx No. 162 191. Several of these testers are already in operation in this country, and Mr. Marx offers to demonstrate the instrument to anyone interested.

Personal and Appointments.

MR. H. WILSON, mains superintendent to the Maidstone Corporation, has been appointed distribution engineer at the Croydon Electricity Works, and will take up his new position at the beginning of October.

MR. G. C. MASON, assistant superintendent of wireless telegraphy at the Post Office, has been promoted to superintendent, and in the engineering department Mr. E. J. Ivson, assistant staff engineer, has been appointed staff engineer.

MESSRS. JOHN NODEN and F. DAVIES, members of the cashier's staff of the British Helsby Insulated and Cable Works, who are both going to be married shortly, have been presented by the staff with a clock and case of carvers and cutlery respectively.

DR. H. FASSBENDER, a privatdozent in electrotechnics and wireless telegraphy at the Berlin Technische Hochschule, has been appointed professor and director of the electrotechnical department of the University of La Plata.

Prof. G. W. O. HOWE, assistant professor of electrical engineering at the City and Guilds Engineering College, has been appointed superintendent of the electrical department of the National Physical Laboratory.

Congratulations to Sir PHILIP DAWSON, M.I.C.E., M.I.E.E., on his election as M.P. for West Lewisham. The contest, which was, unfortunately, marred by excessive personalities, had an electrical flavour about it, as one of the chief supporters of Mr. F. W. Raffety, the Independent Liberal candidate, was Mr. George Ofor, the doyen of electrical engineers. Mr. Ofor is ninety-six years of age.

MR. J. Y. MACKERSIE, A.M.I.E.E., resident engineer of the Summer-lane power station of the Birmingham Corporation Electric Supply Department, is leaving this month to take up an important electrical appointment in Calcutta. On the 6th inst. a presentation to Mr. Mackersie of a canteen cabinet from the technical staff was made by the chief engineer, Mr. R. A. Chattock. Mr. Mackersie has been held in the highest esteem during the past fifteen years by the Birmingham staff, a large number of whom assembled to wish him success in his new sphere in India.

Telegraph and Telephone Notes.

Experiments in RADIO-TELEPHONY, which are said to be giving most satisfactory results, are being carried out between Rome and Sicily.

There has been an increase of 6 250 miles in the TELEPHONE LINES of CZECHO-SLOVAKIA in the last two years.

PRESS TELEGRAMS FOR ITALY are now accepted from 6 p.m. to noon at the reduced rate and on the usual conditions.

THE RADIO-TELEGRAPH SERVICE between ROTTERDAM and HAMBURG will in future be regularly maintained between 10.20 a.m. and 10.20 p.m.

A NEW TELEPHONE EXCHANGE will shortly be opened at HENDON, when subscribers connected with Finchley and Kingsbury exchanges will be transferred.

By the collapse of one of the large masts of the WIRELESS TELEGRAPH STATION near LYONS on Saturday one man was killed and another seriously injured.

As announced in our last issue, SIR ERNEST SHACKLETON'S EXPEDITION is being equipped with wireless telephone apparatus which will insure all its sections being kept in constant touch with one another. Marconi's Wireless Telegraph Company is fitting two 100 W YB wireless telegraph and telephone sets on board the "Quest." One of these is for permanent use on board the ship and the other for base work on land. Their range is about 100 miles. The Avro aeroplane which is being taken will also be fitted with a Marconi wireless telephone, so that it will be able to maintain telephonic communication with the "Quest" and also with Sir Ernest Shackleton's land base.

Matlock Electricity Scheme.

At Monday night's meeting of the MATLOCK Council a report was under consideration from Messrs. Cramp and Frith, consulting engineers, as to a proposal to take motive power from the River Derwent to supply electricity for this Spa. In the report, Messrs. Cramp and Frith state that taking the population at from 7,000 to 10,000, without much industrial demand, they estimated the maximum load about 150 kW. or, say, 200 H.P., though this might take some years to develop. Selling up to about 140,000 units per annum the average load during the year would only be about 11 per cent. of the maximum. If this were sold at 6d. per unit the revenue would be about £3,500 a year. The flow of the River Derwent this exceptionally dry season gave about 8,000 cubic ft. per minute, which, worked through a drop of 10 ft., would give about 100 H.P. In winter there would be no difficulty in doubling this. It was possible to raise the level of the river between 10 ft. and 15 ft. by a weir across the river just above where the Bentley brook joins it—by the park. They answered in the affirmative the query as to whether power could be obtained from the river for the electricity for Matlock. The cost of the proposed station would be £13,000, and besides this there would be £10,000, the cost of ten miles of distribution cables, costing an average of £1,000 a mile. The cost of running would be £2,000 a year, and add to this 7 per cent. interest with 5 per cent. for sinking fund on an expenditure of £23,000, the total running would be £4,760 a year. This showed a loss of £1,260 a year on the estimated revenue, or otherwise it demanded the price per unit should be 8½d. An alternative scheme to the river power was an extension of the recently-installed gas suction plant, which runs the town's cable tramway. This would cost £18,500, and the running would cost £4,350, which gives a loss of £850, or puts up the price per unit to 7½d., which is the price Manchester pays.

Electrical Imports and Exports.

IMPORTS.—The following are official values of electrical machinery, apparatus, and material imported into this country (a) during August, 1921, and (b) the aggregate figures from Jan. 1 to Aug. 31, with increase or decrease compared with corresponding periods of 1920:—

Electrical machinery, (a) £48,362 (decrease £88,366), (b) £548,441 (decrease £182,557); telegraph and telephone cables, submarine (a) nil, (b) nil (decrease £50); other than submarine, (a) £4,337 (increase £858), (b) £63,797 (increase £56,100); telegraph and telephone apparatus, (a) £15,419 (increase £2,203), (b) £241,156 (increase £142,103); other electrical wires and cables, rubber insulated, (a) £5,007 (decrease £3,807), (b) £22,671 (increase £2,453); with other insulations, (a) £6,574 (decrease £2,263), (b) £73,959 (increase £2,239); carbons, (a) £4,575 (decrease £11,521), (b) £70,611 (decrease £14,755); glow lamps, (a) £7,935 (increase £3,320), (b) £184,540 (increase £155,325); arc lamps and electric searchlights, (a) £849 (increase £770), (b) £6,595 (increase £2,835); parts of arc lamps and searchlights (other than carbons), (a) £38 (decrease £2,435), (b) £13,444 (increase £3,992); batteries, (a) £2,959 (decrease £5,212), (b) £89,765 (increase £40,107); meters and measuring instruments, (a) £9,103 (increase £6,299), (b) £124,512 (increase £75,062); switchboards, (a) £20 (decrease £20), (b) £7,405 (increase £6,270); electrical goods and apparatus unenumerated, (a) £35,113 (decrease £44,064), (b) £547,061 (increase £89,089). Total of electrical machinery, apparatus, and material, other than uninsulated wire, (a) £141,335 (decrease £143,237), (b) £1,993,935 (increase £378,367).

EXPORTS.—The exports of electrical machinery, apparatus, and material (a) during August, 1921, and (b) from Jan. 1 to Aug. 31, with increase or decrease compared with corresponding periods of 1920, were as follows:—

Electrical machinery, (a) £408,591 (increase £210,627), (b) £3,284,525 (increase £1,925,433); including railway and tramway motors, (a) £21,554 (increase £18,854), (b) £164,624 (increase £139,630); other generators and motors, (a) £217,052 (increase £88,979), (b) £1,840,040 (increase £1,055,146); and electrical machinery unenumerated, (a) £169,935 (increase £102,794), (b) £1,279,861 (increase £740,657); telegraph and telephone cables, submarine, (a) £2,491 (increase £2,098), (b) £1,956,008 (increase £804,375); other than submarine, (a) £118,078 (increase £41,604), (b) £1,104,676 (increase £449,665); telegraph and telephone apparatus, (a) £183,200 (increase £72,576), (b) £1,277,055 (increase £500,569); other electrical wires and cables, rubber insulated, (a) £88,430 (decrease £59,647), (b) £1,001,376 (decrease £70,919); with other insulations, (a) £136,019 (decrease £21,032), (b) £1,432,405 (increase £38,039); carbons, (a) £3,101 (decrease £4,004), (b) £54,828 (decrease £17,246); glow lamps, (a) £33,394 (increase £4,850), (b) £342,440 (increase £132,775); arc lamps and searchlights, (a) £2,597 (increase £1,549), (b) £11,472 (decrease £1,823); parts of arc lamps and searchlights (other than carbons), (a) £935 (decrease £836), (b) £5,222 (decrease £2,820); batteries, (a) £46,927 (decrease £1,907), (b) £502,769 (increase £170,019); meters and measuring instruments, (a) £36,093 (decrease £4,004), (b) £344,390 (increase £88,733); switchboards, (a) £23,190 (increase £13,004), (b) £153,227 (increase £91,330); electrical goods and apparatus unenumerated, (a) £131,478 (decrease £26,333), (b) £1,518,938 (increase £353,173). Total of electrical machinery, material, and apparatus, other than uninsulated wire, (a) £1,284,511 (increase £198,617), (b) £12,989,331 (increase £4,531,243).

Miscellaneous.

CARDIFF police force has been equipped with electric lamps, in place of the usual oil lantern. The lamps are of a special pattern, which will focus to any distance by the sliding of a button.

Regulations relating to the MANUFACTURE AND SALE OF CELLULOID and articles made of celluloid have been drafted by the Home Secretary. Objections to the regulations should be submitted by Sept. 20.

The "Board of Trade Journal" for Sept. 8 contains useful notes with reference to the MARKING OF GOODS FOR EXPORT, the destinations within the British Empire. Further and fuller information regarding goods shipped to both British and foreign countries can be obtained by British firms on application to the Board of Trade.

In addition to a roll of honour which is being prepared as a war memorial, MANCHESTER COLLEGE OF TECHNOLOGY propose to have a roll of service, containing the names of those who were students of the college prior to joining any branch of H.M. Forces. Names to be sent to Mr. Dempster Smith, Hon. Secretary, War Memorial Committee.

The YORKSHIRE BRANCH of the INDUSTRIAL LEAGUE and COUNCIL are holding a week-end conference at the Seacroft Hydro, Scarborough, on Sept. 23 and 24, the subject under consideration being the capitalistic system. Mr. Ernest J. P. Benn, C.B.E., will open the discussion on the capitalistic side and Mr. Harold Clay, Secretary of the Leeds United Vehicle Workers, will answer from the labour point of view.

The death is announced of Prof. Dr. EMIL ARNOLD BUDDE, the well-known German electrical engineer. Dr. Budde was eighty years of age, and in 1892 he became associated with Messrs. Siemens and Halske as consulting physicist. A little later he became a director of the firm. He was the author of several books and papers on physics, mechanics, &c., and was the German representative on the International Electrotechnical Commission in per-war days.

Messrs. E. and F. N. Spon, referring to the letter in our issue of the 9th inst. on the TESTING OF ARMATURES and the PAUCITY of INFORMATION in books on the subject, write to say that our correspondent's statement is undoubtedly correct, but he will find the identical tests he describes explained in detail and clearly illustrated in "Motor and Dynamo Control," by W. S. Ibbetson, together with numerous other practical workshop tests not met with in most books of the kind. This book was published by Messrs. Spon last year.

On Saturday last some sixty members of BENN BROTHERS' SOCIAL CIRCLE were entertained at Orpington Priory, the residence of Mr. C. E. HUGHES, one of the directors of Benn Brothers, Ltd. After tea the interest was divided between a programme of games and an examination of the Priory itself, which is of considerable antiquarian interest. On leaving, a vote of thanks was accorded to Mr. and Mrs. Hughes for their hospitality, and the care and forethought which had evidently been taken to make the visit a pleasurable one.

From the current number of the "DECIMAL EDUCATOR" (the official journal of the Decimal Association) we learn that Sir Napier Shaw, F.R.S., has been elected a member of the Executive Committee. The issue also contains information concerning progress that is being made towards the metric system, more particularly in the U.S.A. and Japan. An account is given of the introduction of the system into an American workshop, and there are also various conversion tables and short cuts which will be useful during the period of transition.

At the INTERNATIONAL DENTAL EXHIBITION, which was opened at the Royal Agricultural Hall, Islington, London, N., on Monday, there are several exhibits of X-ray apparatus, electrically operated dental appliances, &c. The X-ray installations for photographing teeth sockets attracted much attention, for the method of taking the picture is very simple. The patient holds the small plate, about the size of a penny, in his mouth, and the X-rays are then turned on. Hard tubes of very high voltage are employed, and these give a good penetration and produce clear pictures of the roots of the teeth. The plates are developed at once, and a dentist can begin his examination of a patient by a view of the actual conditions within the jaw.

An accident in the new power house of the POWELL DUFFRYN Colliery was the subject of a coroner's inquiry at Abergele on the 6th inst., the victim being Samuel Evans, aged fifteen. A fitter's labourer stated that on the previous Friday the lad slid down a rope from an upper to a lower floor, where there was an electric winch for lifting concrete. Evans stood with his back to the winch, watching men preparing concrete, when witness saw him suddenly grabbed by his coat and twisted round the shafting of the winch. The machinery was stopped in a few seconds and the boy cut away, his clothing being entangled in the machinery. A nail sticking out some inches, which was used to secure the collar on the shafting, apparently caught the boy's clothing. There was no fencing round the machinery.

The coroner said he did not think there had been any wilful neglect, but whoever left the shaft revolving with that dangerous nail sticking out was guilty of an error of judgment, and the fact that there was no fencing brought the accident into the category of neglect. He returned a verdict that the boy got involved in the machinery and thereby received fatal injuries.

Tenders Invited and Accepted.

PONTYPRIDDE Guardians require tenders by Sept. 21 for the supply of electrical materials, ironmongery, &c. Forms of tender from the Clerk, Union Offices, Pontypridd.

BERMONDSEY (London) Guardians want tenders by Sept. 23 for six months' supply of electric lamps, &c. Forms of tender, &c., from the Clerk, 285, Tooley-street, London, S.E. 1.

BUENOS AIRES STATE RAILWAYS invite tenders by October 21 for one year's supply of electrical stores. Specifications are expected to arrive at the Department of Overseas Trade at the end of September.

Tenders are invited by DURBAN CORPORATION for supply of two 500-kW rotary converters, switchgear, &c. Tenders to Town Clerk's Office, Durban, by Sept. 28. Specifications at the Department of Overseas Trade.

WALSALL Electric Supply Committee want tenders by Sept. 26 for the supply of 320 tons and the laying of 300 tons of c.i. pipes. Specification, etc., from Mr. E. M. Lacey, 12, Victoria-street, London, S.W. 1.

THE BULGARIAN DEPARTMENT OF POSTS, TELEGRAPHS, AND TELEPHONES wants tenders by Oct. 7 for the supply of 100 000 porcelain insulators. Particulars from the Department of Overseas Trade, 35, Old Queen-street, S.W. 1.

PORTSMOUTH Guardians require tenders by Sept. 21, for three months' supply of electrical fittings, ironmongery, &c. Forms of tender from the Clerk, Guardians' Offices, St. Michael's-road, Portsmouth.

EASTBOURNE Corporation require tenders by Sept. 26 for a water-tube boiler, fan and chimney, feed pump and piping, and a 2 500-kW turbo-alternator, with condensing plant and pipework. Specifications from the Borough Electrical Engineer.

THE AUSTRALIAN POSTMASTER-GENERAL'S DEPARTMENT, Adelaide, requires tenders by Oct. 12 for 2 750 yards of telephone cords, 120 handsets, and 160 jacks. Specification can be seen at the Department of Overseas Trade, 35, Old Queen-street, S.W. 1.

Tenders are invited by Oct. 5 for the supply of bronze wire (schedule 536) to the Postmaster-General's Dept., State of QUEENSLAND. Specifications, &c., from the office of the High Commissioner for Australia, Room E 5, Australia House, Strand, W.C. 2.

Tenders are also invited by Oct. 12 for the supply and delivery of galvanised iron and steel wire (schedule 537); and by Oct. 19 for the supply and delivery of insulated wire (schedule 538) to the Postmaster-General's Department, State of QUEENSLAND. Tender forms, &c., from the office of the High Commissioner for Australia, Room E 5, Australia House, Strand, W.C. 2.

The closing date for the receipt of tenders for the supply of 132 sets of accumulator cells required by the VICTORIAN GOVERNMENT RAILWAYS (contract No. 34 171) has been extended from Aug. 31 to Sept. 28. Specification at the Department of Overseas Trade.

THE VICTORIAN GOVERNMENT RAILWAYS invite tenders by Sept. 28 for the supply and delivery of a lifting-magnet and generating set, with control apparatus and accessories (contract No. 34 241). Specifications may be inspected at the Department of Overseas Trade, 35, Old Queen-street, S.W. 1.

WELLINGTON (N.Z.) Corporation require tenders by Oct. 13 for two water-tube boilers, with feed-water heaters, etc., and a 5 000-kW turbo-alternator with condensing plant. Specifications from Messrs. Preece, Cardew and Rider, 8, Queen Anne's-gate, Westminster, S.W. 1.

The date for receiving tenders for the supply of electric light and power plant for BULAWAYO (Rhodesia) Municipality has been extended to Oct. 12 if tenders are delivered to Messrs. Davis & Soper, 54, St. Mary-axe, London, E.C. 3, and to Nov. 15 if tenders are sent to the Town Clerk.

THE BULGARIAN DEPARTMENT OF POSTS, TELEGRAPHS AND TELEPHONES calls for tenders to be presented at the District Office of Finance, Sofia, on Oct. 7, for the delivery of 100 000 porcelain insulators. Specifications, &c. (in French), may be seen at the Department of Overseas Trade up to Sept. 20, after which date they will be sent to interested firms in the provinces.

THE ARGENTINE STATE RAILWAYS invite tenders, to be presented early in November, for one year's supply of railway signal material, fire, water pipes with accessories, telephone and telegraph materials, forge coal and foundry coke. Local representation is essential. Specifications, tender forms, &c., are expected to arrive early in October, and will be available at the Department of Overseas Trade.

BELFAST Corporation invite tenders for the manufacture and erection, at the new Harbour Board power-station, of extra high-pressure and low-pressure switchgear. Specifications and other particulars from Messrs. Preece, Cardew & Rider, 8, Queen Anne's-gate, S.W. 1, and from Mr. T. W. Bloxom, City Electrical Engineer, Tenders to the Town Clerk, City Hall, Belfast, by Sept. 19.

PRETORIA (Transvaal) Municipality requires tenders by Oct. 4 for coal handling plant (contract No. 6), 6 600 V cables (contract No. 7), induced draught and ash-handling plant (contract No. 8), and feed pumps, steam, air, and water piping, &c. (contract No. 9), for the electric light and power department. Specifications, &c., from the General Manager, or Mr. G. M. Clark, 40-42, Meische-buildings, Johannesburg.

THE RAND WATER BOARD invites tenders by Sept. 28 for supply and erection at the intake pumping station, Vereeniging, of two centrifugal pumps, direct-coupled to electric motors, one 10-ton travelling crane, and the supply and erection at the main pumping station site of two centrifugal pumps coupled to electric motors. Specifications of the Department of Overseas Trade, 35, Old Queen-street, S.W. 1.

Tenders are also invited, by 12 noon, Nov. 7, for the supply, delivery, and erection at the Board's Main Pumping Station, Vereeniging, of two steam-driven electrical generating sets of 350 kW capacity, each complete with switchboards and all accessories. Tenders to the Secretary, the Rand Water Board, Central House, P.O. Box 1703, Johannesburg.

The Secretary of the NEW ZEALAND PUBLIC WORKS TENDER BOARD (Wellington) invites tenders by Nov. 1 for the supply and erection of new or secondhand auxiliary plant for the Rotorua electric supply as follows:—One oil engine (200 to 250 B.H.P.) and one three-phase 50-cycle alternator of 190 kW (power factor of 0.8), with exciter, &c.

The NEW ZEALAND Public Works Department also call for fresh tenders for the supply and erection of steel pipe lines and fittings required in connection with the Mangahao power plant. While the quantities, &c., are substantially the same as those specified in the original call for tenders, some of the conditions appear to have undergone modification. The closing date for the receipt of tenders in Wellington is Nov. 1, 1921. Specifications can be inspected at the Department of Overseas Trade.

H.M. Consul-General at Lourenco Marques reports that tenders will shortly be invited by the DEPARTMENT OF POSTS AND TELEGRAPHS at LOURENCO MARQUES for the supply of 4 200 iron telegraph poles (approx. weight 17 lb. or 180 lb), 15 000 g.-i. insulator stalks, 11 000 g.-i. insulator brackets, 15 000 porcelain insulators, 320 tons g.-i. wire (4 mm.), and 90 tons hard-drawn copper wire (S.W.G. No. 14). Tenders (in Portuguese) by Sept. 30. Further particulars from Department of Overseas Trade.

THE VICTORIAN RAILWAY COMMISSIONERS require tenders by Oct. 5 for double-wheel lathes for Joiment Workshops (Contract No. 33 256), by Oct. 19 for d.c. arc welding plant for Joiment Workshops (Contract No. 34 377) and armature winding machine with electric motor and starting gear (Contract No. 34 378), by Oct. 26 by 1 120 cwt. best steel boiler plates (Contract No. 34 342), and by Nov. 2 for storage battery with accessories and spares (Contract No. 34 229). Specifications and conditions can be seen at the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1.

THE ADMINISTRATION OF THE SOUTH AFRICAN RAILWAYS AND HARBOURS invite tenders for the supply, for 12 months ending Dec. 31, 1922, of 85 560 incandescent train lighting lamps (tungsten filament) for 24 V, 8 to 10 c.p.; 8 125 engine head lamps; 150 W. 32 V (gas-filled 1/2 W type with concentrated filament); 50 472 incandescent lamps (tungsten filament); 5 545 incandescent lamps (carbon filament). Tenders by noon, Nov. 7, to the Secretary, Tender Board, South African Railway Headquarters Offices, Johannesburg. Specifications may be inspected at the Department of Overseas Trade, 35, Old Queen-street, S.W. 1.

THE NEW ZEALAND Public Works Department invite tenders for the manufacture, supply, and delivery, ex ship's slings at Auckland, of six sets of three-phase air-brake switches suitable for operation upon 50 000 V circuits in connection with the Waikato Electric Power Scheme. Tenders to the Secretary, Public Works Tender Board, Wellington, by noon on Sept. 27. Telegraphic tenders also accepted. Specifications at the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1. A copy is also available for loan to firms established in the provinces.

THE PUBLIC WORKS DEPARTMENT OF NEW ZEALAND invite tenders for the supply of the following plant required in connection with the Mangahao electric power scheme: Section 12: Three water-wheels of 6 450 B.H.P., and two water-wheels of 3 225 B.H.P., complete with governors, couplings, and accessories; Section 13: Three 6 000 kVA and two 3 000 kVA alternating-current generators; Section 14: two three-unit exciter sets, each consisting of one 375 B.H.P. Pelton wheel, one 250 kW direct-current generator, and one 350 H.P. asynchronous motor; Section 15: seven 4 000 kVA single-phase transformers and accessories; Section 17: insulators for 110 000 V 50-cycle transmission lines; Section 18: lightning arresters for operation on two 110 000 V three-phase transmission lines; Section 19: switchboard, switches, and accessories. Tenders to the Secretary, Public Works Tender Board, Wellington, by noon, Nov. 29. Specifications at Department of Overseas Trade.

BARKING Electricity Committee have accepted the tender of Lund Brothers for wiring and fitting the new school buildings at £265.

DARVEN Corporation have accepted the tender of Mr W. V. Fairhurst for the installation of telephones connecting the various departments.

CREWE Town Council have accepted the tender of Carrington and Button for wiring and fitting Linden Grange Maternity Home, at £150 6s. 6d.

SYDNEY (N.S.W.) Electric Supply Committee have accepted the tender of Thompson Bros. for a 17 500 kW turbo-generator of Australian manufacture for £125 000.

MELBOURNE Urban Council have accepted the tender of the Electric Light Company for street lighting at £3 11s. per lamp for four 300 W lamps, and for sixty-three ordinary lamps at £1 9s. 3d. each.

Catalogues, Price Lists, &c.

THE HEAVY CURRENT ELECTRIC ACCESSORIES COMPANY have issued their September trade price list of switches, connectors, switch-plugs, wall-plugs, &c.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, LTD., have sent us their latest lamp catalogue. It is attractively got up, and gives at a glance detailed information of their numerous "Cosmos" gas-filled and vacuum lamps, carbon filament lamps, radiator lamps, &c.

THE KEY ENGINEERING COMPANY, LTD., of London and Manchester, have issued a new edition of their "Key Fibre Conduit and Troughing" Booklet. The booklet is both interesting and useful, and the 32 pages of excellent illustrations show at a glance the advantages of the Key Fibre conduit over the stoneware conduit.

We have received from THE AABACAS ENGINEERING SUPPLY COMPANY, LTD., of Birkenhead, their latest milling machine circular, containing illustrations, descriptions, and tables of sizes of their horizontal plain, universal, and vertical milling machines, &c. All parts are inspected during construction, and every machine is tested before leaving the works, both as regards accuracy and cutting powers.

A well-illustrated pamphlet, containing a description of the RELAY AUTOMATIC TELEPHONE SYSTEM, together with particulars of its advantages and uses, is being circulated by the Relay Automatic Telephone Co., Ltd., Marconi House, Strand, W.C. 2. Already the system has been adopted for public and private exchanges by various governments and by municipal authorities, banks, hospitals, mills and factories, collieries, newspapers, &c. The General Post Office will now instal on rental the system for private branch exchanges, combining automatic communication between departments, and also connection to the Public Exchange Service.

That manufacturers are coming to realise the importance of adopting scientific methods of heat treatment is evident from the wide range of furnaces manufactured by the AUTOMATIC AND ELECTRIC FURNACES, LTD. The firm's new illustrated catalogue, an advance copy of which we have just received, gives particulars of their Wild-Barfield vertical radiating furnaces, horizontal flat furnaces, carburising furnaces, &c. No efforts have been spared to make the furnaces "fool-proof." Consequently an automatic cut-out, which prevents an excessive tempering being reached by an oversight on the part of the hardener, has been designed, and is fitted to all Wild-Barfield furnaces. Details of the oil tempering baths manufactured by the firm, for tempering at moderate temperatures, and salt tempering baths for any temperature above 300° C., are also given, in addition to particulars of the firm's air tempering muffles, maturing ovens, pyrometers, magnetic sclerometers, &c.

THE DUSSEK BITUMEN COMPANY, Empress Wharf, Bromley-by-Bow, who have been connected with the manufacture of bitumen products for over fifty years, have issued an illustrated booklet dealing with their manufactures. Refined Trinidad bitumen, which is acknowledged to be the most suitable material for solid system cables, is prepared by the company from bitumen imported direct from the Government deposits in the Isle of Trinidad, B.W.I. The natural mineral matter which this product contains gives it the desired degree of strength and toughness to hold the cables in place, while at the same time it possesses sufficient "give" to allow for any sinking in the ground. It provides the best possible mechanical protection to the cables, and is a perfect insulator and preservative. The Board of Trade Committee appointed in December, 1913, to inquire into the causes of cable explosions found that Trinidad bitumen was not so dangerous as pitch and pitch compositions for cable laying. The firm also supply a bitumen composition for use in connection with armoured or lead-protected cables when pure Trinidad bitumen is not necessary and a cheaper material can be employed. The composition is made so as to embody as nearly as possible the same properties as Trinidad bitumen; it is free from the acids frequently found in pitch, and is recommended for use where a cheap but reliable trough-filling material is required. The booklet also contains particulars of the "Trinitide" joint box compound, the lead sleeve and expansion joint compound, "Bitite" non-setting bituminous paste for pavement frames and covers, manholes, &c., "Bitite" bituminous solution for protection against rust, electrolysis, and sea water, and "Bitite" bituminous grout for tramway construction work, packing tramrails, &c.

Educational.

A LECTURE CONFERENCE FOR WELFARE SUPERVISORS organised by the Industrial Welfare Society opened at Balliol College, Oxford, yesterday (Thursday), and will continue until Tuesday.

Arrangements have been made for PROF. WIDDINGTON, of Leeds University, to deliver a series of lectures on wireless telegraphy and telephony at Scarborough during the autumn season.

THE SCHOOL OF ACCOUNTANCY announces that the London Oral Classes for the 1921-22 session begin on Sept. 26. Enrolment for these classes should be effected not later than September 22. Enrolment for correspondence and consulting tuition may be made at any time, but now is the best time of the year to start study. The school's correspondence system of training has proved as effective as oral tuition for obtaining business efficiency and examination passes.

Companies' Reports, &c.

The directors of CLARKE, CHAPMAN & COMPANY, LTD., have declared an interim dividend on the 5 per cent. Ordinary shares.

BROWETT, LINDLEY & COMPANY, LTD., have declared an interim dividend of 4 per cent. on the Ordinary shares.

THE BRAZILIAN TRACTION LIGHT AND POWER COMPANY announce a quarterly dividend of 1½ per cent. on the preference shares.

THE LANCASHIRE DYNAMO & MOTOR COMPANY have declared a dividend of 9d. per share, tax free, on the Ordinary shares.

THE AMERICAN TELEPHONE & TELEGRAPH COMPANY announce a quarterly dividend of 2½ per cent. (less tax) on the capital stock, compared with 2 per cent. in 1920.

SIR W. G. ARMSTRONG, WHITWORTH & COMPANY announce an interim dividend on the Ordinary shares of 6d. per share, less tax. Last year 1s. per share, less tax, was paid.

THE GLOBE TELEGRAPH & TRUST COMPANY have declared a quarterly interim dividend of 5s. per share on the Preference shares, less tax, and of 5s. on the Ordinary shares.

An interim report issued to shareholders of LOW TEMPERATURE CARBONISATION, LIMITED, states that the works at Barnsley have now been reopened, and that the production of coalite has been resumed.

THE CANADIAN GENERAL ELECTRIC COMPANY have declared a quarterly dividend of 2 per cent. for the three months ending Sept. 30, on the common stock, being at the rate of 8 per cent. per annum.

THE SOUTH METROPOLITAN ELECTRIC LIGHT AND POWER COMPANY, LTD., announce that the transfer register and register of 4½ per cent. first debenture stockholders will be closed from Sept. 19 to Oct. 1 (both days inclusive) for the preparation of warrants for interest.

The directors of the EASTERN EXTENSION AUSTRALASIA AND CHINA TELEGRAPH COMPANY, LTD., have declared an interim dividend for the three months ended June 30, 1921, of 5s. per share, payable (tax free) on the 15th prox. The share register will be closed from Oct. 1 to 8, inclusive.

The profit for the year of the DUNDEE BROUGHTY FERRY, AND DISTRICT TRAMWAYS COMPANY, LTD., including £309 brought forward, amounted to £6682. It is proposed to pay a dividend on the Ordinary shares of 7 per cent., less tax, to place £1500 to reserve, and to carry forward £474.

At the annual general meeting of WALTER SCOTT, LTD., held in Newcastle last week, a final dividend was declared on the 5 per cent. preference shares, and one of 5 per cent. on the ordinary shares, making, with the interim dividend of 2½ per cent. already paid, a dividend of 7½ per cent. for the year.

The transfer books of the WESTERN TELEGRAPH COMPANY, LTD., will be closed from Sept. 15 to 21, inclusive, preparatory to paying on the 29th inst. to the shareholders registered on the 15th inst. a dividend of 5s. per share, making with previous dividends a total distribution for the year ended June 30, 1921, of 10 per cent., tax free.

MESSRS. LAZARD BROTHERS & COMPANY announce that they have purchased from the Newcastle-on-Tyne Electric Supply Company script for £633 10s 4½ per cent. first mortgage debenture stock and £100 000 5 per cent. second mortgage debenture stock at 71½ per cent., and are offering same for sale at 73 per cent., less a brokerage of ½ per cent.

On an application by the MONTEVIDEO TELEPHONE COMPANY the Board of Referees appointed to deal with Excess Profits Duty has ordered that the STATUTORY PERCENTAGE respecting the business of supplying telephone service throughout the Republic of Uruguay shall be increased to 7½ per cent. in the case of a company or other body corporate and 7½ plus 2 per cent. in other cases.

THE EASTERN TELEGRAPH COMPANY, LTD., announce the payment on Oct. 15 next of a dividend at the rate of 3½ per cent. per annum (less tax) on the preference stock of the company for the quarter ending the 30th inst., and the second quarterly interim dividend of 2½ per cent. on the ordinary stock (tax free) in respect of profits for the year ending Dec. 31, 1921. The transfer books of the ordinary stock will be closed from Oct. 1 to 8, inclusive.

The liquidator of FRASER AND CHALMERS is now making a further payment of 9d. per share, which will bring the total return of capital up to 32s. 3d. per £1 share. Unless some unexpected claims arise (Mr. McDermott, the liquidator, states) there will be a final payment within a few months of about 3d. per share in completion of the liquidation. Our readers will remember that the engineering business of the company was acquired by the General Electric Company.

The balance sheet of the STILL ENGINE COMPANY as at March 31 shows:—Issued capital, £220 000; sundry creditors and credit balances, £1 209; goodwill, patents, and other assets, acquired under agreements, £154 074; plant and machinery, £10 102; furniture, £1 000; stores, £1 080; experimental and research expenditure, £23 251; head office expenses, after deducting deposit interest, discount on Treasury bills, and transfer fees, £6 469; preliminary and formation expenses, £3 126; underwriting commission, £3 750; sundry debtors and debit balances, £1 069; Treasury bills at cost, £9 850; cash at banks and in hand, £7 438; total, £221 209.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Bankruptcy Information.

BARRACLOUGH, Frank, 55, Wellington-road, Eccles, lately carrying on business as electrical and mechanical engineer at "East-cliffe," Lightcliffe, near Halifax, and formerly at "The Cables," Bailiffe Bridge, near Brighouse, journeyman engineer. First meeting, Sept. 22, 3 p.m., Official Receiver's Office, Byrom-street, Manchester. Public examination, Oct. 12, 10.30 a.m., Court House, Encombe-place, Salford.

WATKINSON, Matthew, 22, Palmer-road; **WATKINSON**, Harold, 344, South-road; and **WATKINSON**, Arthur, 38, Palmer-road, trading in co-partnership as **WATT & CO.** at 22 and 24, Palmer-road, Sheffield, electrical and mechanical engineers. Date of Receiving Order, Sept. 8, debtor's petition.

Notice of Dividend.

THOMAS, Bernard Esmond, 12, Castle-meadow, Norwich, electrical engineer. Amount per £, 1s. 3d., first and final, payable Sept. 17, Official Receiver's Office, 8, Upper King-street, Norwich.

Application for Discharge.

DOWNIE, Charles Philip Manners (trading as and described in Receiving Order as Philip Downie), 355A, Westborough-road, and 88, Ronald Park-avenue, Southend-on-Sea, electrical engineer and factor. Day fixed for hearing, Oct. 17, 11 a.m., Shire Hall, Chelmsford.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors, we do not report subsequent county court judgments against him.]

BARNES, Arthur Daniel, 4, West Street, Newbury, electrical engineer. £26 17s. 9d. July 26th.

BELGRAVIA ELECTRICAL CO., 111, Wilton Road, Victoria, electrical engineers. £35 18s. 7d. July 19th.

BRASON AND FINDLAY, 34, Laygate, South Shields, electrical engineers. £10 8s. 3d. July 19th.

CHURCHILL, Arthur Reginald, electrician, and **CHURCHILL**, Beryl Maud (married), 67, High Street, Staple Hill, Bristol. £22 1s. 8d. July 13th.

DAVIS, A. H., 14, West Street, Soho, electrical engineer. £18 7s. 2d. July 4th.

G. AND P. ELECTRICAL CO., 29, Heathcote Street, Nottingham, electrical engineers. £13 0s. 2d. July 21st.

HURLINGHAM ELECTRIC CO., 285, New King's Road, Fulham, electrical dealers. £13 5s. 3d. July 12th.

LIVINGSTONE, George, 116A, Cheetham Hill Road, Manchester, electrician. £13 14s. 5d. July 5th.

MAGSON, R. S. & CO., 10, Stoney Stanton-road, Coventry, electric light &c. engineers. £18 9s. 7d. July 13.

OSBORN, A. H., 67, Southgate Street, Leicester, electrician. £21 9s. 2d. July 5th.

PROVINCIAL ELECTRIC CO., Northampton Street, Leicester, electrical engineers. £19 16s. July 1st.

RAWSTHORNE, T., 30A, Jervoise Street, West Bromwich, electrical engineer. £10 18s. 2d. July 15th.

RUCK, W. C., 3, Gloucester Place, Cheltenham, electrical engineer. £17 6s. 4d. July 12th.

SIMMS, A. J., 61, Westbury Street, Swansea, electrician. £43 11s. 4d. July 4th.

SLACK, William, and **SLACK**, Sarah, A. (his wife), 36, Willoughby Street, Nottingham, electrical engineer. £11 4s. July 20th.

SULLIVAN, W. (trading as Royal Sovereign Lamp Works), electric lamp manufacturer. £16 7s. 10d. July 21st.

TAYLOR, C. C., 51, Clarence Square, Brighton, electrician. £17 3s. 6d. July 14th.

THOMAS AND EVANS, Salubrious Chambers, Salubrious Place, Swansea, electrical engineers. £11 10s. 7d. July 13th.

THOMPSON, W., 39, Hurst Street, Birmingham, electrical appliance manufacturer. £46 3s. 10d. July 13th.

TURNER, A. H., 27, Uplands, Stoke Heath, Coventry, electrical contractor. £13 15s. July 22.

Bills of Sale.

The undermentioned information is from the Official Registry. It includes Bills of Sale registered under the Act of 1882 and under the Act of 1878. Both kinds require registration every five years. Up to the date the information was obtained it was registered as given below; but payment may have been made in some of the cases, although no notice had been entered on the Register.]

BOWDERY, Victor, South Lodge, Islet, Maidenhead, electrician and estate engineer. August 31st. £35.

DODMAN, Herbert George, 13, Rathgar Avenue, Lavington Road, and 53A, Mattock Lane, West Ealing, builder, decorator, electrician, and gasfitter. September 5th. £52.

JARVIS, William Edwin Charles, 3, King Edward Street, Darlaston, electrical contractor. August 29th. £50.

ROBERTS, John Estall, 56, Garmoye Road, Sefton Park, Liverpool, electrical engineer, September 3rd. £60.

ROBINSON, George William, 74, Northumberland-road, Old Trafford, electrician. Sept. 7. £32 10s.

TRUELOVE, Harold, 136, Middleton Road, Oldham, electric contractor. August 25th. £105.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

EDISON SWAN ELECTRIC CO., LTD., London, E.C.—Registered August 25th, mortgage, to Coutts and Co., securing all moneys due or to become due to the Bank. *346 019. January 31st, 1921.

JOHNSON AND PHILLIPS, LTD., London, E.C.—Registered August 17th, charge under Land Transfer Acts (supplemental to Trust Deed dated July 1st, 1921, securing £350,000 first mortgage debenture stock); charged on lands, factories, messuages, &c., at Charlton. *113,672. May 19th, 1921.

Books Received.

"Electrical Transmission of Energy." By W. M. Thornton. (London: Sir Isaac Pitman and Sons.) Pp. xi.+116. 2s. 6d. net.

"Practice of Electrical Wiring." By D. S. Munro. (London: "Electrical Review.") Pp. xi.+267. 5s. net.

PROSPECTUS OF UNIVERSITY COURSES IN THE MUNICIPAL COLLEGE OF TECHNOLOGY, MANCHESTER. Session 1921-1922.

Prices of Metals, Chemicals, &c.

		TUESDAY, SEPT. 13.	
		Price.	Inc. Dec.
Copper—			
Best selected	per ton	£68 5 0	— £1 15 0
Electro Wirebars	"	£73 0 0	— £2 0 0
H.C. wire, basis	per lb.	0s. 11½d.	— ½d.
Sheet	"	0s. 11½d.	— ½d.
Phosphor Bronze Wire (Telephone)—			
Phosphor-bronze	"	1s. 3½d.	— ½d.
Brass 60/40—			
Rod, basis	"	0s. 8d.	—
Sheet, basis	"	0s. 10½d.	—
Wire, basis	"	0s. 11½d.	—
Pig Iron—			
Cleveland Warrants	per ton	£6 15 0	—
Galvanised steel	"	£23 0 0	—
Wire, basis 8 SGW	"	£23 0 0	—
Lead Pig—			
English	"	£24 10 0	5s. 0d. —
Foreign or Colonial	"	£23 12 6	7s. 6d. —
Tin—			
Ingot	"	£156 5 0	— £3 5 0
Wire, basis	per lb.	2s. 2½d.	— ½d.
Sal ammoniac.—Per cwt. 65s.-60s.			
Sulphur (Flowers).—Ton £13.			
" (Roll-Brimstone).—Per ton £13.			
Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.			
Rubber.—Para line, 1s. 0½d.; plantation 1st latex, 3½d. lb.			

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber prices by W. T. Henley's Telegraph Works Co.

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Notes of the Week.

The British Association and the Public.

THE proceedings at the British Association meeting at Edinburgh show that our recently expressed optimism as to the re-birth of this institution was hardly justified. We refer wholly to what occurred in Section G, though we have reason to suppose that our criticisms are equally applicable to some of the other sections. The general fault that we have to find with the present method of conducting the affairs of the Association is the lack of recognition of the fact that the true aim and object of the British Association—indeed, its whole object—should be to bring the advances which are taking place in science and technology before the public in terms that they can understand. This lack of recognition has resulted in converting what might be a very useful, even a necessary, body, with a unique and clearly defined policy, into yet another society for the promulgation of theories and the discussion of scientific and technical subjects which could be better dealt with, and certainly should be dealt with, by the more highly specialised bodies. The Association very wisely hold their meetings at a time when a maximum of space can be given to their proceedings in the daily Press. Unfortunately, this publicity is seized upon as an excellent means of securing the advertisement of persons rather than causes, with the result that an excellent opportunity of enlightening the public on the general advances in science and technology is missed. In many ways the proceedings this year showed a liveliness which is to be commended, but if the British Association is to justify its continued existence it must shed its academic gown for a more popular habit.

The Protection of Key Industries.

As will be seen from a list we publish on another page, the Board of Trade have lost no time in making arrangements for exercising the powers conferred on them by the Safeguarding of Industries Act. Detailed lists of the articles falling under any of the general descriptions set out in the

schedule to the Act have been prepared, and as from Saturday, October 1st, all imported goods specified in either of these lists, or in the schedule, will be chargeable with a duty of 33½ per cent. Although lists have been issued and there is evident determination to get the Act working as soon as possible, it cannot be said that the descriptive methods adopted will do much to overcome the inertia which accompanies the starting up of any new machine. For instance, we are simply told, in the words of the Act, that "lamp-blown ware, wireless valves and similar rectifiers, vacuum tubes, ignition magnetos and permanent magnets, are lamp carbons, tungsten and manufactured products of tungsten" are to be charged with the import duty. But what both we and electrical manufacturers generally are anxious to see is something which descends to a little more detail, and to have our curiosity as to the construction the Board will place upon such words as "other optical instruments," "other scientific glassware," "other laboratory products," &c., satisfied. It is, indeed, a pity that the Act contains so many vague terms and phrases, as it leaves too much power in the hands of the Board—a feature which, as we have pointed out before, is one of the gravest shortcomings of the whole measure.

Anti-Dumping Measures.

UNCERTAIN as is the position in regard to key industries, it is, at least, relatively clear compared with the lack of visibility surrounding the anti-dumping clauses. As will be remembered, the Board has power, under certain conditions, to impose a duty equal to one-third of their value on any goods imported into this country. To have this duty imposed the following is the procedure. Complaint must be made to the Board that goods (and these may be of any class or description other than articles of food or drink), manufactured in a country outside the United Kingdom, are being sold, or offered for sale, at prices below the cost of production, or at prices which, by reason of the depreciation of the currency of the country of origin, are below the prices at which similar goods can be profitably manufactured here, and that as a result employment in any industry in the United Kingdom is

being seriously affected. The Board *may* then refer the matter for inquiry to a committee of five for investigation, which committee *shall* also report on the effect which the imposition of a duty on goods of that particular class would exert on employment in any other industry using such goods as raw material. It is upon the report of this committee that the Board will or will not act. These are wide and far-reaching powers which will require in some cases long investigation, and it is, therefore, of the greatest importance that the committees should be composed of business men with close, practical experience of each industry affected.

The Panel and the Electrical Industry.

THERE is no branch of industry which has been so badly affected by dumping in the past as electrical engineering, and we therefore regret to notice that only two names among those selected to form the permanent panel of twenty-five are electrical engineers or have any connection with electrical engineering. The exceptions are Mr. F. R. DAVENPORT, of the English Electric Company, who will represent heavy engineering admirably, and Mr. GILBERT C. VYLE. But this is not enough, for in our opinion there should also be representatives of the manufacturers of cables, electrical apparatus and instruments, and of telegraph and telephone material, for if the Act is to be made to work at all its machinery must be designed to operate at the highest efficiency. It must be noted also that all the members represent the manufacturing interest, and we should like to see one or two supply engineers added for this purpose. At all events, it is clear, as it stands, that the permanent panel does not represent the electrical industry, and we hope that the Board will rectify the matter without delay, especially as the size of the panel will not necessarily be a measure of its efficiency.

Transmission at 1 000 000 V.

A NATURAL diffidence, created by long years of experience, prevents us from placing any great reliance on information of a scientific or technical character which may appear in the daily Press. As this diffidence last week received an accretion over the Bradford case, it is with more than the usual reservations that we give publicity to a statement emanating from New York that commercial electrical current has been transmitted at a pressure of 1 000 000 V. This achievement, if it has been achieved, is due to the work of Mr. G. C. CHESNEY, of the General Electric Company of America, and his assistants. For the purposes of demonstration a 2 000 V, 60 cycle current was stepped up by transformers wound with hollow conductors, 4 in. in diameter, and similar conductors were used for transmission. Conditions in the United States have, as is well known, caused the gradual forcing up of the transmission voltages employed in order that as wide an area as possible may be covered from a minimum number of generating stations. This has specially been the case in California and other of the less densely populated States, and the feat which we now chronicle is, therefore, an achievement of degree rather than kind, though in carrying it out some interesting electrical problems must necessarily have been solved. We shall look forward to receiving at an early date some technical details of this gargantuan effort in electrical transmission.

Voltage Measurement by the Spark Method.

AN important discussion on the measurement of extra high voltages by employing the sparking distance between

spheres as a standard has recently been taking place in the "Electrical World." As is well known, this method is simple and allows the quantity involved to be defined in terms of such physical constants as the dimensions of the apparatus, the temperature and the pressure, so long as both spheres are insulated. For these reasons it has been adopted as a standard by the American Institute of Electrical Engineers. The simplicity disappears, however, when one sphere is earthed—a fact which constitutes a serious practical drawback, for it means either that both spheres have to be insulated, which is not easy to arrange, or that simplicity is sacrificed by earthing one of them. In attempting to find a workable compromise, Dr. ALEXANDER RUSSELL, in a recent communication to the Institution of Electrical Engineers, pointed out that if it was assumed that the earthed sphere was at a definite fraction of the total potential difference below earth, then the earth case reduced to the same values of critical gradient as those for the case where both spheres are insulated, and so the use of one formula became possible. The point, however, arises as to the correctness of the deductions of the values of potential gradient, and Dr. RUSSELL, in the correspondence to which we refer, now makes the interesting suggestion that at high absolute potentials there may be some escape of electricity from the sphere, so causing an alteration of the normal electrostatic gradient in the air. We agree with our contemporary that, in view of the importance of as great simplicity as possible being present in all standards, it is desirable that experiments should be carried out with unequal spheres in order to clear up this matter.

Mechanical Improvements in Electric Locomotives.

THE discussion which took place at the recent Engineering Conference on various points connected with the mechanical design of electric locomotives showed that there is still a good deal of ground to be traversed before there is general agreement on certain important fundamental principles. In this country we seem so far to be more interested in the electrical side of the problem, and have therefore, rather naturally lost sight of the fact that there are many mechanical points in electrical locomotive design that are not only as important as the electrical ones, but must be solved with regard to the electrical conditions present. There is, for instance, the question of drives. In an article in a recent issue of the "Schweizerische Bauzeitung" Mr. E. SEEFEHLNER calls attention to the fact that of all the drives now employed—that is, the direct gearless drive, the simple gear drive, and the rod drive in its various modifications—each has its inherent advantages and each has its inherent shortcomings, and that the best, and at the same time the most heroic, method would be to sweep them all away and design something entirely different, which should embody as many of the present advantages, with as few as possible of their disadvantages.

Misplaced Heroism.

HEROISM of this kind is, however, misplaced in engineering, and we are not, therefore, surprised to find that Mr. SEEFEHLNER hardly lives up to his ideals. With quite a human prejudice he sees most advantages in the rod drive with intermediate gear and a back shaft, and really uses that as his foundation with a minimum of iconoclasm. He suggests using a double 90 deg. crankshaft on either side of the motor and the gear jack shaft, and so obtain a very steady pull. He adapts this drive to the various

sorts of locomotives which are required, and in so doing is enabled to cut down the number of motors required to only four. The ideas put forward in this article would be more open to criticism if the author's practice corresponded at all closely with his theory, for, in designing electric locomotives, no less than in building houses, scaffolding is necessary, and the construction of either without its employment would be equally difficult. Mr. SEEFEHLNER, however, makes an interesting contribution to a very important problem, and we therefore hope means will be found to test the idea experimentally with a view to discovering whether it produces better results than the designs now more usually employed.

Progress in Harmonic Analysis.

PROBLEMS of harmonic analysis have always been of interest to practical physicists. As an example of this, we need only instance the historic work of PERRY, SILVANUS THOMPSON and Dr. RUSSELL on the subject. Quite recently, however, the question has advanced into a more practical field owing to the need of dealing analytically with the disturbances induced in telephone lines and at wireless stations by the harmonics in the currents carried by overhead power lines. In order to eliminate these disturbances attempts have been made to design alternators to give an electromotive force with a pure sine wave, or, as this, of course, is not strictly possible in practice, to produce a machine in which the limits to the magnitude of the amplitudes of the harmonics in the waves are fixed. This necessitates some method of harmonic analysis, and Mr. A. E. CLAYTON is therefore to be congratulated on having given in a recent issue of the "Journal" of the Institution of Electrical Engineers a *résumé* of the ordinary methods employed and of two schedules for harmonic analysis by means of selected ordinates. One of these schedules goes to the twenty-fifth harmonic and the other to the thirteenth, it being assumed in both cases that no harmonic higher than either of these is present. Seeing, however, that in actual electromotive force waves there are an infinite number of harmonics present and only a limited number of ordinates are drawn, though Mr. CLAYTON'S method may work out well in practice, it is hardly likely to be held in very high favour among those mathematicians who cling closely to Cambridge traditions.

A University of Industry.

IN a letter which appeared in the daily Press last Saturday, Sir WM. J. NOBLE, one of the most progressive of modern industrial leaders, urges "upon every employer to summon his workers together, setting aside prejudice and suspicion, with a view to bringing them into knowledge of the world facts of economics which shape and rule the destinies of his business just as surely and ruthlessly as the climate governs the harvest." "Our country," he continues, "should become a vast university, where the millions may learn day by day some of the lessons which economic laws thunder into the ears of them who have ears to hear. Until the extreme and one-sided economics, the economics of ruin of industry for ruin's own sake, the pulling down for sheer delight of pulling down, and 'damning the consequences' give place to the true there cannot be a swift return to peace and plenty." Sir WILLIAM imposed upon those employers who will listen to him the duty of the frank enlightenment of those with whom they are connected, and no advice could be more necessary or more timely. It is a new conception to think

of industry as one vast university, and yet what could be more true. Somehow or other, employers, on the whole, fail to realise their responsibilities as educationists. They leave their workers to the agitators, and then complain because their views of industrial problems are so crude and destructive. They refuse to believe in the union of interests between employers and employed, but take no steps to spread that belief by precept or by practice. It is not necessary that employers should turn themselves into professors of economic theory, or treat their workpeople as children requiring education. If they will adopt the much easier and simpler plan of systematically and regularly telling their workers all there is to tell about their own business, the fallacies of the spurious economics now so vigorously preached at every street corner will become self-evident and revolution will be at a discount.

An Aspect of the "Safety First" Movement.

THE movement which is conveniently known as "Safety First" is rightly gaining speed throughout the world, but if the events disclosed by Major G. L. HALL, in his report to the Ministry of Transport on the accident which took place on the 31st July last at Tynemouth, are to be taken as an indication of the state of affairs generally existing, a good deal more has yet to be done before finality is reached. We should say that where the "Safety First" movement is lacking is that it places too much attention on the instruction of passengers by propaganda of a kind with which we are all familiar, and too little on ensuring not only that the servants of the various operating companies understand their duties, but that the rules that are laid down by a beneficent Government for their conduct are strictly carried out both in spirit and the letter. In spite of the fact that five passengers were killed and no fewer than thirty-two injured in the accident to which we have just referred, we think that the most serious aspect of the disaster is that an almost identical accident occurred at the same place less than two years ago.

Details of the Accident.

THE history of the affair is simple. The line on which the accident happened is on a steep-falling gradient with a sharp turn at the bottom. As a result of the previous accident further precautions were imposed in the way of compulsory stops; but the evidence leads Major HALL to the conclusion that these were not regarded as they should have been, and that, in particular, the track-brake was not sufficiently applied before the car started from the top of the hill. The natural result was that in view of the greasy condition of the rails the application of the hand-brake caused the wheels to skid, and that subsequently, when a speed of no less than 25 miles an hour had been attained, the driver lost his head, and seems, in an attempt to apply the short-circuit brake, to have switched the power on to the motors. While this driver was a man of fair experience, the conductor had only been in the company's service for about a month, and so had very little knowledge of the duties he should have performed in such an emergency.

Need for More Supervision.

IN the course of some very severe criticisms, Major HALL states there is a strong suspicion that the speed limits on this descent were commonly exceeded, and that undue liberties were taken with the brake equipment under good conditions of rail, with the result that potential danger arose when very bad rail conditions suddenly developed after a long spell of dry weather. It seems impossible to tell

whether this state of affairs was due to inattention on the part of the motormen or conductors, or to inadequate training and supervision, or to both. But it is certainly a state of affairs that requires immediate attention. Transport undertakings in this country rightly pride themselves on the safety with which they conduct their operations. One accident is usually sufficient to cause any shortcomings of plant or personnel that may disclose themselves as a result of a fatality to be removed. It would seem that the Tynemouth and District Light Railway are not content with one warning. It is to be hoped that two will be sufficient.

A Question of Nomenclature.

THE letter from Mr. LOUIS COHEN, which we publish on another page of this issue, is an interesting sequel to the correspondence which took place in *THE ELECTRICIAN* some months ago on the correct nomenclature for what is known in America as wire radio, in Canada as guided-wave telegraphy and telephony, and in most other countries as high-frequency telephony and telegraphy. It appears that this question of labelling was discussed at the meetings of the provisional technical committee of the International Conference on Electrical Communications, which were held in Paris from June 23rd to August 23rd, but that no agreement was reached owing to the insistence of each of the delegates on his own point of view. This disagreement, though natural, still leaves what is rather an important question still undecided, and we agree with Mr. COHEN that the delay in re-opening the matter should be of the shortest, and that in the meantime a full and public expression of opinion is highly desirable. We need hardly say that we shall be pleased to receive the views of our readers on this subject, and, though at this state of the proceedings an editor is well advised to act in a more or less judicial capacity, we plead in advance for some term which shall not distort too greatly the fair design of the English language, and shall at the same time describe as accurately as possible what the system in question is and does. In many ways we lean towards the use of the term high-frequency telegraphy and telephony, though we quite admit the force of Prof. MAILLOUX's arguments against this term.

Advertising British Goods Abroad.

ANY scheme for advertising the products of British industry in foreign countries deserves at least sympathetic consideration and generally active support. Hitherto, we are afraid, British manufacturers and exporters have been rather too individualistic in the planning and execution of schemes for the export of their goods, while their publicity methods in foreign countries have equally often left much to be desired. A somewhat unusual, though not a quite unprecedented, scheme for developing exports has recently been launched by British Trade Ship, Ltd. In effect it is proposed to build a large ship of 20 000 tons of special design, which is to be named "British Industry," and four decks of this ship, which is to make a tour of the world, will be devoted to exhibits of goods. It will thus be a floating exhibition of British manufactures. The scheme is an ambitious one, for even in its construction the ship, which will be furnished on a luxuriant scale, will be an illustration of British equipment. There will be accommodation on board for 300 trade representatives, and there will be also facilities for banking, cabling, and everything else requisite for performing commercial operations.

The chief criticism we have to offer is that, as the expedition will only touch at the chief ports of South America, South Africa, China and Japan, there will be no appeal to the representatives of the inland trades of these places, and it is also somewhat unfortunate that the ship will not set out on her cruise until nearly two years hence. In the meantime, a similar ship, the "St. Louis," will set out on a world trip in January next with the products of 300 American manufacturers. About fifty different ports are to be visited, so that, compared with the American voyage, the British ship will be not a little behindhand.

Electric Vehicles at Glasgow.

THE annual report of Mr. W. GREIG, the Glasgow Cleansing Superintendent, contains some interesting information regarding the relative merits of electric vehicles and vehicles propelled by other mechanical means. For refuse collection there are in Glasgow twenty-two 2-ton electric lorries and two 3-ton petrol wagons. The latter were acquired in 1913, and of the electric vehicles eight were purchased last year, eight in 1919-20, and the remainder within the past six years. The petrol wagons have not proved entirely suitable for the work, and their running cost has been higher than that of either the electric or the horse-drawn vehicles. On the other hand, it is gratifying to learn that the electric vehicles have given satisfactory results, "having been found efficient, reliable, economical, and easily driven." Though this is a flattering testimonial, it is only what might have been expected, and it is confirmed by the experience of other local authorities, though the example of using electric vehicles wherever possible is one which even now might be more widely followed. It is stated that more economical results would be achieved if the drivers would assist in the loading and packing of the vehicles, as in the case of horsed vehicles. At present the electrics require a "loader and packer" in addition to the driver, and if this extra cost could be eliminated a great saving would be effected.

Electrical Fires in America.

STATISTICS compiled in the United States by the Society for Electrical Development show that, while electricity is the safest form of illumination, as in this country, when the origin of a fire is unknown, it is the common practice to ascribe it to the fusing of an electric wire. This shows a lack of imagination on the part of both officials and journalists, which we are surprised to find in so go-ahead a country. The statistics to which we have just referred were prepared as a counterblast to the fire loss statistics compiled by the National Board of Fire Underwriters, which showed that electricity was the chief single cause of fires. As a matter of fact, reports received from 349 cities where 138 553 fires occurred in 1919 indicate that only 3 568 of these, or 2.57 per cent., had an electrical origin. For 1920 questionnaires were sent out to the fire departments of all cities in the States of 5 000 population or more, and the replies show that, while electricity is rapidly replacing all other sources of illumination, the number of fires due to electrical causes have not increased in anything like the same proportion. For, while fifty-six cities and towns reported no fires of electrical origin during 1920, the total fire loss from other causes was more than \$1 600 000, and in many individual cases the loss from electric fires was only about 0.25 per cent. The aim of the Society is not so much to obtain the Fire Department's

figures as to educate their officials to recognise what should and what should not be classified as an electrical fire—a type of propaganda which might well be inaugurated over here. Apart from this, it is important that efforts should be made to classify all electric fires according to their cause, so that it may be possible to take steps to correct the faults, and thus reduce the number of such fires to a minimum. This is very useful work, and another example which might be copied in this country.

Some Thoughts on an Exodus.

At this time of year an exodus, whose significance is not generally realised, takes place from our engineering colleges. It comprises a band of embryonic electrical engineers who, having tackled their final examination with greater or less success, are now faced with the unaccustomed task of "getting a job." For the past few years their daily course has been mapped out for them on rigid lines. In return for certain fees, usually from their parents' pockets, they have been entitled to attend certain courses of lectures and to perform certain laboratory experiments. Their success in the lecture-room and laboratory has been dependent on a certain natural absorptive ability, a certain amount of enterprise and on a certain desire to acquire knowledge for themselves. While some qualities whose possession will be always useful have been called into play, lack or failure to use these qualities has not been followed by any condign punishment; and in all their doings there has been a singular lack of that financial influence which for the rest of their lives is to play the most important part in their existence.

Distaste for Technical Education.

The young man who has completed his course at a technical college is, in fact, ill-equipped for commercial life. Except his intrinsic possessions, he has nothing he can turn into money, and, for a time, therefore, is forced to work under those to whom, with the egotism of youth, he feels he is intellectually superior for a wage on which existence is often impossible without a parental subsidy. In the short space of a few weeks he is thrown from a cloistered environment into one full of wondrous traditions and ideas so new and strange that he had never imagined them in his wildest dreams. It is at this time that he acquires that distaste for technical knowledge which receives forcible and unjust expression in after-life. This new force may, in fact, so re-orient his views and actions that he may find the technical information he has so laboriously acquired become of less use to him as time goes on compared with those wider qualities which are either inborn or self-taught.

A Thankless Task.

That this should be so is no slur on our technical universities and colleges, and still less on those whose thankless task it is to impart knowledge to a seemingly indifferent youth. It is rather an argument for a wider outlook on education, using the word in the broadest sense of the term, and a plea for a change of viewpoint towards certain fundamental factors which go to make up a satisfactory technical training. This plea is addressed to the students themselves rather than to the teachers. The latter know that the best they can do is to make a careful

selection from the many varieties of seeds at their disposal, to scatter these seeds to the wind, and to hope that somewhere they will find fertile ground on which to grow. To develop the metaphor they know that there is a seed best suited to every ground, but they are also aware that the time is too short for each different soil to be analysed and for the seed that will flourish most vigorously in it to be determined.

The Need for Fundamentals.

To adopt common terms again, as our knowledge widens it is still less easy to cover the ground in any subject in the time at the teacher's disposal. In electrical engineering it is especially difficult. And, as we have pointed out before, the best that can be done, therefore, is to deal so far as is possible with fundamental questions, and trust that the information given will enable the student to discover for himself the subject at which he can work with most profit.

The Importance of Non-Technical Qualities.

But most courses at one of our engineering colleges deal solely with technical education. They leave out of account altogether instruction in those other qualities which it is becoming more and more recognised are of the highest importance to the equipment of the engineer. Indeed, without cynicism, it may be said that engineering knowledge is among the least of things that the engineer will require in after-life, and that success in his profession will depend much more on the possession of such qualities as initiative, tact, executive ability and personality than what he knows about this or that branch of engineering.

The Disheartening Effect of Sudden Change.

We do not put this argument forward as anything new. Indeed, it has often been said before in a variety of ways—in addresses, at prize-givings and on other occasions where a moral can suitably be drawn. But we do not think it is realised how disheartening must be the effect on the young man who has successfully followed his technical course that all that he has done is as nothing without the possession of certain qualities which he has never been taught and of which up to now he has never felt the need. His first feeling is naturally one of disappointment. His second is as naturally one of disgust, not with himself or with his college, but with the complacent old gentleman who can talk such nonsense. It drives him more often than not into a narrow groove, where at a low wage he takes no interest in anything but his immediate job until he must gradually be numbered with those who work but do nothing to assist real progress. Yet the old gentleman at whom he sneers was quite right, only a little tactless, in his presentation of facts which he did not realise would be a little unpalatable.

Specialisation Essential.

If, therefore, neither as a teacher nor a preacher, but as a looker-on we may say a word to students, we would remind them that, though the ever-increasing development of electrical theory and practice makes specialisation an essential for success in their new life, the cultivation of the broadest outlook, the development of initiative, the maintenance of an interest in all the affairs of life, attention to what is being done in art, science and literature are all a necessity. Only in this way can the fallows of their mind be kept pure and sweet and that flexibility obtained which is not only a guerdon of success, but a joy to its possessor.

The Heaviside Unity and Unit Impulse Functions.

By A. PRESS.

In a previous article (see THE ELECTRICIAN, March 25, 1921) the writer endeavoured to clear the way for an understanding of the type of generalized algebra contemplated by the symbolic methods employed in the "Electro-magnetic Theory" of Heaviside. In the course of the article he had occasion to refer to the Heaviside unity function. Since, in symbolic analysis, it is often the aim to express the various types of functions in terms of such standard unity function it will be of service to those who may desire to read "Heaviside" with profit to go into the matter rather more fully than has been done heretofore.

Consider the functions

$$y = x^m; \quad U = x^{m=0}$$

We may define the Heaviside unity function U as the limiting form of the prior function as m approaches zero value from positive values of m only. However, the matter is not as simple as might appear due to the prevailing laxity in the use of the word "limit" in mathematical literature. (Compare, in this regard, "Fundamental Conceptions of Modern Mathematics," by Richardson and Landis, Open Court Publishing Company.) In the accompanying Fig. 1 a series of curves are given. It will be seen that representatives of all the above types of curves occur in the first quadrant only, whereas the several types for m , integral, fractional, odd and even, are variously distributed in the remaining quadrants. If, then, we confine the word "limit" to mean "the asymptotic form" approached by the function $y = x^m$ as m continuously approaches zero, it will be seen that the function approached from the plus side of m only occurs in the first quadrant. In other words, not only is a *continuum* in the sense of a variable not to be considered as an infinite aggregate of discontinuous or disjointed points, but, over a given finite range, no discontinuities whatever are presumed to occur.

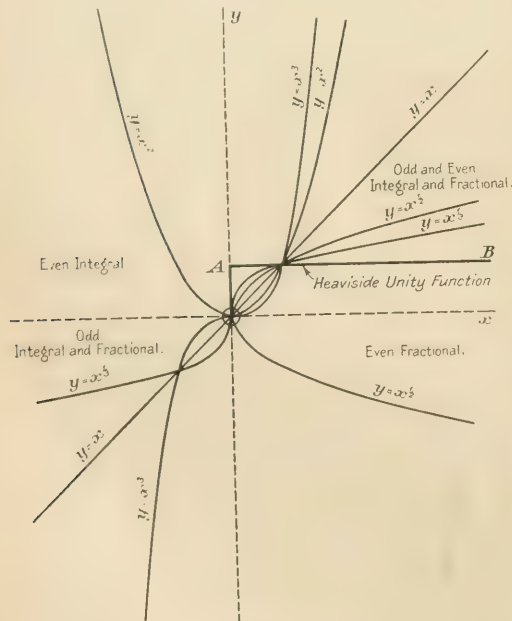


FIG. 1

A curious example of a line made up of an infinite number of discrete points occurs in the theorem aiming to establish the fact that the two sides of every triangle equal the third. The

trouble with the so-called "proof" is that a continuous ("smooth-functioned") approach to the boundary form is not obtained. In Fig. 2, bisecting the sides AB and BC , and drawing parallels, we have $AD \cdot D'D \cdot DD'' + D''C = AB \cdot BC$. Continuing the bisection, the points D' , D_2 are produced. In the "limit," however, all we have is a "line" made up of an infinite number of points D , obviously there can be no real tangent (derivative) at any point along the boundary line AC .

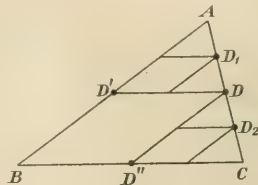


FIG. 2.

From the standpoint above it will be seen that in reality no negative branch at all occurs in the function (OAB , Fig. 1) in which

$$y = x^m = U = f(x) = x^{m=0}$$

The index zero implies here that m approaches this value from plus values whence the index can be written d_m if preferred.

Why Constants of Integration are Avoided.

If, now, we should integrate the above function, it will follow

$$\int y dx = \int_0^x y dx = \int_0^{x_0} y dx = x$$

without any constants of integration being necessary. This is really because the inferior limit of y when x is zero is already set. The unity function U , as stated above, does not exist for values of x less than zero. It should be remembered the last statement is very different from saying that the negative branch is the axis of x itself.

Integrating once more we have

$$\int_0^x x dx = \frac{1}{2} \cdot x^2$$

and again no constant of integration appears to bother one. In fact, it is a peculiarity of Heaviside mathematics that integrations do not require the usual indefinite "constants of integration" at all. It is this feature that makes for so much simplicity in symbolic analysis.

The Unit Impulse Function.

If, now, we differentiate the function

$$y = x^0$$

an inspection of the graph shows that the differential coefficient is zero for all values of x applying to the flat top portion AB of the curve. For the portion of the curve CA starting from the origin and passing along the axis of y , the tangent value is infinity. We can therefore say that the integration of the function

$$y_1 = \frac{dU}{dx}$$

will result in the original unity function of Heaviside without any indefiniteness due to unevaluated constants of integration.

Common Symbolism and Formulæ.

Indeed, because constants of integration do not appear at all it follows that the general formula of differentiation with regard to x^m can be employed in integration as well. It is

because of this that it is preferable to adopt the Heaviside notation of differentiation, to wit:—

$$d dx = x_1 \quad ; \quad d dt = t_1 \quad ; \quad d dz = z_1, \text{ etc.}$$

Thus, since an integration step necessarily undoes a differentiation step, and *vice versa*, the one is inverse to the other. This suggests that we symbolize integration as follows:—

$$\int_a^b \frac{x}{x_1} dx = \frac{1}{x_1} \left(\right)$$

It will then follow

$$d \left(\int_a^b \frac{x}{x_1} dx \right) dx = x_1 \cdot \frac{1}{x_1} \left(\right) = \left(\right)$$

In other words, the symbolic algebra of the differential operators themselves, quite apart from the consideration of what the operand might be, implies that

$$x_1 \cdot \frac{1}{x_1} = 1 = \frac{1}{x_1} \cdot x_1$$

The above will be true at least as long as the function or operand symbolized by $()$ can be developed in terms of the Heaviside unity operand.

Turning, therefore, to the general differentiation formula, with x^m as operand it is seen that

$$\frac{d}{dx} x^m = x_1 x^{m-1} = \frac{m}{x_1} x^m$$

Operating on both sides with x_1^{-m} (equivalent to operationally dividing by x_1^m) we have

$$x_1^{-m} \cdot x_1^m x^{m-1} = x_1^{-m} \cdot \frac{m}{x_1} x^m$$

That is, it follows as an integration formula:—

$$\frac{1}{x_1} x^{m-1} = \frac{m}{x_1} x_1^{-m} x^m = x_1^{-m} x^m$$

It should be remembered that the last is only interpretable ordinarily when n is integral. However, as already pointed out in a generalized algebra such as Heaviside has contemplated the above formula "applies" even when n is fractional or otherwise.

Operational Development of the Sine Function.

The above analysis lends itself admirably to a study of functions, not in their usual algebraic form but rather in a

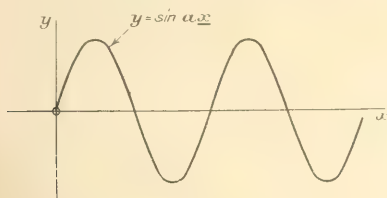


FIG. 3.

novel operational form quite distinctively "Heavisidean." Thus we have, for example, the usual series development of the sine

$$\sin ax = ax - \frac{a^3 x^3}{3!} + \frac{a^5 x^5}{5!} - \dots$$

Various function terms appear each involving a power form of ax . In view of the fact that all physical phenomena require an initial stage in being it is well to consider whether $\sin ax$ cannot be developed in terms of the Heaviside unity function:

$$U = x^0.$$

For this to be the case it will be necessary to consider the n curve (see Fig. 3)

$$y = \sin ax$$

as only existing for values greater than $x=0$. The graph

Fig. 3 would then have no negative branch. Now it follows necessarily that the general formula permits us to write

$$\begin{aligned} \frac{a}{x_1} &= a \cdot \frac{1}{x_1} \\ \frac{a^3}{x_1^3} &= a \cdot \frac{1}{x_1^3} \\ \frac{a^5}{x_1^5} &= a \cdot \frac{1}{x_1^5} \end{aligned}$$

so that it is possible to equate

$$\sin ax = a \cdot \frac{1}{x_1} - \frac{a^3}{x_1^3} + \frac{a^5}{x_1^5} - \dots$$

Separating out the operational part from the common unity operand x^0 we have

$$\sin ax = \left\{ \frac{a}{x_1} - \frac{a^3}{x_1^3} + \frac{a^5}{x_1^5} - \dots \right\} x^0$$

The Algebra of Operational Transformations.

However, as an algebraic expression in terms of the operator x_1 itself, quite apart from the truly algebraic function x^0 , it follows

$$\frac{a}{x_1} - \frac{a^3}{x_1^3} + \frac{a^5}{x_1^5} - \dots = \frac{a}{x_1} \cdot \frac{1}{1 + \left(\frac{a}{x_1} \right)^2}$$

which exemplifies the *algebraic equivalence* of a complex species of operation to be performed. Thus we have the above very compact and finite operational form coupled with an operand function x^0 and

$$\sin ax = \frac{a}{x_1} \cdot \frac{1}{1 + \left(\frac{a}{x_1} \right)^2} x^0$$

A second form even more remarkable obtains by multiplying the numerator above and below by ax_1 and then we have

$$\sin ax = \frac{1}{a} \cdot \frac{\left(\frac{a}{x_1} \right)^2}{1 + \left(\frac{a}{x_1} \right)^2} x^0$$

From the latter point of view the operand function is now the unit impulse function $Y = x_1 x^0$ instead. In the last we must consider the complex operator function of the prefactor expression which, when acting on the unit impulse function, actually gives rise to the sinoidal function for all values of x greater than zero. This type of development is of the greatest usefulness when dealing with Bessel's functions. More of the latter on another occasion.

American Electric Plant Exports.

It is reported that there is a growing demand from all over the world for American electrical plant, especially for hydro-electric work. In the fiscal year 1915 the total value of the exports of the group officially designated as "electrical machinery and appliances" amounted to only \$19 772 000, but had advanced to \$54 547 000 in 1918. Then with the world's return to peace the total exports jumped to \$80 000 000 in 1919, \$87 000 000 in 1920, and \$119 221 000 in 1921. This increase of \$32 000 000 in the electrical exports in the last fiscal year is the more remarkable in view of the fact that in the other important classes of machinery the exports of 1921 showed but comparatively slight gains. The exports of electrical machinery increased 37 per cent. in value, while those of all other machinery only rose 10 per cent. It is stated that the growing demand for electrical machinery comes from every direction, and includes every sort of appliance. Electric motors are the biggest single item in the \$119 000 000 worth of exports in 1921, amounting to over \$18 000 000, dynamos and generators to about \$7 000 000, and insulating wire and cables to over \$11 000 000. The 1921 figures showed in each instance a larger total than in 1920, despite the fact that prices per unit of quality in 1921 were in many instances less than in 1920.

Some Notes on Large Electric Units.*

By STANLEY PARKER SMITH, D.Sc.

Introductory Note on Prime Movers.

THE development of prime movers has largely influenced the development of electric generators, and conversely. Transmission problems and the growing demand for electrical energy have given a great impetus to alternating-current machinery.

development has been the "Ljungström" steam turbine, in which the electric unit is split into halves. By making these halves rotate in opposite directions, the relative blade speed in the turbine is made equal to twice the actual running speed, resulting in a very small turbine, low steam consumption and the

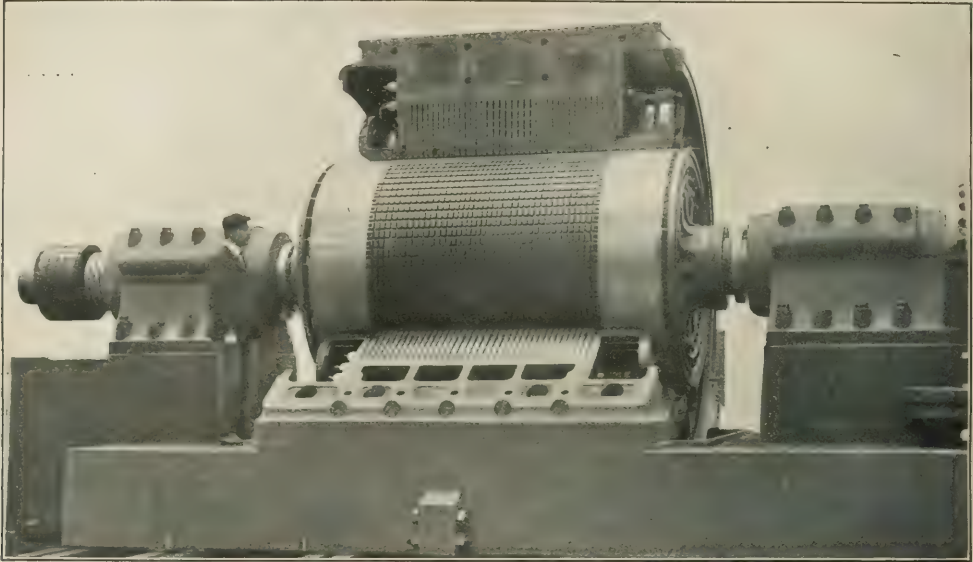


FIG. 1. ROTOR AND PART OF STATOR OF A TURBO-ALTERNATOR OF 8000 kVA, 833 REVS. PER MIN., 42½ CYCLES, AT THE STE. AME "LE TRIPIHASE" AT ASNIÈRES. (SOC. ALSACIENNE DE CONSTRUCTIONS MÉCANIQUES A BELFORT.)

The steam turbine has now reached a high stage of development. Units of 25 000 to 35 000 kW are probably large enough to give good all-round economy, without involving too much capital

possibility of much larger units at 3 000 revs. per min. than with ordinary turbines. The two stator windings are connected permanently in parallel, the two rotor windings in series. The set is started with the exciter circuit closed and the two alternators synchronise automatically at about half speed. The whole set can be mounted on the condenser.

Large internal combustion engines have been widely developed on the Continent. Gas engines are now installed in most iron and steel works to utilise blast-furnace gas. The exhaust gas from the engines can be used for gas-fired boilers, and subsequently for heating the feed water—the extra power thus obtained may amount to one-eighth or more of the total. Recent developments include greater reliability, simplification of valve gears, use of compressed air for starting, &c. Flywheels may be necessary for reducing cyclic irregularities, but may be dispensed with in alternators driven by twin-tandem engines. Assuming 2 000 h.p. per cylinder as the present limiting output, such a set could give 8 000 h.p. The outputs and speeds obtainable with gas engines are exemplified by the following figures for tandem engines:—

Cockcroft: 1 000 h.p. at 115 revs. per min. to 3 600 h.p. at 94 revs. per min.

M. L.N.: 715 h.p. at 167 revs. per min. to 3 500 h.p. at 94 revs. per min.

Twin-tandem (4-cylinder) engines give about twice the above powers.

These figures may be compared with the following figures for Diesel engines with one to six cylinders:—

Salzer: 20 h.p. at 260 revs. per min. to 4 000 h.p. at 125 revs. per min.

M. L.N.: 85 h.p. at 200 revs. per min. to 1 500 h.p. at 150 revs. per min.

In regard to water turbines, development in hydro-electric work has been exceptionally rapid; the design of both impulse and reaction turbines has been greatly improved. Heads of 3 000 ft. and units of 20 000 h.p. are becoming quite common. So long as coal was relatively cheap and easily obtained, development was rather slow, but the coal famine of recent years proved sufficiently powerful to overcome the adverse financial conditions. In many countries definite policies are being carried out in connection with water-power schemes—e.g., the Alpine stations in Italy are linked up with the Apennine stations to secure continuity of supply;

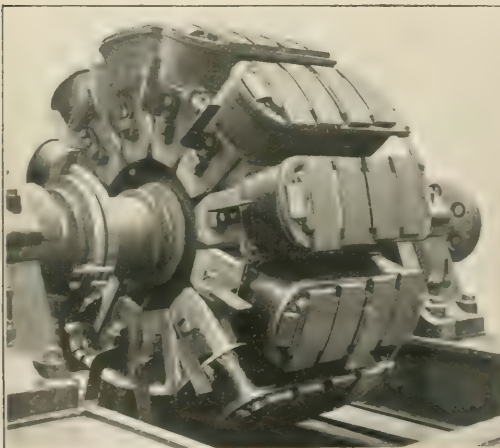


FIG. 2. ROTOR INSTALLED AT L'ENERGIA ELÉCTRICA DE CATALUÑA AT BARCELONA OF 6 000 kVA, 12 000 V, 500 REVS. PER MIN. (SOC. ALSACIENNE DE CONSTRUCTIONS MÉCANIQUES A BELFORT.)

expenditure in spare plant and without causing too much disturbance in the event of failures. One most interesting

* Abstract of a Paper read before the British Association.

in Switzerland high-head stations with storage capacity are linked up with low-head river stations working on constant load. In Germany power is obtained at the weirs of canalised rivers. Railways are being worked electrically by power obtained from hydraulic stations in Sweden, Switzerland, Austria, and Italy. The greatest difficulty in the construction of alternators for this work is the need for safeguarding them against overspeeds, which vary from 80 to 100 per cent. according to the type of turbine, &c.

Production of Alternating-Current Energy.

The difficulties of rotor construction, now well understood, have increased with increasing outputs. 3 000 revs. per min. has become almost the standard speed for 50 cycle machines, and outputs up to 20 000 kVA per unit are now practicable at this speed. This entails peripheral speeds up to, or even beyond, 25 000 ft. per min. Despite the difficulties in obtaining large forgings, weighing 20 to 25 tons, in their finished condition, the solid rotor seems to be generally preferred to a built-up construction. Hence dynamo makers are insisting on more rigorous guarantees from steel makers, and a hole has generally to be bored through the shaft to enable the interior of the forging to be examined and to provide test pieces.

The provision of efficient ventilation channels becomes difficult in large sizes; and there is a marked tendency to rely exclusively on surface cooling, safety being ensured by non-combustible insulation. Water-cooled rotors are built, but such cooling may become superfluous if the simpler method proves satisfactory. Despite mechanical weaknesses, the built-up rotor enables all parts to be thoroughly examined during construction and simplifies the provision of ventilation ducts. For large 4-pole rotors, weighing 35 to 45 tons, some form of built-up construction appears necessary.

Among special constructions may be mentioned the parallel-slot rotor, and the salient-pole rotor. An interesting example of

Stator Losses Problem.

In stators ventilation problems are accentuated by the greater losses, and great care has to be taken to keep down additional

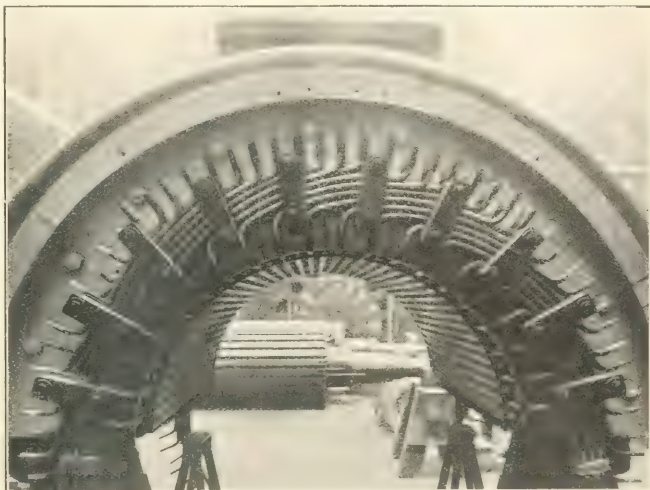


FIG. 3. HALF STATOR OF A TURBO-ALTERNATOR OF 16 000 KVA, 1 500 REVS. PER MIN., 11 000 V. (SOC. ALSACIENNE DE CONSTRUCTIONS MÉCANIQUES À BELFORT.)

losses, especially in the embedded copper. For large sizes, neither simple axial nor simple radial ventilation is alone sufficient, but the air must be made to flow in some pre-ordained manner. The manufacturer's difficulties in this country are often enhanced by having to build the stator on site. Water cooling is also being attempted to assist stator cooling. Station engineers are not yet wholly satisfied with the methods adopted for cleansing the cooling air—the method of circulating the cooling air through a refrigerator is being tried in several places. In the Schneider water-cooled stator, the water is first passed through the refrigerator used for cooling the circulating air. After absorbing heat from the air and from the machine, the water is then used to heat the feed water.

The end-windings call for special consideration. Turbo-alternators can safely withstand sudden short-circuit conditions, though in low-frequency systems an external reactance coil is sometimes considered a desirable additional safeguard. Both single and double-layer stator windings are widely used. With the latter arrangement the coil-span is often adjusted to suit design conditions. Automatic voltage regulation is becoming universal, the popular methods being those which act on the exciting current of the exciter.

Waterwheel Alternators.

The main difficulty in all waterwheel-driven generators arises from the runaway speed, which is usually 80 to 100 per cent. above the normal speed. A great variety of methods is used for securing the poles and windings. As in turbo-alternators, the stator winding is usually well braced to prevent accidents due to sudden short-circuit. Most modern types of waterwheel alternators are entirely enclosed to reduce windage loss and noise, and to protect the machine against eventual leaks. Large flywheel effect is generally important. The water-turbine manufacturer usually prefers to have the necessary flywheel effect embodied in the rotor of the alternator, so as to dispense with a separate flywheel—a condition not always easily fulfilled.

Slow-Speed Alternators.

These machines have again become important (after their suppression by the steam turbine) owing to the development of the internal-combustion engine and the adoption of reduction gearing. The large flywheel effect needed to obtain steady running with gas and oil engines often entails an "outer-pole" type of construction.

Production of Continuous-Current Energy.

The following alternative methods for producing continuous-current energy will be considered:—(1) Direct-driven, slow-speed generators; (2) slow-speed generators with reduction gearing; (3) rotary and motor converters; and (4) mercury rectifiers.

The continuous-current turbo-generator may be regarded as

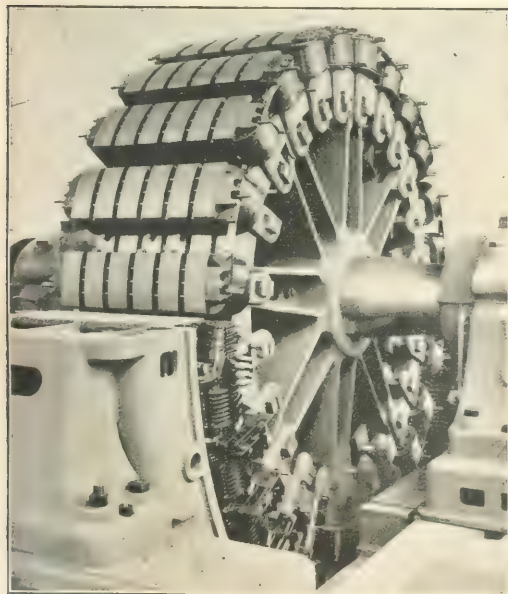


FIG. 1. OERLIKON WATER-WHEEL ALTERNATOR 17 000 KVA, 11 000 V, 250 REVS. PER MIN., 50 CYCLES.

the latter is the arrangement by Ganz, in which grub screws are made to secure a solid pole-shoe and a sleeve which carries the winding. In large machines, particularly of the 4-pole type, the rotor end-bells are often troublesome to design.

dead. After being developed successfully at enormous cost, it has been ousted by more suitable apparatus. The direct-driven continuous-current generator owes its extension of life largely to

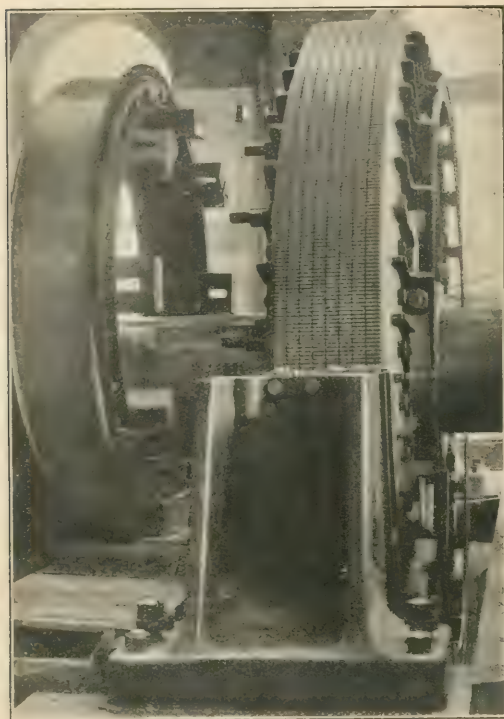


FIG. 5. D.C. GENERATOR OF 4500 kW, 94 REVS. PER MIN., 550 V., AT CHARLEROI.

the development of the internal-combustion engine. Probably the sternest competitors at the moment are the slow-speed generators driven by steam turbines through reduction gearing and the combination of turbo-alternators with rotary converters. For large powers, the latter is probably cheaper and more economical; but for small powers the geared generator appears to many to be the ideal arrangement. Gearing has now been brought to a high pitch of efficiency. It permits the turbine to be run at a speed consistent with low steam consumption, and makes possible an economical type of generator. Mercury rectifiers have only lately appeared, and their influence, particularly when cost of manufacture is reduced, remains to be determined.

These may be coupled to slow-speed engines (steam, gas, or oil) or to water turbines, or to steam turbines through reduction gearing.

Rotary and Motor Converters.

Large converters started from the alternating-current side have usually a starting motor with two poles less than the converter. The starting motor is of the induction type, commonly supplied with a solid cast-iron rotor for cheapness. In order to synchronise correctly automatically, it is usual to connect an impedance in series with the armature when applying the alternating pressure. One common way of doing this is to utilise the stator winding of the starting motor, by opening the neutral point and joining the phases in series with the slip-rings. Another method is to insert a choking coil in series with the slip-rings. The current is thus limited to a value insufficient to reverse the residual magnetism in the converter, which thus synchronises correctly. By increasing the induction motor field when the set approaches synchronous speed, Messrs. Mather & Platt have found that the converter will synchronise when the motor has as many poles as the converter. In this way surging and sparking during the transition period are prevented. Damping windings are universally used to prevent hunting. The bars must be spaced so as not to produce fluctuations in the continuous pressure, because of the danger of telephonic interference. Various methods are in use for obtaining

voltage regulation, including reactance control, booster control, induction-regulator control, and rarer methods such as the split-pole converter.

The difficulties connected with the design of rotary converters for 50 and 60 cycles have been largely overcome, but high pressures impose limits. Thus at 50 cycles it is not feasible to build a rotary converter for more than 1000 V. This is important for electric traction where it is desired to obtain 1500 V at 50 cycles. In this case it becomes necessary to use either motor-generators, two rotary converters in series, motor-converters, or mercury rectifiers.

The motor-converter owes its development mainly to Messrs. Bruce Peebles. Owing to the fact that pressures up to 11 000 V can be applied direct to the stator winding of the induction machine, a transformer becomes unnecessary with these sets in many cases. The development and use of converting plant appears to be more general in Great Britain and in the United States of America than on the Continent of Europe.

Mercury Rectifiers.

After much experimental work these have now been successfully developed by Messrs. Brown, Boveri, & Co., and are now on the market in three sizes, namely, 300, 600, and 1000 A at voltage up to 1500. Rectifiers are also being built by German firms. Owing to the short time this apparatus has been in general use, it is too early to make a proper comparison with other types of converting machinery. From all accounts, however, it would appear that a very useful alternative method of converting alternating into continuous-current energy has now been made available.

Information for this lecture was kindly supplied by the following firms:—

Firm.	Abbreviation.	Information.
Allis-Chalmers Mfg. Co.	Allis-Chalmers	Waterwheel alternators, c.c. generators.
Ateliers de Constructions Electriques Charleroi.	A.C.E.C.	Slow-speed alternators, c.c. generators.
Bergmann Elektrizitäts Werke.	Bergmann.	Turbo-alternators, slow-speed alternators, rotary converters.
British Thomson Houston Co.	B.T.H.	Turbo-alternators, water-wheel alternators, rotary converters.
Brown, Boveri, & Co. (Power-Rectifiers).	B.B.C.	Mercury rectifiers.
Bruce Peebles & Co.	Bruce Peebles.	Motor-converters.
Brush Electrical Engineering Co.	Brush.	Ljungström steam turbine sets.
English Electric Co.	E.E.C.	Turbo-alternators, water-wheel alternator, rotary converter.
Ganz & Co.	Ganz.	Turbo-alternators, water-wheel alternators.
General Electric Co. (Witton).	G.E.C.	Turbo-alternators, water-wheel alternators, rotary converters.
Maschinenfabrik Oerlikon.	Oerlikon.	Turbo-alternators, water-wheel alternators, slow-speed alternators, rotary converter, c.c. generators.
Mather & Platt Co.	Mather & Platt.	Slow-speed alternators, rotary converters, c.c. generators.
Metropolitan-Vickers Electrical Co.	Metrovick.	Turbo-alternators, water-wheel alternators, rotary converters.
Parsons & Co.	Parsons.	Turbo-alternators.
Schneider & Co.	Schneider.	Turbo-alternators, water-wheel alternators, rotary converters.
Société Alsacienne de Constructions Mécaniques.	S.A.C.M.	Turbo-alternators, water-wheel alternators, c.c. generators.
Svenska Turbinfabriks Aktiebolaget Ljungström.	S.T.A.L.	Ljungström steam turbine sets.
Swedish General Electric Co.	A.S.E.A.	Waterwheel alternators.
Westinghouse Electric International Co.	Am. West.	Turbo-alternators, water-wheel alternators, rotary converters, c.c. generators.

Valuable information on internal-combustion engines was also supplied by the Société Anonyme John Cockerill, Sulzer Frères, and by the Maschinenfabrik Augsburg Nürnberg.

The British Association at Edinburgh.

Extreme pressure on our space last week prevented us from completing our account of the proceedings at the British Association's recent meeting at Edinburgh. We therefore give below some further details of the Papers read before Section A (Physics) and a general account of what happened in Section B (Chemistry). The greater part of the proceedings in both these sections was, of course, outside the domain of both the electrical engineer and the electrician.

Section A.

Monday, Sept. 12th.

A discussion on the quantum theory was opened to-day by Mr. G. C. DARWIN. The inconsistencies between the quantum theory and the classical theory of radiation still, said the author, existed. There was no complete logical foundation for the theory at present. The essential feature of the theory was Planck's Universal Constant, $h = 6.55 \times 10^{-27}$ erg. sec., which in some unexplained manner took part in energy changes, in such a way that these exchanges with a system of frequency γ only took place in integral multiples of $h\gamma$; which was conveniently illustrated by the cases of the emission of X-rays when high velocity electrons bombarded a metal plate, and of the emission of electrons when light fell upon a metal surface. Poincaré proved that Planck's quantum hypothesis accounted for the known phenomena of radiation, and moreover that these phenomena could only be explained on Planck's assumptions. Planck tried partially to reconcile the quantum theory with the classical theory by further assuming, that, whereas emission of radiation takes place in discrete amounts or quanta, absorption was continuous in character. But this assumption conflicted with Poincaré's proof and did not give satisfactory results in spectrum theory, though it worked quite well in other directions. He considered, therefore, that Planck's further assumption should be abandoned, although some quite competent critics desired its retention.

Bohr's Orbit Conception.

In dealing with Bohr's conception of stationary, or permissible, orbits, in which the electrons rotated around the nucleus, Mr. DARWIN referred to the difficulty that these stationary orbits might be fixed in several ways, each giving rise to a different set of orbits, with the same set of values for the energy of each, and hence giving the same spectrum. The Zeeman effect was explained quantitatively on the classical theory, and the quantum theory suggested that this was so, because we have a quantum equation in which have occurred on both sides, and hence cancelled out. This suggested that many phenomena usually considered as satisfactorily explained by classical dynamics were really quantum phenomena, and would probably be of immense importance in the extension of the quantum theory. The forces inside a body must be of electric and magnetic origin, and the quantum theory suggested that the approximate rigidity of a body was explained by the radius of the permissible orbit which an electron described about the nucleus.

Derivation of the Balmer Formula.

Sir OLIVER LODGE gave a novel example of the derivation of the Balmer formula, imagining that an electron was fired into the nucleus of atomic number N , so that the atom becomes of atomic number $N-1$, the outer electron orbit becoming elliptical and radiating the Balmer series.

Prof. J. W. NICHOLSON, referred to the present state of Bohr's theory and Sommerfeld's extensions. He dealt with the methods of representing the electron orbits in the case of helium, and he was convinced that the electrons certainly did rotate in opposite directions about the nucleus, and that they obeyed a complex law of motion. Bohr's model of the helium atom, in which two electrons in the same plane rotated in the same direction about the nucleus, was impossible from magnetic considerations, since the helium atom was magnetically neutral.

He gave a diagram of his conception of the quantum representation of the hydrogen molecule.

Faraday on Magnetic Force.

Dr. H. S. ALLEN referred to Faraday's writings on tubes of magnetic force and showed that if one considered Planck's expression for the angular momentum of an electron in a permissible orbit to be identical with the angular momentum of the magneton system, and the charge on the magneton to be equal to the electron charge, then it was found the number of tubes of magnetic induction passing through the electron orbit to be equal to $n(h/e)$. He had recently shown that when an electron revolved round the positive nucleus in an elliptic orbit, the sum of the two quantum integers which represented the size and shape of the orbit, represented the number of quantum magnetic tubes passing through the elliptic orbit. The results indicated the existence of discrete tubes of magnetic induction as Faraday suggested, in fact, the unit tube

might be regarded as one quantum. He exhibited a working model which illustrated various electromagnetic phenomena.

Dr. LANGMUIR suggested that one must look for the mechanism of radiation inside the electron itself.

The Energy of X-Ray Radiation.

Prof. C. G. BARKLA, in an interesting Paper on the energy of X-radiation, described experiments which lead to the conclusion, that, whereas all atoms and all the electrons inside a body were capable of scattering X-rays in a continuous manner according to the classical laws of radiation, yet only a very few atoms were able to emit a characteristic X-radiation, and this emission is apparently governed by quantum relations.

In the afternoon, Prof. A. S. EDDINGTON, F.R.S., delivered a very clear account of Einstein's Theory of Relativity.

Tuesday, Sept. 13th.

This morning a joint discussion with Sections C, D and K on the age of the earth took place, the proceedings being opened by Lord RAYLEIGH, F.R.S.

Subsequently Prof. R. A. SAMPSON, F.R.S. read a Paper on the microchronograph. A clock signal or other signal causes an electric current of a few milli-amperes to pass through a detector consisting of a short loop of fine platinum wire suspended under tension between the poles of a powerful electromagnet. The detector is bridged by a small plane mirror which reflects a beam of light on a moving photographic film. The signal current causes a small rotation of the mirror, and consequently, a movement of the spot of light on the film. In order to avoid errors due to slight irregular movements of the film, a simple, freely vibrating steel tongue cuts off the light at intervals of approximately 1/10 sec. With the arrangement as used by Prof. Sampson, the movement of the mirror is magnified 1000 times, and the clock times of any signal may be accurately and consistently measured to 1/1000 sec., owing to the freedom of the instrument from a variable lag of its own.

Section B.

The meetings of Section B were largely attended, and on the occasion of the joint discussion with Section A the lecture room, although the largest in the building, was packed. The proceedings this year had a strongly bio-chemical bias. The President's (Dr. M. O. FOSTER) address being a brilliant exposition of the progress which has been made in the study of those remarkable syntheses and decompositions which go on in the living organism without the intervention of high temperatures or violent chemical reagents.

A discussion on the type of atomic structure associated with the names of Lewis and Langmuir was opened by Dr. LANGMUIR himself, who gave a very clear account of the ideas of electro-valence and co-valence, and of the distribution of electrons in the case of both forms of combination. Prof. SMITHells exhibited models to illustrate the atomic structures proposed, and views both in favour of and against the hypothesis were expressed. On the whole, the feeling among chemists was probably that many difficulties remained to be overcome, and that much more work would be necessary to bring the theory into harmony with the facts of structural chemistry. Dr. Langmuir's address did much to clear the ideas of chemists on the difficulties of chemical valency.

The Problems of Surface Tension.

At the concluding meeting of the section, three Papers were read on subjects connected with surface tension. Prof. JAEGER, of Groningen, described the very delicate apparatus which he had devised for determining the surface tension of liquids over the wide range of temperature from -80°C to $+1600^{\circ}\text{C}$. The precautions for eliminating experimental errors aroused much interest, and the curves of surface-tension and temperature showed clearly the high accuracy of the method. Mr. COSMO JOHNS gave evidence to show that the surface of liquid steel was protected from oxidation by a layer of iron vapour, and discussed the variations of the surface-tension of molten steel in contact with slag as the reactions in the steel furnace proceed. Incidentally, he pointed out the interesting fact that the skilled workman, who was able to judge the temperature of molten steel by the eye with an accuracy of something like $\pm 10^{\circ}\text{C}$, did so by observing the wetting power of the steel towards solid surfaces, that is, by its surface tension, even more than by observing its optical properties. Prof. DESCH described the close relationship between the forms of foam cells and those of crystal grains in metals, thus proving the importance of surface tension in the process of solidification. The remainder of the sitting was devoted to a discussion of the solid impurities in the air of towns. Two forms of quantitative apparatus were described, and many results were given, mainly from London and Manchester, showing the diurnal and annual variations in the smoke content. The remarkable purity of even town air during the continuance of the coal dispute was clearly demonstrated.

The Olympia Engineering Exhibition.

(Concluded from page 361.)

The Jackson Electric Stove

The Jackson Electric Stove Company's exhibit is an interesting example of the great progress made in the design and manufacture of electric cooking equipment for marine use. One naturally expects to find the apparatus manufactured by this firm to be of high class, as they have specialised in this direction for several years, and inspection of the several pieces of apparatus on view fully justifies this expectation. A striking feature is the solid and sound construction of the apparatus, both from the mechanical and electrical points of view. The electrical portion is mainly built up from solid rod connections, and the many disadvantages incurred by the use of asbestos-covered wire, beaded leads or mica insulation are thereby avoided. For insulation purposes porcelain insulators are employed throughout. The second factor of note is the easy manner in which access can be obtained to all elements and connections. In connection with boiling or stewing pans, steaming ovens, water ovens, &c., the studs fitted to the bottom are welded in the case of steel and brazed in the case of brass,

$\frac{1}{2}$, 1, and $1\frac{1}{2}$ kW. The frame of the fire is intended for mounting on a wall bracket, and by the release of one fly nut the front of the heater falls forward, and thus ready access is given to the elements for replacements, &c. At the back of the heater frame a flue is provided to prevent the possibility of scorching the bulkhead and to assist the radiation of heat. The elements are of the Jackson standard type, consisting of a wire spiral wound upon a fireclay former.

Metropolitan-Vickers Electrical Company.

A section of this firm's stand is set apart for an exhibit of "Cosmos" domestic appliances, including "Cosmos" radiant fires, electric irons, kettles, hot-plates, grillers, &c. The "Cosmos" radiant fire, which fills a recognised demand for a substantial heating appliance, is built for stability, utility and efficiency. The heavy cast-iron box is of neat design, beautifully finished in black enamel, and is a safeguard against accidental overturning. The heating element is easily removable, and is wound on a cylinder of specially manufactured refractive

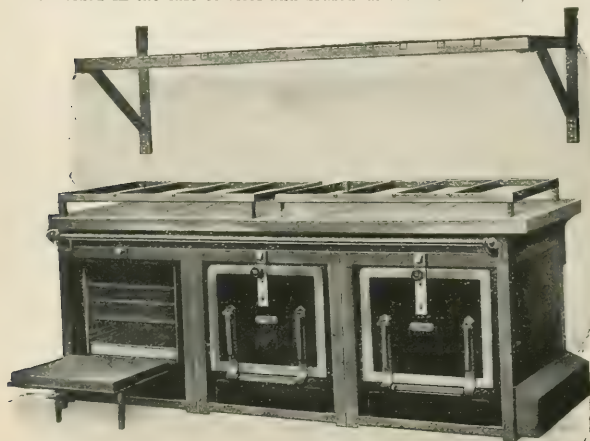


FIG. 7. A "JACKSON" TRIPLE SHIP'S GALLEY RANGE.

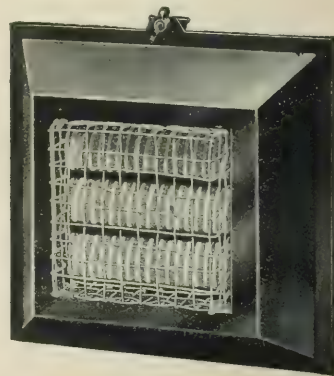


FIG. 8.—VIEW OF CABIN HEATER.
(JACKSON ELECTRIC STOVE CO.)

and the bottoms of these pans are not pierced, so that in the event of their being boiled dry no serious damage is likely to occur. During the war we understand that some 400 cooking ranges and ovens were supplied for use in H.M. Navy, together with a large number of hot cupboards, urns, boiling plates, &c., and it is interesting to note that this apparatus adequately stood the severe conditions of sea service. Since the Armistice Jackson appliances have been supplied for cooking and heating purposes for two boats of the B.I.S.N. Company, and in four municipal housing schemes Jackson electric cookers have been used. At present negotiations are in progress for installing cooking ranges, hot cupboards, steamers, &c., on the G.N. Railway Company's restaurant cars.

We illustrate (Fig. 7) the triple ship's galley range of standard type. This range can be supplied as a single, double, triple, or larger unit. Each oven, being a separate unit, can be readily bolted to another oven when placed in position. The ovens are built of mild steel, adequately packed with heat insulating material. The heating elements are mounted on the sides, being supported upon specially designed frames and fitted behind suitable element guards. Connections are of solid rod supported upon porcelain insulators. Above the ovens is mounted a hob containing the boiling plates, which are rectangular in shape, made of cast iron, and having the top surface machined flat. Eight plates 12 in. by 8 in. are fitted on this range, but the number can be varied to suit requirements. Fiddle bars are fitted above the hob, and, when required, a handrail and pan rack.

Another interesting item exhibited was an electric cabin heater (Fig. 8), the frame of which is made of stainless steel, the loading being arranged to suit requirements. Standard sizes are

material, which quickly attains the same red heat as the element. This heating element is fixed by a simple screwed ring, its centre coinciding with the focus of the parabolic reflector. In this manner the heat is radiated in parallel rays, and complete protection is afforded by a stout wire guard. The reflector is of solid copper, the reflecting surface being highly polished and lacquered, while the back is finished matt black. The reflector is fastened to a pressed steel bracket, finished in black enamel, and fitted with a swivel and trunion movement, which allows adjustability and control of heat rays. An ebonised wood handle is provided for carrying the fire, which is readily portable. The terminals are protected by a round pressed steel guard.

The kettles, which are spun, not pressed, are constructed of best heavy-gauge sheet-copper, and are supplied either in polished copper or nickel-plated finish on copper, being in each case pure tinned inside. The heating elements, of nichrome resistance wound on mica, are firmly secured to the bottom of the kettle by a specially designed stud making a mechanical and water-tight joint, and giving an even distribution of heat. The outer bottom of the kettle is readily detachable, and the elements can be easily replaced in a short space of time. The elements themselves are not connected in series, so that in the event of one element breaking down partial heat is still obtained.

All "Cosmos" domestic appliances are fitted with the standard "Cosmos" sleeve connectors, which are built on sound engineering lines and engage with pin terminals protected by an improved type of metal guard, making them shock-proof. A long coil-spring protects the flexible cable and eliminates strain on the contacts. It is impossible to touch the terminal pins when the connection is in position.

Babcock & Wilcox, Ltd.

A comprehensive display of models of various types of boilers, steam plant and coal-handling plant is shown on this stand. Probably of chief interest to the electrical engineers is the Babcock & Wilcox patent standard hand-type, water tube, steam boiler, fitted with a super-heater and chain-grate stoker. This plant has withstood the test of many years' severe service under widely varying conditions.

The coal strike and consequent coal shortage generally caused attention to be directed to the use of small coal and alternative fuels. In both directions there is apparatus of interest on this stand. Firstly, the Riley Stoker has advantages in connection with the use of very small coal. The riddlings are reduced to a minimum, and the admission ports for air supply are so arranged that the percentage of coal allowed to pass through to the ash-pit is very low. A self-sumping arrangement breaks up the ash and clinkers discharged from the front of the stoker by a combination of circular and reciprocating motions. Secondly, the question of alternative fuels is covered by the exhibit of a pressure-type oil-fuel burner for mounting on the furnace front and working on a forced draught, and by an oil-fuel burner operating with steam as the atomising agent.

British Electric Vehicles, Ltd.

A novelty at this stand was an electric battery loco. of metre gauge, capable of hauling 10 tons on the level. This loco. is suitable for use in works or metalliferous mines, and the model can also be adapted to meet the official requirements for use in coal mines. One charge of the battery gives a journey service of about 20 miles. A 5 000 lb. electric truck, named the "Super-Giant," also attracted interest. It is a soundly constructed piece of apparatus, and the important questions of repair and adjustment have received due attention at the hands of the designer. The wheels, for instance, are detachable without interfering with the roller bearings. W-



FIG. 9.—ELECTRIC LOCOMOTIVE ON CURVE ON GRADIENT OF 1 IN 30 AT GRONDE GLEN, ISLE OF MAN. (BRITISH ELECTRIC VEHICLES LTD.)

illustrate in Fig. 9 an electric railway loco. built by this firm, which is now running at Grondle Glen, Isle of Man, the illustration showing the loco. on a curve with a gradient of 1 in 30.

Boulton & Paul, Ltd.

Pumps and water elevators were the special feature of this firm's exhibit. The Turbo-Chaine-Helin, which is designed to lift 2 000 gallons per hour from a well 300 ft. deep, and will deliver 1 000 gallons per hour against an 80 ft. head, was the most noticeable. The principle involved consists of the revolution of an endless spiral chain, the water being lifted by the rapid movement of the chain. The installation and upkeep charges of a water elevator of this type are remarkably low.

Another interesting exhibit was the "Electrolite" $\frac{1}{2}$ kW dynamo set, driven by paraffin or kerosene, and arranged to start with a small quantity of petrol or light spirit. The set is very compact, and has a self-contained switchboard, which provides for stopping the engine when the batteries are charged or in case of fusing, &c. The plant can also be used as a power unit for belt driving, when the dynamo is cut out of action. Another important feature is that while the batteries are being charged the line voltage of the house lights remains constant, avoiding any risk of burning out the lamps.

Laurence, Scott & Company, Ltd.

An interesting exhibit on this stand was a 4-ton worm-gear electric deck-winch, shown in Fig. 10. It consists of a variable speed reversing motor acting through a silent worm

gear and fitted with specially designed electric control. The speeds at all loads are changed automatically, and are equal to those of steam winches; it is claimed that the winch is

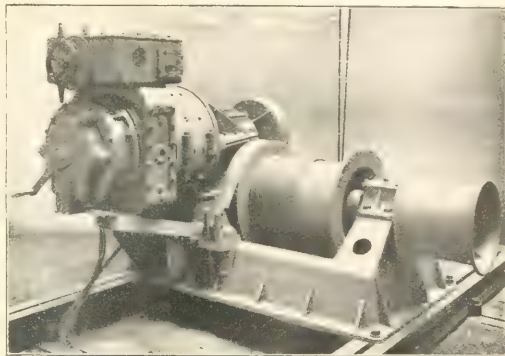


FIG. 10.—A LAURENCE-SCOTT ELECTRIC WINCH.

"fool-, weather-, and rogue-proof." The winch and also an electric steering gear were shown in actual operation. Other features of interest were standard motors for continuous running, automatic starters and regulators, barrel-type starters for engine-room auxiliary machinery, an auto-starter with locked shunt regulator, and master controller, &c.

Siemens Brothers & Company.

The electrical engineer interested in the apparatus required for the electrical control of ships will find much to attract him at this stand in the form of telegraph appliances, loud-speaking telephones, helm indicators, revolution counters, depth and speed indicators, and small wireless sets of the cabin type. On the other hand, there is a most complete set of pyrometric and thermometric appliances, temperature recorders, &c. In addition, a range of Siemens' cables of all types are shown, together with incandescent electric lamps, fittings, heating and cooking appliances, &c. Whilst in the main the appeal is of a marine character, there is much to interest the landlubber, be he a specialist in metallurgy, steam, or a purely electrical enthusiast.

The loud-speaking telephones comprise a system of connections which enables them to be operated by batteries only, and the current used is so small that in the ordinary way a set of Siemens' inert batteries will last twelve months on this service, and, further, the batteries do not deteriorate in stock.

The cabinet type wireless sets are intended for use on small vessels for connecting the ships' mains if available, or a 3 kW d.c. generator can be supplied for the purpose. The transmitter is operated from a 50 V battery of accumulators, which, under Board of Trade rules, must be installed outside the operating or living rooms. The motor generator consists of a d.c. motor driving a 500-cycle $\frac{1}{2}$ kW generator. The excitation circuit comprises four specially insulated glass condensers, an inductance, a quenched spark gap, and an aerial lengthening variometer enabling the wave length emitted to be very accurately adjusted. An aural receiver with contact detector is employed, has a wave-range of from 200 to 2 000 metres, and provides a wide range of variation of coupling, enabling very exact tuning to be made. A valve amplifier set can be fitted if required.

A.I. Manufacturing Company.

A unique and attractive feature of this company's exhibit is that the panels of the fence around their exhibit is made up entirely of a great variety of applications of welding; spot welding, seam welding and butt welding samples have been so ingeniously contrived as to form particularly attractive panels. Special attention is drawn to the butt welding of the angle irons that form the frame of one of these fences. They are exhibiting their No. 2 spot welder, which is especially adapted for light repetition work in the hollow-ware trade, toy and other industries of that character, as it is designed with a view to getting into very awkward places and being operated by young girls at a remarkably high rate of speed. There is a double-face plate enabling the lower arm to be adjusted to a range of positions in relation to the upper arm, and the upper arm itself is provided with an exceptionally long electrode, so that it can be radiused and thrown inwards and outwards to

accommodate any special shaped arm that may be required at the bottom. Two seam-welders are shown, one for doing the longitudinal sides of drums and the other for doing the circumferential welding round the two ends of the drums. These machines are provided with particularly ingenious jigs that hold the drum parts rigid in position, ensuring absolute uniformity of size and perfect results.

Premier Electric Welding Company.

This company, which specialises in electric welding plants, were exhibiting a number of petrol or oil-driven generator sets. The special feature of the design of these plants is that the wasteful use of series resistances in the welding circuit is

50, thus eliminating danger from shock when alternating current is used in shipyards. The weight of the machine is only $3\frac{1}{2}$ cwt. complete.

Parsons Motor Company, Ltd.

Three paraffin-driven electric generating sets were exhibited—one land, one marine, and the third marine auxiliary type. The first two have four-cylinder engines and the latter a two-cylinder engine. Those interested in paraffin and petrol engines for industrial purposes generally would do well to inspect these engines carefully. It should be noted that the firm has now placed on the market an engine suitable for

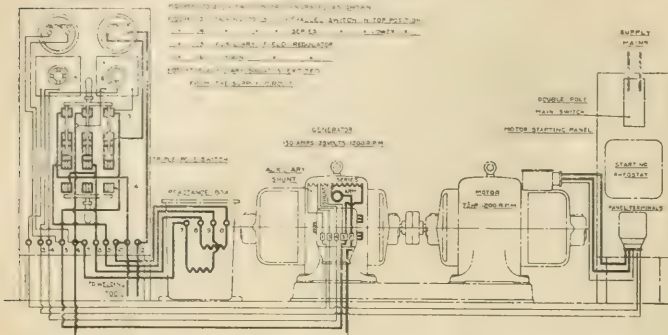


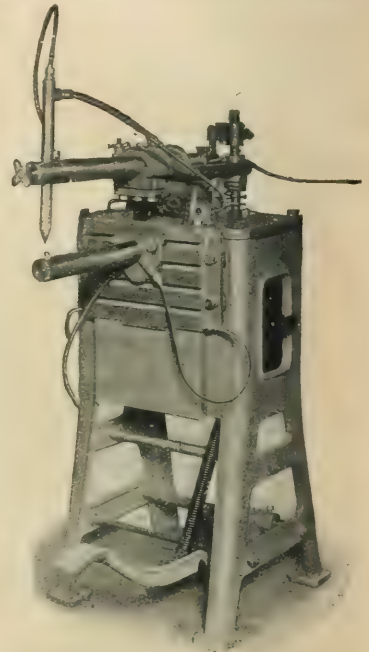
FIG. 11.—GENERAL ARRANGEMENT AND CONNECTION DIAGRAM OF THE PREMIER MOTOR GENERATOR SET WITH PATENT REACTANCE AND SWITCHBOARD FOR ELECTRIC WELDING.

obviated. A diagram of connections for this plant is reproduced in Fig. 11. The machine is fitted with regulators giving various welding speeds, so that graduations suited to a large variety of work may be obtained. The plant is water-cooled and designed to give perfect cooling and efficient results. The hard-drawn copper jaws, which permit of ready and easy replacement, can be made in various shapes according to requirements. The transformer embodied in the machine can be wound to suit any single phase alternating current from 40 to 60 cycles and from 100 to 500 V. In the case of a polyphase supply the machine can be connected up to one phase of the circuit. A view of the latest type of welder is given in Fig. 13.

Allen Welding Processes, Ltd.

This firm, who make a speciality of electric arc welding plant, were showing three new types of equipment. One is a petrol-driven electric arc welding set, absolutely self-contained, claimed to be the lightest and most efficient on the market, which is shown in Fig. 12. The other is a motor generator set, specially designed to meet tramway engineers' requirements. Both sets are enclosed in sheet-metal covers. Water-tight instruments and switchgear are fitted on the ends of the steel enclosures; thus the whole presents a compact and symmetrical appearance, and could be used in the open without any other

FIG. 13.—THE LATEST PREMIER ELECTRIC WELDER.



running on alcohol, alcohol benzol, &c., mixtures. The company's very complete and illustrated catalogue gives full particulars and details as to weights, shipping measurements and everything required by the overseas buyer.

Brecknell, Munro & Rogers, Ltd.

The chief item of attraction at this firm's stand was a working model showing the application of the B. M. and R. automatic trolley reversers. The chief points about these reversers are extreme simplicity, immunity from damage to the trolley head or trolley wire, low first cost, and additional safety for the public and tramcar operatives. There was also exhibited a full range of overhead equipment fittings, current collectors for electric cranes, &c.

The Carron Company.

The Carron Company's wide range of products naturally provide much that interests the enquirer, no matter what particular branch of the profession he specialises in. Electrical men will find that electric cooking and heating on board ship has received due prominence on this stand. Here are to be seen an ordinary electric galley range, which is of strictly marine character, and, in addition, a representative display of Carron electric appliances for use in restaurants, hotels, &c., such as steaming ovens, fish friers, boiling pans, grills, toasters, and a number of patterns of electric fires.

W. & T. Avery, Ltd.

This firm's exhibits will arouse interest in those concerned with the mechanical testing of materials. Among the smaller machines is a new type of crankshaft balancing machine, which has several points of interest. Their patent connecting rod-balancing machine has been improved with the idea of getting

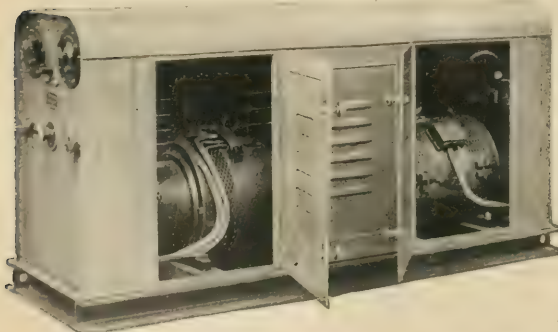


FIG. 12.—THE A. W. P. MOTOR GENERATOR ARC WELDING PLANT

covering. A new type of arc welding plant was also on view, the special advantage of which is that the voltage used is only

quicker operation, and an example of the latest design is being shown. Examples of their well-known "Izod" impact testing machine and their lever type Brinell hardness tester were also on view. As regards the Brinell test, the firm are showing a new apparatus in the form of a special calibration level, which can be applied to most Brinell machines for proving their accuracy. The need for checking the accuracy of Brinell machines generally is appreciated by most engineers, but hitherto there has not been apparatus which will apply a dead load test.

J. G. Statler & Company.

Messrs J. G. Statler & Company are exhibiting a 100 kW Westminster Transformer having a ratio of 10 000 V to 400 V. The transformer is shown out of its tank, thus facilitating the inspection of all coils, connections and insulation. The general design and workmanship are worthy of the attention of those readers who visit the exhibition.

The London Electric Firm.

The London Electric Firm's interesting display of search-lights and projectors attracted a large amount of attention,

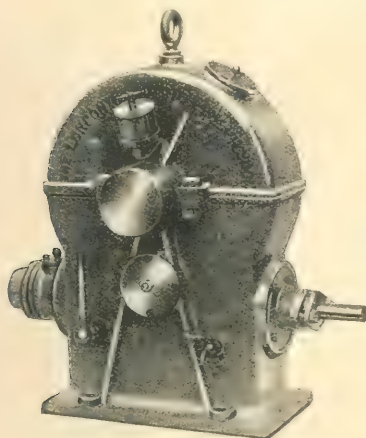


FIG. 14.—TYPICAL LONDON ELECTRIC FIRM
WORM REDUCTION GEAR.

but, in addition, we noticed a range of flexible couplings and a compact worm reduction gear. The latter is a totally enclosed gear, mounted in a cast-iron casing and running in an oil bath, Fig 14. The Electric Heating Company, of Croydon, were showing on the same stand a full range of electric irons and kettles.

The Record Engineering Company, Ltd.

In addition to paraffin and petrol engines, this firm are showing complete electric lighting sets for land and marine use. An interesting fitting to these engines is the S.A. Impulse starter, which obviates the use of accumulators. In this apparatus the magneto armature is temporarily arrested by the action of pulling a pawl into engagement with the armature plate, which is attached to the armature spindle. The action of arresting the rotation of the armature causes a spiral spring inside the starter to be wound up, as a result energy is stored in the spring until such time as a cam disengages the pawl from the armature plate. When this disengagement has occurred the spring imparts a rapid impulse to the magneto armature equivalent to revolving the armature at 500 revs. per min., thus producing the required spark in the cylinder. The spiral spring is so arranged that after the impulse has taken place the armature plate and cam casing are spring-locked, so that the ordinary timing of the magneto is maintained and the starting device functions purely in the manner of an ordinary coupling. Immediately the engine revolves under its own power, the pawl is thrown out of operation, and it is impossible for the impulse starter to come into operation once the engine is running.

Johnson & Beekwith.

The main item of interest on this stand is the "Cornhill" potato washing and peeling machine, which is electrically driven and capable of peeling 15 lb. of potatoes in less than a

minute. All the vital parts are built above the body of the machine, thus securing absolute freedom from water and dirt. Among other exhibits are the "Saxon" grinding outfit and the "Coburn" system of overhead runway.

Automatic & Electric Furnaces, Ltd.

Those interested in steel-hardening processes, particularly in relation to small tools, dies, &c., would be well advised to devote time to inspect the furnaces exhibited by this firm. All these furnaces are practically automatic in action, the Wild-Barfield indicator showing the exact moment when the furnace charge reaches its critical temperature. A special safety device has been introduced, and by means of this device current is immediately cut off should a temperature be reached which is liable to injure the windings of the furnace.

The "Hotpoint" Electric Appliances.

A complete range of these well-known appliances was shown, including both the lighter articles, such as irons, toasters, coffee percolators, &c., and also a dishwasher and clothes-washer.

Miscellaneous Exhibits.

Among other exhibits of interest to the electrical engineer were the following:—Benn Brothers, Ltd. (technical publications); Leeds Electrical Construction Co., Ltd. (rivet heaters and electric furnaces); Ozonair, Ltd. (ventilating and deodorising appliances); De Laval Steam Turbine Co. (power plant); Evershed & Vignoles, Ltd. (electrical instruments, ships' indicators, revolution counters, &c.); Telephone Mfg. Company, Ltd. (intercommunicating telephones); Clark, Chapman, & Company, Ltd. (pumps); Edison Accumulators (secondary batteries); Vickers-Petters, Ltd. (marine semi-Diesel engines, electric lighting sets, &c.); Aster Engineering Company, Ltd. (petrol-electric generating sets); Yorkshire Copper Works, Ltd. (tubes); Campbell & Isherwood (switchboards, generating sets, motors, &c.).

The Trolley Omnibus in America.

An experiment is being made in Richmond (Virginia), a town that claims to be the first to employ the overhead trolley system of traction, in the use of a new kind of vehicle termed the "trollibus." According to the "Electric Railway Journal," for about a mile of route along Floyd avenue a negative wire has been installed, so that the "bus" really supplements the rail service on that part of the route. Among the reasons for supplementing the car service was the demonstration of the ease with which the railless vehicle could manoeuvre in traffic as well as to compare its cost of operation and popularity with other transportation methods. The "trollibus" resembles the one-man prepayment car, as each has the same seating capacity, combines several of the good features of light-weight body construction, electric motor drive, mechanical door control, and prepayment fare collection with the flexibility of the automobile chassis, and, to some extent, the mobility of the self-propelled vehicle. By its means the railway company hopes to be able to combat free-lance competition with a minimum of investment and cost of operation.

Since there are no rails to complete the electric circuit, two overhead wires are used. Cushion wheels are used exclusively. On these wheels are mounted solid rubber tyres of the caterpillar type. Power is furnished by a standard ball-bearing ventilated railway motor, a type largely used for driving safety cars. The motor is so supported between the side frames that it can be directly connected to the propeller shaft in the same manner as an automobile gear drive-shaft is connected. By pressing on the pedal lever, which is mounted in all respects similar to the motor-car clutch foot-pedal, the driver can actuate the controller point by point by alternately applying and releasing the pressure.

Power is taken from the two overhead wires by a specially designed collector, which has two sliding shoes. The operator can manoeuvre this collecting mechanism from inside the "trollibus." A vertical wheel which actuates a lever operates against the tension spring and makes it possible when one "bus" vehicle passes another, utilising the same trolley-wires, to clear the line and allow one "bus" to proceed. Afterwards the current collector can be replaced on the wire and the trollibus proceed on its run. When necessary or desirable, as on returning to the car house at night or for repairs, it can be made to operate on a standard 800 V trolley circuit. A short-circuiting sliding-contact trolley shoe is inserted in the collector, which provides the positive side of the circuit. To get an earth or complete the circuit a metal shoe is fastened to the body frame and dragged along the top of the earthed track rail. By this means it has been found possible to operate the vehicle at a speed of eight or nine miles per hour.

By order of court, dated Sept. 8, Mr. H. S. Mackay, of 4-6, Copthall-avenue, E.C., has been appointed receiver of all the rights of the ELECTROLYTIC COPPER COMPANY, LTD., under an agreement, dated Nov. 24, 1915, with the Mackay Copper Process Company, and in the patents and applications for patents mentioned therein. The Electrolytic Copper Company, Ltd., is incorporated in Guernsey.

The Negatron.*

By JOHN SCOTT-FAGGART.

Introduction.

The first negative resistance vacuum tube, in 1919, was the "divided anode" tube, known as the "divided anode" tube. Since that time the art has been steadily improving, and the "divided anode" tube has been replaced by the "negatron" tube. The negatron tube is a vacuum tube which contains a filament, two anodes, and a control electrode.

The negatron tube has been shown to possess a small negative resistance, which is sufficient to produce a high frequency oscillation. These are the two main uses of the negatron tube. The negatron tube is also used in the production of continuous oscillations for use in wireless transmission or reception by the beat method.



FIG. 1. Negatron Valve.

The negatron tube has a negative resistance of the ordinary kind, and it is possible to produce signals of all kinds to be greatly amplified, and makes it possible to cut down the resistance of long stretches of telegraph cable. The other use of a negative resistance valve, however, is in the production of continuous oscillations for use in wireless transmission or reception by the beat method.

The Negatron.

The principle on which this device works is briefly as follows: A thermionic valve is arranged with two flat anodes one on each side of a filament. Each anode is connected through an anode circuit to the filament so that the electrons emitted by the incandescent filament are distributed equally between the two anodes. A control electrode, e.g., a flat grid, is also arranged within the valve between the filament and one of the anodes. This latter anode will be called the "diversion anode," while the first one will be called the "main anode." By suitably arranging the relationship between the electron emission and the anode voltages, we have obtained a saturation effect. When the main anode voltage is increased the grid potential is increased, electrons are diverted from the main anode and the anode current decreases. Hence the negative resistance effect.

Theory of the Action.

Fig. 1 illustrates the negatron valve. Its action will be best understood from Fig. 2, which shows negative resistance character lines. Between the anode A and the filament F is a battery H, and two terminals I, J. A cathode ray tube can be connected. The anode is connected through a battery B to the grid G. This circuit keeps the grid at a suitable potential, probably slightly

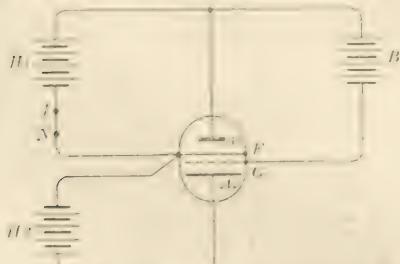


FIG. 2. Circuit Diagram of the Negatron Valve.

negative. Between F and the diversion anode A is a second battery H. Both H₁ and H₂ are usually of about 60 volts, but their values are not very important provided that the current supplied to the filament F may be adjusted to produce the saturation effect. Now if we increase the voltage of H₂, we should normally expect the current to A₁ to increase, but as the potential of A₁ increases so does that of the grid G. Since G becomes more positive

the current to A₁ will increase. The electrons which go to A₁ must come from those which would have gone to the anode A₂. There is, therefore, a diversion of electrons. If the A₁ anode current increases the A₂ anode current must decrease, and conversely. This effect is conditional on the existence of saturation in the valve. There are two effects which govern the A₁ anode current. The increase in the A₁ anode potential tends to increase the A₁ anode current; the diversion effect, however, tends to decrease the A₁ anode current. But the dominant effect is to increase the A₁ anode current. Thus the negatron acts as a negative resistance.

Characteristic Curves of the Negatron.

The above explanation is borne out by characteristic curves obtained with the negatron, three of which curves are shown in Fig. 3. The curves bring out clearly the "robbing" action which the negatron utilises. The top curve shows that the negative resistance effect is obtained while the valve is saturated. The curve is only

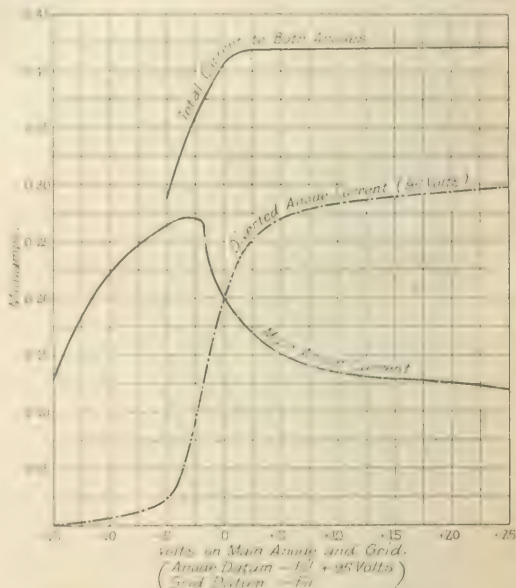


FIG. 3. CHARACTERISTIC CURVES OF A NEGATRON VALVE.

used along its downward sloping portion and oscillations will only be produced when the main anode and grid potentials are at suitable values. In practice, the grid potential is usually slightly negative and no grid voltage adjustment is necessary.

Applications of the Negatron.

The main use of the device is as a generator of continuous oscillations for the transmission or reception of continuous waves. It may be used for receiving spark signals by reducing the effect of positive resistance. As a local oscillator it is exceedingly convenient as it will oscillate on all ranges from 600 m. to 20,000 m. (the usual commercial range) without any complicated switching arrangements. The circuit arrangements are the same as those in Fig. 2, except that the two batteries are replaced by a single one H of about 60 volts. The main anode is connected through a leaky grid condenser to the grid G, a resistance R₁ being connected across grid and filament. This leaky grid condenser merely replaces the battery for the purpose of avoiding a high positive grid potential. The filament F is heated by current from the 6 V accumulator through a rheostat of about 70 resistance, which is adjusted until continuous oscillations are produced. The diversion anode circuit plays no part other in the circuit than as a path round which electrons are shunted. The A₂ anode current produces no effect whatever on the oscillatory circuit.

In the original Paper the author demonstrates by means of curves that the negatron only oscillates over a given range of filament current. The negative resistance effect disappears completely when the filament current is above 0.575 A. Likewise, it disappears for another reason when the filament current is very small.

*Abstract of a Paper on "The Negatron: A New Negative Resistance Tube for Use in Wireless Communication," read before Section G of the British Association at Edinburgh, September, 1921.

Reviews.

Principles of Radio Communication. By J. H. MORE (ROFT, assisted by A. PINTO, and W. A. CUREY. (London: Chapman & Hall, Ltd.) Pp. x.+935.

The publication of an advanced text-book on general wireless telegraphy is opportune. Whilst many first-class books have recently been published dealing with the thermionic valve, and particular systems, very little has appeared regarding general progress in other branches of radio-telegraphy during the years of the war, such as arc work, problems of radio-transmission, &c. If we consider what may be regarded as "standard" text-books, we find only two first-class books, one English and one German, both biased in different directions and both originally published long before the war. Although periodically revised, they still contain a great deal of data which time has shown to be unimportant, and they lack the extensive revision necessitated by present-day practice.

The present book will undoubtedly take its place as the most modern "standard" general text-book, and as such, it is an extensive summary of modern papers, some of which, such as those from the proceedings of the American Institute of Radio Engineers, are not easily available to the average wireless reader. Others, such as those from "Die Jahrbuch der drahtlose Telegraphie" are only available to engineers able to read German.

Unlike most wireless books, it is quite impartial and does not consist merely of a biased description of one particular system. Dealing with the work in detail, the first chapter is an extensive one of 110 pages, and comprises a very complete treatment of general electrical theory leading up to problems of resonance with coupled circuits. The second chapter deals with considerations of resistance, inductance and capacities with reference to high frequency technology, and has a place in a book of this nature, although of minor importance, in practice. The third chapter, entitled: "General View of Radio Communication" falls short of the general high standard of the book, unless read in conjunction with Chap. IX. on "Antenne and Radiation," and both chapters might well have been extended to include the large amount of work on wireless propagation to be found in Vol. XII. of the German "Jahrbuch." The book also lacks complete references and bibliography, for example, the natural wave-lengths of various aerial types given on p. 760, are undoubtedly those determined by Miessner, as given on p. 270, Vol. XIV. of the "Jahrbuch," and it would have added to the usefulness of the book if a reference had been given instead of "it has been found," since other technologists may differ from this data. Chap. IV. on the "Laws of Oscillating Circuits" is good. On p. 298 the author's statement that oil condensers are not much used in general practice is erroneous, and on p. 314, the statement that the quench-spark gap requires for its action the formation of an oxide on the electrodes, is entirely wrong, as is his statement that the spark takes place in an air-tight chamber (this being only approximately the case in practice). Silver-faced electrodes are mostly employed in practice and not copper electrodes, such as the author describes. The silver electrodes always retain their oxide, which does not disappear on a further working as the author states is the case with copper electrodes. Chap. V. on "Spark Telegraphy," does not require further comment, except to state that it is well done. Chap. VI. on "Vacuum Tubes" is in general very good, but the author's hydrostatic analogy of the thermionic valve is not very helpful, whilst his analogy of the action of the valve as an oscillator to a violin string and bow, is one of the most helpful the reviewer has met. This chapter is one of the best present-day treatments of valves yet written, and whilst somewhat overlaid with ordinary characteristic curves, has a great many useful diagrams. An omission is the treatment of the effect of phase to valve circuits giving rise to a phenomenon called by the Germans the "Ziehen" effect, which in practice gives rise to great irregularities, and which has been recently

extensively treated mathematically by Möller and others. The chapter on "Continuous Wave Telegraphy" is good, and contains much recent information, but possibly the modern static high-frequency generator of the Arco type, which is being more and more applied abroad for high-power stations, could profitably have been more extensively treated than the older Alexanderson machine, which owing to its limitations has been less extensively used for long distance work. The Marconi multi-gap continuous-wave method is somewhat scantily treated, possibly owing to the author's remark that this not used to any great extent.

The author's efficiencies of various C.W. generators on p. 619 are much higher than those usually given, and in the case of the static frequency charger the efficiency of 86 per cent. for a 28 kW transformer, presumably relates to Taylor's tripler, which has not been applied to practical transmission when circuit losses would probably reduce.

The chapter on "Radio-Telephony" is extensive, and compares well with the usual "stepmotherly" treatment of this subject. Alexanderson's modulation method is well done, but the Kuhn control system, which has been extensively used in actual practice is omitted. The Heising method of modulation on p. 664 is not unknown to the British Air Force under the title of "choke-coil control." Chap. X. on "Wavemeters and their use," is of practical value and very extensive.

The numerous line drawings are excellently produced, but the half-tones are few, and in general poor.

The above criticisms refer to points of only secondary importance and are not intended to detract from the undoubted value of this volume, which can be strongly recommended to all those wishing to possess a well-written, comprehensive, up-to-date text-book of radio-telegraphy.

B. J. L.

Shorter Reviews.

Tidal Power. By A. M. A. STRUBEN, O.B.E., A.M. Inst. C.E. (London: Sir Isaac Pitman & Sons, Ltd.) Pp. xii.+115. 2s. 6d. net.

In this little book the author indicates some of the possibilities opened up by the use of tidal power, the various difficulties which have to be faced, some possible systems of development, and the further research work that appears necessary. As he points out, the subject cannot be dealt with exhaustively in a small primer, but he aims at stimulating interest in a subject which is likely to attract a considerable amount of attention in the near future. He certainly ought to succeed in this aim, for he has presented the main outlines of the subject simply and attractively, and we can recommend the book to all who wish to be acquainted with the general outlines of the subject.

In addition to chapters on Tides, Measurements, Potential Tidal Power, Systems and Preparation of Projects, the author also deals with the financial side. May we point out an error—a misprint—at the foot of page 17, where kilowatt-hours are given as the product of *area* and *head of water* in *feet*. For "acre-feet" should be read "acre-feet per hour."

Power Factor Correction. By A. E. CLAYTON, B.Sc., A.K.C., A.M.I.E.E. (London: Sir Isaac Pitman & Sons, Ltd.) Pp. xi.+108. 2s. 6d. net.

This book should appeal to all those who have been in doubt about the evils of low-power factors and the methods of power factor correction. We quite agree with the author when he says that "the importance of maintaining the power factor of alternating current systems at as high a value as possible is now so generally realised by electrical engineers that no apology is needed for the appearance of this little book." Mr. Clayton has dealt with the fundamental principles of the subject in a pleasing way. He has assumed on the one hand that his reader has intelligence and can appreciate arguments, and on the other hand that he would not be reading the book if he already knew all about power factor correction. It is not every author who can successfully write a book based on both assumptions.

The book deals briefly with causes affecting power factor, improvement of power factor, static condensers for power factor correction. It is not every author who can successfully write motors, and a comparison of the methods of correction.

Correspondence.

THE "FORBE" AS AN ELECTRICAL UNIT.

To the Editor of THE ELECTRICIAN.

SIR: IN THE ELECTRICIAN of September 9th Capt. P. Dunsheath proposes for the unit of thermal resistance the title "Forbe," in honour of one of the early workers on the problem of current-conducting capacity of wires.

I am far from intending to diminish Forbes' merits in this special field, but as this quantity is used by a very great number of workers in other branches of technical science and natural philosophy, who are not as familiar with the name of Forbes as we electricians, I think it would more likely meet with the general consent of engineers and scientists if this unit were called the "Newton," after the great genius, who was the very first to establish the law of transmission of heat as expressed by this unit.

The parallelism between Ohm's law and Newton's law, which is so useful for the understanding of both, would be emphasised better by adopting the title "Newton" for a thermal unit, which is analogous to the electrical unit named "Ohm."

I feel sure technical science would be proud indeed to include Newton's name in its nomenclature. I may venture perhaps to say that it constitutes a neglect not to have done so before. I am, &c.,

Budapest, September 13th.

L. STARK.

A QUESTION OF NOMENCLATURE—"WIRED RADIO."

To the Editor of THE ELECTRICIAN.

SIR: With reference to the discussion which took place a short time ago in the correspondence columns of THE ELECTRICIAN, it may be of interest to your readers to know that this subject of nomenclature came up for consideration at the meetings of the Provisional Technical Committee of the International Conference on Electrical Communication which were held in Paris from June 23rd to August 23rd.

A special sub-committee was appointed to consider and report on nomenclature on subjects relating to the work of the conference. Many subjects were considered, among them "Wired Radio," over which there was considerable debate in the selection of a suitable name. Various names were proposed, but after consideration most of them were found unsuitable. The debate finally resolved itself into the choice between the following two names: "High-frequency Telegraphy and Telephony" and "Line Radio." The American delegates strongly supported the adoption of the name "Line Radio," while the delegates of the other countries favoured the term "High-frequency Telegraphy and Telephony," principally because it was already in general use in their respective countries.

In the report of the sub-committee the following statement is made in regard to this subject:

The International Provisional Technical Committee decided to prepare the following list of French and English terms, which, although, belonging, strictly speaking, to the province of the International Electrotechnical Commission, yet seemed necessary at this time in order to classify and systematise the committee's own proceedings.

It is the desire of this committee that this table should be brought to the attention of the International Electrotechnical Commission at its next meeting for information as that body sees fit.

In regard to "Wired Wireless," the representatives of France, Great Britain, and Italy state that the terms "High-frequency Telegraphy" and "High-frequency Telephony" have already been adopted in their respective countries. The Japanese representatives were also in favour of these terms, although other terms were also used in Japan. The American delegation was stated to favour the term "Line Radio."

This question will surely come up again for discussion at the next conference of the International Electrotechnical Commission. It would be, therefore, very desirable to have at this time a full expression of opinion

on the choice of a name for this new art from engineers associated with the development of it.

Prof. Mailloux, President of the International Electrotechnical Commission, who happened to be in Paris during the conference, was good enough to attend the meetings of the nomenclature sub-committee and actively to participate in its deliberations. Prof. Mailloux strongly urged the adoption of the term "Line Radio." He took the view of the American delegates that the term "Radio" has assumed a wider significance than that of simply denoting radiation properties.

The term "Radio" is now applied to methods and apparatus associated with the use of alternating currents of a large range of frequencies irrespective of the radiation characteristics of the system. We generally speak now of radio instruments, such as radio transformers, radio condensers, &c., without any regard to the system in which they are employed. It was the opinion of the American delegates that the term "Line Radio" adequately described the Squier system of telegraphy and telephony. It was also argued that since the frequencies employed in line radio range from 5 000 to 500 000, the term high frequency as applied to this system is rather ill-defined, and for that reason not well adapted. I am, &c.,

Lausanne, September 10th.

LOUIS COHEN.

THE RECORDING ULTRAMICROMETER.

To the Editor of THE ELECTRICIAN.

SIR: In your issue of September 16th you give an account of my demonstration of a recording ultramicroscope at the British Association, Edinburgh. I should like to thank you for the very full account you give, but perhaps you will allow me to point out one or two slight inaccuracies, probably due to the rather condensed account I was able to give in the brief time allotted.

(1) The general principle of the instrument is new, being based on the employment of a galvanometer in the anode circuit. I gather the writer of the report had in mind the variation of capacity of the condenser. This is, of course, also used by Whiddington.

(2) Whiddington's heterodyne method is not more sensitive. In the "Philosophical Magazine" of last November he gives his results. The smallest result he obtained with certainty was a displacement of 10^{-8} cms., but he states that a sensitiveness of 100 times that amount could be obtained without much difficulty. For rough work his apparatus is apparently capable of measuring 10^{-6} cm.

My apparatus under ordinary conditions, without special precautions and using a moderately sensitive galvanometer (10^{-8} amp. per division), will usually measure 10^{-8} cm. displacement, and I have occasionally obtained ten times this sensitiveness. By using a more sensitive galvanometer (10^{-10} amp. per division) the apparatus was still quite stable in action, and was, of course, 100 times more sensitive.

(3) As appears from the theory given in "Engineering" (September 9th), my apparatus has a constant sensitivity over a large range of displacement.

I do not wish to enter into any discussion as to the general merits of my apparatus, pending the publication of a full account of the work, but you will understand my anxiety to contradict any mis-statement in regard to it. I am, &c.,

JOHN J. DOWLING.

Dublin, September 20th.

P.S.—The sensitiveness of the Edinburgh apparatus was 10^{-7} cms. It was kept low to facilitate demonstration under unfavourable conditions.

It is reported from MOUNTMARY, MOUNTBELLEW, that a copper, coal, and iron mine has just been discovered, or re-discovered, in the locality known as the "Coal-pits," where many years ago coal was raised by the Royal Sappers for some local purpose. It is known that an iron foundry once existed in the neighbourhood, though there are no traces of it now. Local residents have taken the matter up with a view towards asking the Irish Industrial Research Committee to inquire into it.

The Mazda Window Display.

We give below (Fig. 1) an illustration of an attractive "Mazda" window display which the BRITISH THOMSON-HOUSTON COMPANY have purchased and are supplying to a limited number of contractors and dealers. The display has been designed not merely to advertise



FIG. 1. A TYPICAL "MAZDA" WINDOW DISPLAY.

Mazda lamps in the most effective manner, but also to permit of rapid installation in any size window.

The display can be erected in a few minutes, and it is not necessary for the window to be cleared for its reception. It consists of a number of separate articles, which may be arranged according to taste, and includes one papier-mâché model, 2 ft. high, one three-sided cardboard screen printed in three colours, six pyramidal lamp-stands, two Mazda revolving lampshades, and two mounted showcards, one reproduced from a humorous drawing by Heath Robinson (Fig. 2) and the other a symbolic design by Septimus

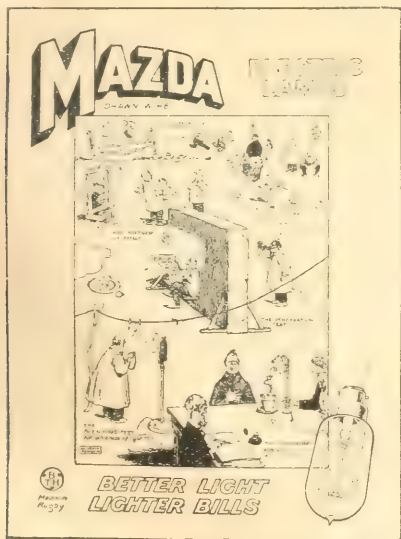


FIG. 2. HEATH ROBINSON ON "MAZDA" LAMPS.

Scott. The general colour scheme is harmonious, Wedgwood blue and orange chrome predominating.

It will be seen from the illustration of the showcard, designed by Mr. Heath Robinson, that the artist's ideas on the subject of

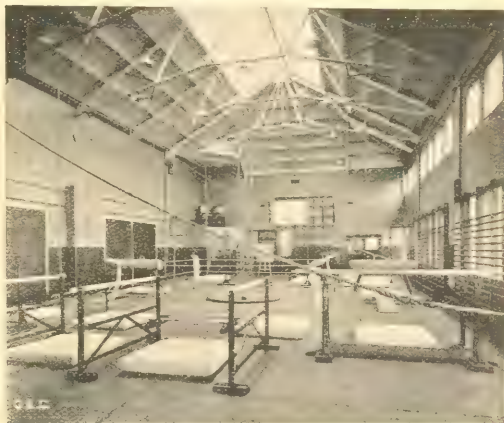
testing a Mazda lamp are not quite in accordance with the actual methods practised by the manufacturers, but they are certainly much more amusing. Mr. Heath Robinson, for example, envisages the durability test as a horticultural affair, allied in some mysterious fashion with the artificial ripening of gooseberries. He also depicts the appropriate tests for other Mazda qualities. There is the vibration test—a most energetic business; the test for softness of effect, in which a human face, subjected to the beneficent rays of a Mazda lamp, assumes an expression of almost buttery softness; the penetration test, which proves that stone walls are no more impervious to Mazda light than to the indomitable spirits of incarcerated heroes. The pleasantries of Heath Robinson stick in the mind, and no one who has chuckled his way from the top left-hand corner to the bottom right-hand corner of this showcard will forget those ecstatic moments of Mazda merriment. Both the showcards are lithographed in twelve colours, mounted on stiff boards, and provided with cords for hanging. They measure 15½ in. by 11 in.

A limited number of these displays are available for distribution to dealers who stock Mazda lamps. The displays are lent for a fortnight and must then be returned to the company. Further information on this matter may be obtained from the Advertising Department of the British Thomson-Houston Company, 77, Upper Thames-street, E.C. 4, or from the company's nearest branch office.

Plaistow Red Triangle Club.

Of the countless local war memorial schemes in all parts of the kingdom, none is happier in conception than the Red Triangle Club in Greengate-street, Plaistow.

The scheme was initiated by a small party of Y.M.C.A. workers in Plaistow, but the great shipping companies gave whole-hearted and substantial support, the success of the scheme being due in no small measure to Mr. J. H. Silley, O.B.E. (Messrs. Green, Silley and Weir), the hon. treasurer of the building fund. The building is a handsome structure of reinforced concrete. Separate accommodation for both sexes and all ages is provided, with an arrangement whereby men and women have the common use of certain rooms, such as the restaurant, general lounge, cinema hall, and public billiard hall, on the ground floor. The first floor is reserved for use as a men's club, while the two upper floors are devoted to boys' work and girls' work, with educational, recreative, and physical culture sections. The central hall, on the ground floor, can be used in connection with any department, or can be let without inter-



VIEW IN THE GYMNASIUM OF THE PLAISTOW CLUB.

fering with any of the club's activities, and the gymnasium and swimming bath can also be made available for all departments.

The equipment throughout has been planned on the most modern and comfortable lines. The electric light installation was designed by the illuminating engineering department of the GENERAL ELECTRIC COMPANY. The semi-indirect system has been largely adopted for clubrooms, lounges, and halls. Simple yet substantial bowl fittings, manufactured by the G.E.C., are used, and are provided with "Superlux" diffusing glassware. "Superlux" is a white-cased glass, with a special matt or "eggshell" finish, and combines excellent reflecting and diffusing characteristics with a very low absorption of light. The lighting of the swimming bath and gymnasium is by means of direct-type steel reflector fittings of white vitreous enamelled steel. They are mounted at carefully calculated spacing and heights, so that a practically uniform illumination of 3½ foot-candles results. Osram vacuum and gas-filled lamps have been fitted throughout. The installation was carried out in a very workmanlike manner by Messrs. Coleby and Co.

We are indebted to the National Council of the Y.M.C.A. for permission to publish this account and to reproduce the illustration of the gymnasium lighting arrangements.

Safeguarding of Industries Act.

In accordance with section 7 of the SAFEGUARDING OF INDUSTRIES ACT, the President of the Board of Trade has appointed the following gentlemen to be members of the permanent panel from which committees, consisting of five persons, will be selected from time to time to consider and report upon complaints referred to them by the Board under Part II. (Prevention of Dumping) of the Act:—Sir W. M. Acworth, Mr. J. Arthur Aston, Sir William Ashley, Mr. Arthur Balfour, Sir George S. Barnes, Sir John N. Barran, Bart., Mr. J. T. Brownlie, Sir Cecil L. Budd, Sir James C. Calder, Dr. J. H. Clapham, Mr. T. P. Cook, Mr. F. R. Davenport, Mr. A. K. Davies, Mr. F. P. Dorizzi, Mr. Rayner Goddard, Sir E. C. K. Gonner, Sir George R. Lowndes, Prof. D. H. Macgregor, Mr. Stanley Machin, Mr. G. A. Moore, Mr. J. W. Murray, Sir Douglas Newton, Mr. Owen Parker, Mr. R. G. Perry, Mr. Arthur Pugh, Sir R. Henry Rew, Mr. C. A. Russell, Mr. Arthur Shaw, Sir Charles Stewart, Sir Edwin F. Stockton, Mr. H. L. Symonds, Mr. Gilbert C. Yule, Sir Frank Warner.

The Schedules.

A list issued by the Board of Trade shows that the following are among the articles affected by classes set out in the schedule to the Act. These articles will be subject to a duty of 33½ per cent. *ad valorem*, upon importation into this country on or after October 1 next:

Lenses, magnifiers, parabolic reflectors, polarisers, optical photometers, and other optical instruments, electrolysis tubes, X-ray tubes, and other scientific glassware, laboratory porcelain, including Bunsen burners, crucibles, mercury pumps and troughs, &c., scientific instruments, including ammeters, calorimeters, electro-dynamometers, electrometers, electroscopes, fluxmeters, frequency recorders, galvanometers, galvanoscopes, hysteresis testers, induction coils, electric influence machines, electrical laboratory furnaces, magnetometers, milliamperemeters, voltmeters, millivoltmeters, voltmeters, micrometers, ohmmeters, wattmeters, oscillographs, oscilloscopes, permeameters, physical lecture and experimental apparatus, potentiometers, electrical pyrometers, vacuum pumps, slide rules, fluorescent screens, insulation and conductivity testing sets, thermo-couples, thermostats, and X-ray apparatus, gauges and measuring instruments of precision used in machine shops, compounds of thorium, cerium, and the other rare earth metals.

In addition there is a list, covering 57 pages, of chemicals subject to the 33½ per cent. duty. Of the items in this list, those marked "D" come within the scope of the Safeguarding of Industries Act only when their importation has been permitted for purposes other than those in which the Dyestuffs Act is concerned, and those marked "R" where crude product is not included within the provisions of the measure.

The list can be obtained from H.M. Stationery Office, Kingsway, London, W.C. 2, price 9d.

Under the general headings of lamp, blown ware, wireless valves, and similar rectifiers, and vacuum tubes, magnetos and permanent magnets, arc lamp carbons, metallic tungsten, ferro tungsten, and manufactured products of metallic tungsten, lists of specific articles have not yet been issued.

Members of the London Chamber of Commerce met on Tuesday and formed a committee to watch and if necessary, oppose every demand to schedule a particular class of imports as contravening the provisions of the Act, and therefore liable to the duty of 33½ per cent.

A Floating Exhibition.

In our issue of Sept. 9 we gave some particulars of the objects of the British Trade Ship, Ltd., the names of some of the directors, and other information regarding the project. On the 15th inst. Earl Grey, the chairman, presided at a luncheon at the Shipbuilding, Engineering, and Machinery Exhibition to the Press and other guests.

EARL GREY said it was intended that the exhibition ship, to be named the "British Industry," should start from London in August, 1923, and visit ports in various parts of the world. In the majority of cases in the East the great ports were also the great trading centres. It was believed that the ship would be able to do a real service to British and colonial trade. The promoters considered that if the ship sailed sooner it would be of less advantage than the date that had been selected. He could not believe in any quick revival of trade in this or any other country being a genuine revival, though we might have a fictitious boom in the autumn. He thought in two years' time we should be ready to launch out into long commitments, because then our manufacturers would be in a stronger position than any of our European competitors, who would have to contend with greater difficulties than we would have to face. The British manufacturer was equal to any opportunity that came his way, owing to our greater financial stability. He believed we should secure a greater predominance in the future than we had had in the past. The promoters had so much support that the success of the ship was assured.

Commander RODERICK W. DAY, R.N.R., said in 1918 Mr. E. Hill and he discussed the question of sending a ship round the world with trade representatives. With ships constructed in the usual manner the representatives and the samples could not be accommodated in one vessel, but that difficulty would be overcome in the "British Industry." The war had given this country its opportunity, and he believed that after the whole world had been out of trade for eight

years they would do well to follow the example of their grandfathers and take the flag round in the trade ship.

SIR GEO. HUNTER said that this country was not getting its share of the orders of the world, and we all felt the need of a great revival in our manufactures and trade. We must do everything possible to shorten the period of depression, and more important than even the British trade ship was the necessity of reducing our costs. It was intended by means of the British trade ship to assist in restoring prosperity and bringing in orders which would provide employment for our people.

EARL GREY, replying to a question, said they would have every assistance from the British Consuls. They did not, however, want to be run by Government departments. They wanted to get the support of the trade, and when they had that they could command the support of the Government.

Electricity in Mining.

In order to clear up certain doubts as to the interpretation of some of the general regulations as to the installation and use of ELECTRICITY IN COAL MINES, a conference was recently held between the switchgear section of the B.E.A.M.A. and Mr. J. A. B. Horsley, H.M. Electrical Inspector of Mines, in regard to the rules governing the construction and use of switchboards in mines. Dr. Giffard, chairman of the Switchgear Technical Committee, being in the chair. As some of the matters for discussion also had their counterpart in factory switchboards, H.M. Electrical Inspector of Factories, Mr. G. Scott Ram, was also invited to attend.

After Mr. Ram had explained the bearing of the factory regulations on the points in question, Mr. Horsley dealt with the requirements of the Mines Rules, and called attention to the information contained in "Mines and Quarries, Form No. 11," which contains the electricity regulations and the revised official memorandum thereon.

After discussion, it was agreed to place on record the following views:—

- (1) *Isolation of circuit breakers for cleaning or repairs.* In colliery surface switchboards, when a switchboard circuit, comprising air-break circuit breakers or contactors, cannot be shut down regularly, say, once a week, exclusive of Sundays, to permit of cleaning and adjustment being carried out with safety, means must be provided for isolating such circuit breakers or contactors.
- (2) *Screening.*—In view of the foregoing rule, provision for fixed or movable partitions may or may not be necessary, depending upon the nature and design of the switchboard.
- (3) *Insulating Barriers.*—When a switchboard has an open type busbars arranged in the horizontal plane, insulating barriers must be fixed between them projecting at least 8 in. above the upper surface of the busbars.
- (4) *Shrouded Circuit Contacts.*—When a surface switchboard contains cut-outs having surface contact fixed on the front, and the distance between opposite poles is less than 6 in., such contacts must either be shrouded or protected by fillets provided between the poles.

The London Toll Exchange.

The Postmaster-General (the Right Hon. F. G. Kellaway) opened the new LONDON TOLL TELEPHONE EXCHANGE in Norwich-street, Fetter-lane, on Saturday last. Some particulars regarding the exchange were given in our issue of July 22, and at a Press demonstration last week it was stated that the objects in view in planning the new exchange were to relieve the London Trunk Exchange, to save the time of the subscribers, and to reduce the labour of the operators. The traffic passing over the trunk telephone system to and from London had for some years been increasing at the rate of approximately 10 per cent. yearly, and the provision of relief arrangements had become a necessity. New facilities have been introduced for operating calls so that connections to provincial towns served by the exchange may be obtained on demand. A number of cables to provide additional toll lines are being laid where necessary on the provincial routes. In addition to the traffic outgoing from London, the Toll Exchange will deal with the traffic incoming from the provincial towns involved in the London toll scheme, and the arrangements for operating this traffic should speed up the service materially. Provision has been made for the development which may be expected during the next few years. Accommodation for 400 outgoing and 600 incoming toll lines to the provinces and for 500 outgoing and 600 incoming junctions to the London local exchanges has been installed. At the date of opening some 200 outgoing and 230 incoming toll lines and 340 outgoing and 220 incoming junctions will be connected.

The Collection of Debts by Travellers.

In the Shoreditch (London) County Court on Tuesday the WESTON ELECTRIC LAMP COMPANY sued Mr. F. W. PEARCE, ironmonger and electrical sundriesman, of Maidstone, for 35s. for goods supplied.

DEFENDANT said the amount had been paid to plaintiffs' traveller, and PLAINTIFFS agreed that the signature on the receipt was that of the traveller, but there was a notice on the invoice to the effect that accounts should not be paid to travellers. As no notice had been given for the production of the invoice, Judge Cluer gave judgment for defendant.

Educational Notes.

The new session of the various technical colleges and institutes will commence either next week or the first week in October.

The 1921-22 session of the COLLEGE OF TECHNOLOGY, MANCHESTER, which will open on Thursday, Oct. 6, is divided into the following terms:—Michaelmas term, Oct. 6 to Dec. 16; Lent term, Jan. 11, 1922, to March 31; summer term, April 25 to July 8; long vacation term, July 10 to July 28.

Students who are able to obtain an approved course of practical training extending over not less than two months in a works, or otherwise, will be excused attendance during the long vacation term. Students will be enrolled on Monday, Tuesday, and Wednesday, Oct. 3, 4, and 5, between 10 a.m. and 1 p.m., and between 2 p.m. and 4 p.m. New students can also be received at the college between 10 a.m. and 1 p.m. from Sept. 26 onwards (except on Saturdays), when they can be advised in regard to their courses and can complete their enrolment. After Oct. 31 students are only admitted for special reasons by permission of the Principal and the Vice-Chancellor.

The work of the college includes advanced study and research in various branches of science and technology; University courses in the faculty of technology extending over three years and leading to degrees and certificates in mechanical engineering, electrical engineering, sanitary engineering, and applied chemistry, which includes (a) general chemical technology, (b) chemistry of textiles (bleaching, dyeing, printing, and finishing), (c) paper manufacture, (d) metallurgy and assaying, (e) chemical technology of brewing, (f) electro-chemistry, (g) photography, architecture, mining, &c. There are part-time day courses for engineers and other apprentices whose employers allow them to devote one whole day per week to study; part-time evening courses, involving attendance on three evenings a week for five years, which, although they cannot cover the whole ground of the University courses, afford an alternative means of acquiring that training in scientific principles and their application which is required to fit a man, if he possesses the character and personal qualities essential to a manager, to occupy effectively a position of responsibility in industrial affairs; and other part-time classes for advanced study and research or in preparation for the external degrees of the University of London, or in technological or trade subjects, or in various branches of natural science, or in other subjects of which particulars are given in the latter part of the college calendar.

The NORTHAMPTON POLYTECHNIC INSTITUTE starts its evening courses and classes on Sept. 26 and the day courses a week later. The entrance examinations will be held on the 27th and 28th inst. Last session marked the resumption of full work in all departments on the conclusion of the war. The enrolments being more numerous in all courses and classes than in any pre-war session, many applicants for evening work had to be placed on waiting lists. Very substantial additions were made to the equipment during last session owing to a liberal grant of the London County Council. Although it cannot be said that in all directions the well-known character of the equipment has been resumed, a good start has been made in supplying the deficiencies due to the war, both in the engineering departments proper, but more especially in the department of optical engineering and applied optics. A further grant has been made by the L.C.C., which will be expended during the current session in dealing with the most urgent needs. The programme of the work for the new session now resumes its full pre-war aspect, and it is confidently expected that the enrolments will again justify the submission of this programme. The courses in the Engineering Day College are the full four-year courses so familiar to engineers in pre-war times, and in all these there are indications that the enrolments will again be heavy. In the evening classes in engineering the regular classes are announced, and also short courses of lectures in special subjects. In all the departments, including civil and mechanical engineering, electrical engineering, optical engineering, and technical chemistry, the programmes have been brought up to date. Full details of the syllabuses and the equipment are given in the "Announcements" of the Polytechnic.

The calendar of the TECHNICAL COLLEGE, BRADFORD gives details of the full-time (day) and part-time (mainly evening) courses in the departments of textile industries, chemistry, mechanical, civil and electrical engineering. The full-time courses extend over three or four years, and lead to the diploma of the college, and the part-time courses, which involve attendance on three evenings a week during three or five sessions, lead to senior and advanced course certificates. The courses are designed to meet the needs of students wishing to receive a technological training which will enable them to occupy higher positions in industry. The full-time courses are of university standard, and candidates for admission to these courses who have not passed the matriculation examination or its equivalent are required to pass the college entrance examination. The evening courses are intended to meet the needs of students engaged in industry during the greater part of their time. These courses form a large and important part of the work of the college. Many of the advanced courses are attended by students who have already completed systematic technological courses. In addition to the organised courses, the college provides special facilities for students who undertake advanced study or research. Additional equipment and accommodation are being provided. A special feature of the equipment is the power house, which has been arranged for demonstration purposes, and which supplies the whole of the power and light required by the college. Mention should also be made of the new engineering apparatus, which will provide special facilities for

microphotographic work for automatic engineering, and for metal treatment.

The day classes of the sixty-sixth session of the MERCHANT VENTURERS' TECHNICAL COLLEGE (in which the Faculty of Engineering of the University of Bristol is provided and maintained) begin on Oct. 4 and end on July 11, 1922. The evening classes begin on Oct. 3 and close on March 24, 1922, with a vacation of about two weeks at Christmas. In addition to the various subjects dealt with, a five years' scheme of training for engineers, called the "Bristol Sandwich" scheme, is provided (optional), and consists of a five years' course, of which about half will be spent in the university and the rest in a works. For example, after the first ten months in the university, fourteen months will be spent in a works, followed by a further ten months in the university, two months in a works, ten months in the university, and the last fourteen months in a works.

A Method of Photo-Sculpture.

Some particulars of a METHOD OF PHOTO-SCULPTURE, developed by Mr. H. M. Edmunds, of Brighton, were given in "The Times" last week. By means of the new method carving in greater or less relief can be made from a solid object by the use of the camera. It is said that a photographer of ordinary skill can make, with the necessary combination of camera and projector, the photographic record required for the carving machine, and when once a negative is made it can be sent to the works where the carving machine is operated. Any number of direct replicas in relief can be made from it, to say nothing of their reproduction by casting. The carving can be done either in relief or intaglio by the operator of the machine. By the new process it is possible to photograph a sitter or any suitable solid object in such a way that from that photograph a carving can be made in ivory, alabaster, wood, or other material. An optical projector with a very long focus and well-corrected lens, a powerful source of illumination, such as a gas-filled incandescent lamp of about 1500 c.p., and in place of the ordinary lantern slide an accurately drawn spiral photograph on a sheet of plate glass is used. The spiral is projected and focussed upon a plane surface at a distance of about 10 ft. from the projector lens. A camera is fixed to the side of the projector with the nodal points of its lens lying in the nodal plane of the projector lens. A photographic plate put in the camera at right angles to the axis of the lens will photograph the spiral projected on the plane surface. The broad principle by which the carving is effected is that by substituting any solid object of an irregular form for the plane surface, the distortions produced in the projected spiral give a record of the object, and so provide means by which the carving can be effected. The photographic negative obtained is carefully enlarged on to an opal glass, as the exact dimensions of the enlargement must not be altered by development. The carving machine consists of three parts:—(1) A face plate, which holds the material to be carved; (2) a moving carrier, which holds the photographic record; and (3) a high-speed drill and microscope mounted up together, which can be moved in and out by a controlling lever. The operator of the machine merely has to follow the lines indicated on the photograph with the cross-hairs of the microscope, moving the microscope to do this with the controlling arm already mentioned. In moving this microscope he also moves the drill, so that it cuts the material at varying depths according to the form of the original subject.

A Plot to Inflate the Currency.

The period of recovery from a heavy drinking bout is understood to be a very difficult one. The "next morning" is probably one of the most unpleasant experiences, and it is, unfortunately, the fact that another nip of brandy is particularly welcome to the victims of that feeling. It seems that a plot is on foot to subject the nation to the nip-of-brandy process in connection with the painful recovery to sobriety in currency and finance through which it is now passing. The unemployment and other inconveniences afflicting us at the moment are in part, although, of course, not wholly, due to measures that have been taken to prevent further inflation of the currency and to bring finance and credit back to a sound basis. We are recovering very slowly and very painfully, and our old-time sovereign is beginning to move in the direction of its old value. This is a healthy and a necessary process through which we must pass before we can regain our constitutional soundness and be healthy and fit for normal development. The temptation to the politicians to avoid all this trouble is very great; a good big dose of new currency at this juncture would undoubtedly give us a short period of good trade and better employment and false prosperity. It would remove the pressing necessity for a policy of anti-inflation, it would make it easier for the Chancellor to balance his next Budget, and it would postpone to some future date, if, indeed, it did not make altogether impossible, the ultimate recovery of the country. It is very much to be regretted that the Federation of British Industries has shown a tendency to throw in its lot with the politicians, and is demanding a new Committee to reconsider the currency policy in the light of recent events. Unlike the Federation of British Industries as we have known it, it is suggested that this Committee should include representatives of Labour, feeling, no doubt, that Labour leaders would be as glad as everybody else to relieve themselves of all the troubles associated with the curing processes through which we are now passing. Chambers of Commerce and Trade Associations will do well to keep a close eye on this movement.

Electricity Supply.

SWINDON Urban Council has applied for a loan of £15,930 for electricity purposes.

Estimates are being obtained for the installation of electric light in BEDWORTH Parish Church.

Permission has been granted to LILLEY Urban Council to borrow £11,000 for electricity purposes.

Arrangements have been made for the erection of a transformer station in CROMPTON Council's tramway depot.

GOUROCK Town Council is negotiating with Greenock Corporation for a supply of electricity from the Dellingburn works.

At a recent meeting of BUXTON Electricity Committee the engineer reported that the total expenditure on the new plant to date was £5,380.

In connection with the LOCH DOON electricity scheme, an electrical engineer, a fishery expert, and a civil engineer have been appointed.

A bowling green for the employees in the GLASGOW Corporation Electricity Power Station at Dalmarnock was formally inaugurated on Saturday.

The electric light installation in CAVAN is almost complete. A number of shops have already been connected with the mains and are lighted by electricity.

In order to be able to extend their electricity mains into Lytham, ST. ANNE'S Urban Council are making application to the Electricity Commissioners for a loan of £9,740.

BARNSELY Town Council have received sanction to loans of £18,573 for mains and services, £1,533 for sub-stations and equipment, and £1,449 for meters and current limiters.

An enquiry was held last week into the application of the BOGNOR Gas Light and Coke and Electricity Company for an increase in the maximum price of electricity from 8d. per unit to 1s. 2d.

The profits for the first half of the current year of the BRITISH ELECTRIC TRANSFORMER COMPANY amount to £52,000, as compared with £35,300 for the corresponding half of 1920 and £21,400 for the first half of 1919.

NEWPORT (Isle of Wight) Town Council has decided to oppose the recommendation of the Isle of Wight Electric Light and Power Company for sanction to increase the maximum charge of electricity from 10d. to 1s. per unit.

The SOUTHPORT electrical engineer has been instructed by the Public Halls and Markets Committee to instal the necessary wires, lamps, &c. (excluding tenants' own wiring, lamps, and fittings), for lighting the Southport open market.

MR. FRANCIS TEAGUE, engineer at the Bath Corporation Electricity Works, on Tuesday afternoon gave an address to members of Bath Rotary Club, entitled "What is a Watt?" in which he outlined the history and possibilities of electrical development.

At Alfreton, last week, W. Street, W. H. Bower, and A. Nuttall, were bound over by the Bench for twelve months in their own recognisances, and each ordered to pay £5 5s. 6d. costs for STEALING ELECTRICAL APPLIANCES from the Pinxton Collieries, where they were employed in positions of trust.

TODMORDEN Town Council has agreed to supply electricity to the outlying districts, and has decided to proceed with an extension to Lydgate at an estimated cost of £350, and to Robinwood and Cornholme at an estimated cost of £3,170, subject to an agreement being entered into with a large firm regarding the supply of current.

Mr. J. E. Macewan, engineer, Glasgow, has intimated to CRIEFF Town Council that the preparation of the necessary electrical details required by the Electricity Act (1919) being now practically completed, he finds that, owing to pressure of work, he is unable to continue to act in the capacity of electrical adviser to the Council.

AMBLE Urban Council is seeking power to get the parishes of Birling, Gloster Hill, and Warkworth into its area. At the inquiry held by the Northumberland County Council into the application, it was stated that it is the intention of the council to obtain authority to supply electricity and to take a bulk supply from the Amble Ship-building Company.

The work of laying new cables in the STROCKTON district, which is being carried out by British Insulated and Helsby Cables Limited is nearing completion. The cables are three core copper, paper insulated, lead covered, and steel armoured. Other undertakings recently carried out in the district include the laying of a cable from Grange town to Middlesbrough.

The sub-committee appointed by HALIFAX Council to reconsider the heavy increases charged on the last quarter's electricity accounts recommend rectifications whereby power consumers, instead of paying the high increase, which is criticised, will pay one penny per unit more than was charged on their previous accounts, which will mean a substantial reduction on the charges complained of.

A meeting of the BRISTOL Electricity Committee was held on the 15th inst., when the question of the revised charges for current was considered. It is understood that an increase of 20 per cent will be necessary. After discussion, it was decided to refer the subject to the ordinary meeting of the committee, to be held on Sept. 30, when further information will be submitted by the City electrical engineer.

CARDIFF Corporation announces a cut of 15 per cent. in its electricity charges, with the possibility of a further reduction shortly. Subject to confirmation by the council, the maximum rates will be as follows:—Lighting, 6¹/₂d.; heating, 1¹/₂d.; power, 2¹/₂d. per unit. In addition to these rates they have, of course, special power rates for large supplies, subject to a coal and wages clause, which will automatically receive the benefit of the reduced operating costs.

With reference to the proposed supply of electricity for the village of BISHOP'S LYDEARD (Somerset), it has been decided to canvass the parish to ascertain the probable number of consumers. Mr. A. Howard, electrical engineer, of Taunton, estimates that the cost of erecting a H.T. main from Stapleford to Bishop's Lydeard and a L.T. distributing main through the parish would be, approximately, £1,500.

A long discussion on the question of the lighting of SUBBURY streets took place at a meeting of the Town Council last week. The matter was under consideration at the beginning of July, and estimates have since been obtained for lighting by gas and for lighting certain areas by electricity. No decision was arrived at, and a resolution that the question be referred back to the General Purposes Committee, with power to act, was carried.

OLDHAM Gas Committee have decided to ask the Electricity Committee to issue a warning to local electricians as to the danger of placing electric wires too near gaspipes. At last week's meeting of the Gas Committee a short length of gas service pipe in which a hole had been fused was produced. It was stated that the pipe had been cut from the bedroom of a house in which electric light had also been installed, and the wire was placed close to the pipe. The fusing of the hole caused a leakage, which almost suffocated the occupant of the room.

LINDSAY County Council at a recent meeting considered a report from representatives who attended a conference of local authorities at Doncaster with regard to the establishment of the proposed North-East Midlands Electricity District. After discussion the council adopted resolutions to the effect that in view of the incomplete state of legislation concerning electricity, the holding of an inquiry into any scheme for the constitution of a joint electricity authority for the North-East Midlands Electricity District would be premature, and recommending that the provisions of section 19 of the Electricity (Supply) Act, 1919, be exercised in the proposed electricity district to meet any emergency.

On Friday, September 16, members of EDINBURGH Electric Lighting Committee made their annual visit of inspection to the various power stations in the city, including Leith, Leith Docks, McDonald Road, and Dewar Place. The chief interest, however, centred in the new electric station at Portobello. During the last eight months rapid progress has been made, and a frontal view of the building now affords some idea of its size. Within the last few weeks the 70 ton crane has been placed in position, and it is expected that before the end of this month at least one of the turbo-generators will have arrived. Three are to be installed, each with a capacity of 10,000 kW, and while to begin with the power produced will be 30,000 kW, provision has been made for increasing this output to 100,000 kW. The Committee are hopeful that by April next the station will be in working order, and in a position to supply power for the electric cars. In the evening Mr. Bruce Lindsay, the Convenor of the Committee, entertained members of the Committee, officials, and others to dinner in the Caledonian Station Hotel.

At a meeting of ERITH Electricity Committee last week Mr. Williams, the engineer, reported that Callender's Company had completed the cable-laying for Erith's half of the Erith-Woolwich scheme, and that the other part would soon be finished. Under this scheme Erith will be able to obtain electricity at a much more economic rate of production. The contract with Callender's Cable and Construction Company was for £20,000, which was raised by a special loan. The contracts let for cable, transformers, switch-gear, &c., to enable the Council to take supplies from Woolwich Borough Council, and also to make provision for supplying the requirements of Messrs. Vickers are given on page 396. The total cost was put at £28,273. This did not include protective gear, &c., for the main 10,000 V cable. As this was a question which equally concerned Woolwich Council it had been left over for the present. The cost varied from £200 to £500, according to type, and would be equally divided between Woolwich and Erith. It was reported that formal application had already been made for the loan required. Messrs. Vickers required the Council to be in a position to take over the whole of their supplies by January 1 next. The engineer had interviewed one of the commissioners and explained the position, and promise of sanction was given.

Obituary.

We regret to record the death of MR. R. E. BAYNES, Lees Reader in Physics at the University of Oxford.

The death took place at Burton-on-Trent, in his 87th year, of SIR JOHN H. HEFFERMAN, a distinguished naval engineer, who assisted in laying the first Atlantic cable.

The death is announced at the age of fifty-seven years of MR. ARTHUR A. DAY, former electrical engineer of Bolton, to which position he was elected in August, 1900. In 1904 he took over the management of the tramways. Under his control these departments made excellent progress, but in September, 1912, Mr. Day's health broke down, and he resigned both positions in the following June.

Electric Traction.

Additional cars and longer trains are shortly to be employed on the BAKERLIGO LINE during the morning and evening rush hours.

Six new saloon electric trams ordered by SWANSEA Borough Council from the Brush Electrical Works, Loughborough, have been delivered.

The DARTFORD LIGHT RAILWAYS (AMENDMENT) ORDER, 1921 (authorising additional borrowing powers), has been submitted to the Minister of Transport for confirmation.

At a meeting of DUNDEE Tramway Committee, the tramway manager was instructed to see what he could do with regard to running through trams from Lochee to Broughty Ferry.

BRADFORD Tramways Committee has adopted a proposal of the Ministry of Transport that the qualifications of men employed on traffic service should be tested by examination every twelve months.

WALSALL tramways manager has been instructed to negotiate with the Wolverhampton Corporation and the Wolverhampton Tramways Company for a through service of trams between Walsall and Wolverhampton.

For some time tests as to the practicability of a system for the AUTOMATIC PREVENTION OF RAILWAY COLLISIONS have been carried out by railway and electrical experts on the short line connecting Brighton with the Dyke, and a demonstration of the apparatus is to be given this week to various representatives of railways.

It was reported to WALSALL Corporation last week that there was a loss of about £5,000 on the first quarter's working of the tramways. The manager has been authorised to negotiate with Wolverhampton Corporation, and the Wolverhampton District Electric Tramways, Ltd., for a through service between Walsall and Wolverhampton.

The tramway strike in SALFORD, which arose through inspectors leaving the United Vehicle Workers' Union and joining the Association of Local Government Officers, ended last Saturday, and the usual service of cars was resumed after a five days' stoppage. The points at issue have been referred to arbitration. The suspension cost Salford £1,000 a day.

With regard to recent reports that the EXTENSION OF THE TUBE RAILWAYS is to be undertaken at an early date, it is officially stated that the position is practically the same as in February, when Lord Ashfield informed the shareholders of the company that it was hoped to proceed with the scheme when conditions permitted and the required sum of £1,750,000 could be raised on reasonable terms.

The recommendation of the GLASGOW Corporation Wages Committee that the tramway workers' war bonus should be reduced by 3s. per week, the reduction to take effect on the first pay day in October and to continue until, and including, the last full weekly pay day in November, when the position would be reviewed, has been approved by the tramway men, with the reservation that whatever alteration takes place in November it should be based upon the national agreement for the tramway industry, which has a sliding scale in accordance with the cost of living index figure.

With the object of cutting down expenses, the GREAT EASTERN RAILWAY COMPANY is going to introduce the conductor-guard system on its branch lines; in other words, the tramway system is to be applied to railway trains. Passengers on the trains concerned will get their tickets from the conductor-guard, the ticket being in the form of a tramway ticket. Special rolling stock on the principle of that already in use on the "Tube" railways is being constructed by the company at Stratford. Later on, it is stated, a special type of engine may be provided.

Mr. H. Ford, at a recent meeting of NOTTINGHAM City Council, referred to the urgent necessity of constructing a branch railway line from the new power-station at Clifton to the Midland Railway at Lenton South. If begun now, he said, the work would give employment to many men, and he reminded the Council that the Lord St. David's fund was at their disposal in the matter, while the material for filling-in purposes could be obtained from several places. By being able to use their own branch line and taking other matters into consideration, he thought the Council would save £7,000 the first year. The committee are to consider the question at their next meeting.

At the SUNDERLAND Town Council the Tramways Committee recommended the acceptance of a tender from a foreign firm for the supply of rails, fishplates, &c. The chairman, Alderman New, stated that the foreign tender was the lowest, and that only one English tender was received—from a Middlesbrough firm, whose price was £2 per ton higher. Except by the express desire of the council, the committee felt they were not justified in departing from the policy of accepting the lowest tender, especially when in the past foreign rails had been proved to be far superior to English rails. An amendment that while there were so many men starving in the country they ought not to send work out of the country. Dr. Bell described this doctrine as a wicked economic fallacy, as damnable as the fallacy of Karl Marx.

During the past week-end the LEEDS tramways have attained their jubilee, the service having been started on Sept. 16, 1871, when a line was opened from Boar-lane to the Oak at Headingley. Previously, the "Yorkshire Post" states, there had been a preliminary trial line laid on waste ground in Cookridge-street, near the present Leeds Institute, and the curious were invited to step into the model

car and become familiar with the easy going of a tramcar as compared with a cart, for the tramcars were at that time drawn by horses. The opening of a regular line aroused much interest, and crowds assembled to watch the passage of the cars, while everyone was eager to make a trial trip. The Headingley line was soon followed by the construction of others from Boar-lane to Chapel-town, to Marsh-lane (with terminus at the Woodpecker Inn), to Hunslet (with terminus at Thwaite Gate), and to Kirkstall, with terminus at Commercial-road. The horse cars were succeeded in 1877 by steam cars, and in 1891 by the use of electric traction.

Municipal Accounts.

The accounts of the ABERDEEN Corporation Electricity Department for the year 1920-21 show that fuel for the generation of electricity cost £68,207. The total revenue amounted to £174,884 18s. and 22,561,910 units were generated. Of the revenue, £20,426 was obtained for city traction purposes and £1,826 for suburban traction, while £140,408 was for ordinary meter service.

The accounts for the past year of the CORNWALL ELECTRIC POWER COMPANY, which is associated with the Urban Electric Supply Company, show an increase in the net revenue from £14,900 to £23,400, and an increase from £99,600 to £130,200 in the total sales. The available balance at £25,900 is £8,700 higher, but the dividend is unchanged at the 4 per cent. paid for the preceding four years, the additional surplus being utilised in raising the transfer to general reserve from £2,000 to £5,000 and the carry-over from £1,200 to £4,600. The allocation to depreciation reserve is unaltered at £5,000.

A heavy loss is shown on the working of LEEDS tramways during the summer. Between April 1 and August 31 the income has decreased by £10,277, as compared with the same period last year, and the expenditure has increased by £24,494, making a deficit of £34,771 on the five months' working. The increased fares have resulted in an average increase of £227 per day, but increased costs amount to nearly 5d. per mile, while the income is only larger by a little under 2½d. per mile. There has been an economy of 543,263 car miles run, but this has been accompanied by a fall in the number of passengers of 5,332,000—an aggregate of 55,946,592, in place of 59,279,437 during last summer.

The annual report of BURNLEY Corporation Electric Supply Works states that the total amount borrowed on capital account is £187,054, and the total amount paid off by sinking fund and sale of old plant £102,972 19s., leaving £84,081 1s. owing on mortgage loan. The total works costs, excluding interest and sinking fund and income tax on profits were £60,178 6s. 5½d., against £40,558 11s. 6d., an increase of £19,619 14s. 11d. The net income from all sources was £75,255 9s. 10d., against £60,800 1s. 11d., an increase of £14,455 7s. 11d. The interest and sinking fund charges and income tax on profits were £15,617 6s. 8d., against £14,523 17s., an increase of £1,093 9s. 8d., making a loss of £540. During the year 7,594,107 units were sold, against 7,113,310 in the previous year, an increase of 480,797, equal to 6.76 per cent. The sale of units for lighting showed an increase equivalent to 21.84 per cent; power, an increase of 28.19; and heating and domestic purposes, 12.46. Only traction (3.57) showed a decrease, and this was due to the coal dispute.

The annual report of the BRADFORD Corporation tramways undertaking for the year ended March 31 shows an increase in revenue of £109,549, but also a net increase in expenditure of £152,369. For the increase in expenditure, wages and salaries, repairs to the permanent way, and power expenses were largely responsible. Advances of wages and increases to the staff amounted to £79,851, rates and taxes increased by £6,314, upkeep of the permanent way cost £18,679 more, and power expenses went up by £14,853. The total revenue in 1921 was £718,539, the working expenses were £655,903, and the gross profit £64,636. But against this has to be charged interest, income tax, sinking fund, &c., amounting to £86,881. The loss, which is debited to the reserve and renewals fund, was £22,245. Last year, when the gross profit was £107,456, £30,000 was appropriated to the relief of rates. A table showing the percentage of cost of labour to gross revenue since 1909 shows that in that year on working expenses of £170,196 the sum of £81,572, or 47 per cent. of the total expenditure, was paid in wages; in 1921, on working expenses of £653,904, £415,070, or 63½ per cent., was paid. In 1909 the total revenue was £244,235, and the percentage of wages paid was 33 per cent.; in 1921 the revenue was £718,540, and the percentage of wages was 57½. The income earned by the railways system was £21,384 and the expenses were £32,226. The present vehicles have practically run their useful life and will be superseded in the future by vehicles of a more modern type. A one-man type has been approved. The total number of tickets sold during the year was nearly 89,000,000, an increase on the previous year of nearly 3,000,000. Bradford contains fifty-nine miles of tramways, and the car mileage covered (exclusive of trackless) was nearly 6,000,000, an increase of about 700,000 on the mileage covered last year. The cost of carrying blind people free was £657. The Bradford Tramways Committee recommends that reconstruction of tramways tracks in Bradford be proceeded with as follows, regard being had to the materials available for the work—E. Ashill section, from Idle-road to terminus, estimated cost £16,623; Wyke section, near Odsal Top, estimated cost £9,523. The council is recommended to apply to the Ministry of Transport for sanction to borrow so much of these sums as would properly be met out of capital account, having regard to the time which has elapsed since the existing track was constructed.

Personal and Appointments.

Mr. W. WYLD, borough electrical engineer of Hampstead, is resigning that position to join the Spengler Boiler Company.

Mr. ALFRED SHEPHERD has been appointed chairman and Mr. GEORGE BALFOUR, M.P., vice-chairman of the Lancashire Electric Light and Power Company, Ltd.

Mr. A. T. SMITH, managing director of the Castner, Kellner Alkali Company, has been asked to join the board of the Cassel Cyanide Company, and Mr. WILLIAM NEILL, managing director of the latter company, has been asked to join the board of the Castner, Kellner Alkali Company.

Lieut. A. A. DAVIS, D. E. ROSS, and W. A. GLADWIN, of the Tyne Electrical Engineers, have been transferred to the regimental list of the Territorial Reserve of Officers. Lieut. H. HUTCHINSON and W. DIXON, of the same corps, resign their commissions and retain their rank.

Mr. J. W. RODGER, A.M.I.E.E., of Messrs. Ferranti, Ltd., Hollinwood (transformer department), was married on the 14th inst. to Miss Kitty Rhodes, daughter of Mr. W. H. Rhodes, Fulwood, Preston. At the reception the firm was represented by Mr. V. de Ferranti and Mr. Gardner.

Messrs. Johnson & Phillips, Ltd., Charlton, have appointed CAPT. H. J. GROVES-WEBB, A.M.I.E.E., to be the engineer and branch manager of their London office at 12, Union-court, Old Broad-street, E.C. 2, in succession to the late Mr. A. R. CONNOL. Capt. Groves-Webb was appointed chief assistant engineer at the London branch in August, 1919, on his return from France, and enters upon his new duties immediately.

Mr. J. W. HAME, who has been in ill-health for some time and is now on sick leave, has resigned his position as electrical engineer and tramways manager to the York Corporation. Mr. Hame is a native of Hull, and was educated at Kingston School, Yeovil, and Finsbury Technical College, London. He served his apprenticeship with Messrs. Ronald Scott and Co., electrical engineers, London, and in 1894 joined the St. James' and Pall Mall Electrical Light Company, London. Three years later he was appointed as an assistant engineer at the electricity works of the Leyton Urban District Council, and subsequently entered the employment of the Cork Electric Tramways Company, which he afterwards left to become chief assistant electrical engineer to the Wigan Corporation. In the latter capacity he took an active part in preparing and carrying out an electric lighting and tramway system. He left Wigan in 1902 to take up the position of chief assistant electrical engineer at York, and was appointed chief electrical engineer in 1906. Since then he has done much good work in connection with the development of the electric car system in the city, and in recent months has been actively engaged in the installation of a new hydraulic electric power station at Linton Locks, near York.

Wireless Notes.

Direct wireless communication is now established between MADAGASCAR, BORDEAUX, and ANTANANARIVO.

Encouraging experiments in WIRELESS TELEPHONY have been carried out by the Indian Posts and Telegraph Department BETWEEN BOMBAY AND POONA.

Owing to the increasing development of their commercial business, the MARCONI WIRELESS TELEGRAPH COMPANY are taking over extensive premises at 2-12, Wilson-street, London, E.C.

It is announced that a new TELEGRAPHIC CABLE is to be installed BETWEEN ITALY AND SOUTH AMERICA. It will start from Fiumicino (Rome), and will touch Spain, Brazil, Uruguay, and Argentina, and eventually the Canaries and Cape Verde Islands.

The American Minister in PEKIN has notified the State Department of the signing of a supplementary agreement between the Federal Wireless Company and the Chinese Government. The agreement, Reuter's Washington correspondent states, relates to the issue of bonds for financing the project.

HULL Corporation has paid the Government £63,000 as royalties on their telephone undertaking, which is the only municipally controlled service in the country. At a meeting of the Telephones Committee on Monday it was resolved to make representations to the Government for relief from this burden. It was stated the royalties now amount to £10,000 per annum. Notwithstanding this annual charge the undertaking is being made to pay its way.

Institution Notes.

The president of the AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS for the year 1921-22 is Mr. Wm. McClellan.

The L.E.E.O.C.A. (London Electrical Engineers' Old Comrades' Association) are holding a smoking concert at the Bridge House Hotel, London Bridge, on Thursday, Oct. 6, at 7 p.m. Admission by membership card. Mr. F. Franking (hon. secretary), 108, Heathwood-gardens, Charlton, S.E. 7.

The annual dinner of the FARADAY HOUSE OLD STUDENTS' ASSOCIATION will be held at the Holborn Restaurant (Crown Room) on Friday, Oct. 21, at 6.30 (for 7). Mr. C. C. Paterson, the president, will be in the chair. It will be remembered that this was to have taken place on April 15 last, but had to be postponed owing to the threatened transport strike.

THE MIDLAND ELECTRICAL ENGINEERS' BALL is to be held this season at the Grosvenor suite, Grand Hotel, Birmingham, on Friday, Nov. 25. Mr. R. A. Chattock will again act as chairman, and Messrs. C. J. Bish, Vickers' House, Loveday-street, Birmingham,

and W. Y. Anderson, 14, Dale-end, Birmingham, as joint hon. secretaries. Joyce's London Band will be in attendance, personally conducted by Mr. Archibald Joyce. Tickets at 1 guinea each may be obtained from either the chairman or hon. secretaries.

Mr. G. H. KNIBBS, director of the INSTITUTE OF SCIENCE AND INDUSTRY, announced recently that in future all the Australian States, as well as the Commonwealth, would order RAILWAY RAILS AND FISHPLATES to standard specifications. This would greatly facilitate production and expedite delivery by the steel manufacturers. The Institute has made a beginning in the standardisation of materials, and especially of engineering materials, and has secured the adoption by Australian manufacturers and users of standards for structural steel sections, tramway rails, and fishplates, and railway rails and fishplates.

Business Items, &c.

Mr. J. W. BEAUCHAMP, of the B.E.D.A., 84, Kingsway, W.C. 2, will be glad to receive communications from firms manufacturing modern types of windmill suitable for pumping or driving electric generators.

MESSRS. CUNNINGHAM, LTD., of 169-171, Edgware Road, W. 2, invite inspection of their private wireless station, which is now in operation. Mr. C. J. Close, late of the Government Wireless Service and Marconis, is in charge and will give advice and assistance to amateurs.

On Saturday, Sept. 17, THE ELECTRICAL WHOLESALERS' FEDERATION, LTD., sent the following telegram to the Chancellor of the Exchequer:—"At a meeting of the Electrical Wholesalers' Federation to-day the following resolution was passed: 'That the Federation of Electrical Wholesalers consider that taxation exceeds the limits that commerce can bear, and that much more drastic economy than hitherto practised is essential for the welfare of the country.'

Forty Years Ago.

(THE ELECTRICIAN, SEPTEMBER 24, 1881.)

ELECTRIC LIGHT AT NORWICH.—The Norwich Town Council have accepted the tender of Messrs. Crompton & Co., of London, for lighting several of the principal streets of the city by their arc lamps for twelve months.

UNIVERSITY COLLEGE, NOTTINGHAM.—Evening lectures on electricity and magnetism will be delivered by Professor Fleming at this college on Thursday evenings, commencing the 13th October next. There will also be technical classes in electrical instrument making and telegraphy, on the scheme of the City and Guilds Institute, every Monday and Wednesday during the next session.

ELECTRIC LIGHT IN CLUBS.—The British Electric Light Company have introduced their incandescent lamps into the smoking-room of the Junior Carlton Club with success. The lamps are fed by Faure batteries placed in the basement of the building. Fifteen lamps have replaced twenty-five gas burners, by which the room was ordinarily lighted; they have been grouped together beneath a reflector, so as to resemble the modified form of gas sun, which they have replaced. The work has been carried out by Mr. Radcliffe Ward, the company's engineer.

INTERNATIONAL ELECTRICAL EXHIBITION.—To show the interest taken by the general public in this exhibition, we may quote from a daily contemporary's correspondent in Paris. He says:—"Three or four new pieces are announced for representation at various theatres this week, but the Electricity Exhibition runs every other attraction a very close race. It is perfectly marvellous to a commonplace observer to see a queue of three thousand persons waiting for their turns at the telephone to hear a few bars of music sung or played at the opera, when they might hear the whole opera sitting at their ease and see the ballet as well. But such is the effect of novelty. It is for a similar reason that crowds gather round the Exposition of the Submarine Cable Company. They do not well understand what they see, but they know that, thanks to the cable, conversation can be kept up between the New World and the Old, and they gaze at the admirable apparatus and appliances in pardonable though childish amazement."

New Companies.

RICHARD WHIFFEN, LTD. (176 605.) Registered Sept. 2. Excelsior Works, Carriage-street, Old Trafford, Manchester. Electrical installation contractors. Nominal capital, £15,000 in 15,000 shares of £1 each. Directors: R. G. Whiffen, R. Attwater. Qualification of directors, 1,000 shares governing directors. Private company.

BRITISH AUTOMATIC TELEPHONE INSTALLATION COMPANY, LTD. (176 608.) Registered Sept. 3. 92, Victoria-street, S.W. To carry on the business of making, selling, maintaining, and working private or other telephones and telegraphs. Nominal capital, £10,000 in 10,000 shares of £1 each. Directors: G. W. Tempest, C. G. Tideman, J. Hunter, A. Channing. Qualification of directors, £250. Private company.

CLEAR HOOTERS, LTD. (176 641.) Registered Sept. 6. Hooterland, Highgate-square, Camp Hill, Birmingham. Manufacturers, dealers, and agents for electric motor and all other kinds of horns and hooters. Nominal capital: £5,000 in 3,000 participating cumulative preference shares and 2,000 ordinary shares of £1 each. Directors: W. A. Crosbee, H. H. Mills, W. J. Spicer, T. S. Rogers. Qualification of directors, 250 fully-paid shares. Private company.

Imperial Notes.

The Clifton Hill Heidelberg section of the MELBOURNE SUBURBAN RAILWAYS is now worked electrically.

The VICTORIAN ELECTRICITY COMMISSIONERS are contracting for the purchase from the Zeitz Company, of Germany, of briquetting plant for use at the brown coal mines at Morwell. The cost is stated to be £110,000.

The ENGLISH ELECTRIC COMPANY OF AUSTRALIA proposes to manufacture aluminium at its new works at Spotswood, Melbourne. Alunite exists in Victoria, and in exceedingly rich deposits at Bullahdelah, in New South Wales. The exports of alunite from 1890 to 1918 amounted to 57,000,000 tons.

A supply of electrical energy from the Victorian Railway Commissioners' power station is now available for working the FOOTSCRAY (VICTORIA) tramways. The track has been ready nearly two years, but the current has not been available hitherto.

With regard to the contract which SYDNEY (N.S.W.) Electric Supply Committee has placed with Thompson and Co. (Castlemaine), Pty. Ltd., for a 17,500 kW turbo-generator, the city Solicitor has advised Sydney Council that if they confirm the acceptance of the tender they will be liable to an action for breach of contract with the English Electric Co. (Australia), Ltd.

For the first time since the commencement of the TASMANIAN GOVERNMENT'S ELECTRIC POWER SUPPLY in 1916, the plant was brought to a standstill on July 26 last by the intensely cold weather, which caused the screens at the penstock chamber at the head and the pipe lines to become choked with ice and snow. For about 2½ hours the Hobart tramways and the supply of power and light in the city were stopped. The severity of the weather is stated to have been unprecedented.

The ENGLISH ELECTRIC COMPANY OF CANADA, LTD., which has recently been registered, holds the exclusive manufacturing rights for Canada in perpetuity, and acts as the agency through whom all selling, engineering, and construction work in Canada is done, and holds the right to sell its own products in the United States. The Canadian Company has the use of all patents, designs, and processes of the English Electric Company, Ltd., of Great Britain, and secures preferred prices on all imported machinery and equipment as well as the benefit of the preferential tariff and favourable exchange rate. The Canadian company has also working arrangements with Siemens Brothers & Company, Ltd., English Electric and Siemens Supplies, Ltd., Consolidated Construction Company, Ltd., Les Constructions Electriques de France and Les Constructions Electriques de Belgique, Toyo Denki Seizo Kabushiki, Kaishi, and the English Electric Company of Australia, Ltd. The entire undertaking of the Canadian Crocker-Wheeler Company, Ltd., has also been acquired. Mr. Gordon F. Perry, president of the National Iron Corporation, Ltd., is chairman of the board.

Foreign Notes.

In the course of a statement on the OIL INDUSTRY IN THE ARGENTINE, the current monthly review issued by the London and River Plate Bank says that the Astra Petroleum Company is now controlled by a German syndicate. The A.E.G. is supplying an additional \$2,000,000 paper capital, and has undertaken to utilise all the mineral produced at its power stations at Buenos Aires and Monte Video.

The KIANGSI KAIMING Electric Light Company, Ltd., has gone into liquidation. Its assets amount to \$200,000, while its liabilities total in the neighbourhood of \$700,000. Some shareholders have suggested a reorganisation. The Chinese Ministry of Communications has registered the Kingsha Electric Company at Kingsha.

It is reported that an ECONOMY CAMPAIGN is in full swing in AMERICA, and among the savings to be effected is a large cut in the naval appropriations. This, apparently, will have a serious effect on the manufacture of electrical equipment for naval vessels, and it is reported that consequently the manufacture of ship-propulsion machinery has been stopped by the General Electric and Westinghouse companies.

In connection with the ELECTRIFICATION OF THE MIDI RAILWAY, the Swiss firm, Brown, Boveri et Cie., has recently secured a contract for the complete equipment of the five sub-stations of Pau, Lourdes, Tarbes, Montrejeun, and Lannemezan with mercury arc rectifiers. The contract comprises sixteen 1200-kW rectifier sets to operate at a direct-current pressure of 1575 V. Each set consists of a single main transformer supplying two high-tension rectifiers in parallel. The primary supply will be three-phase at 60,000 V and a periodicity of 50 cycles. The overload capacity for which the rectifiers are being designed is 50 per cent. for two hours and 200 per cent. for five minutes.

The first motor show to be held in CHINA will take place at Shanghai in November. Keen American competition is anticipated. Owing to the short time available, and the lack of particulars as to the cost of exhibiting, &c., interested British firms, having no agency in China, are advised to cable direct to Mr. Fox, the British Commercial Counsellor at Shanghai, who will endeavour to secure the services of local British agents for show purposes. Cable address: "Commintell, Shanghai." Postal address: "British Commercial Counsellor's Office, Shanghai."

THE UNITED STATES DEPARTMENT OF COMMERCE has established a branch office at Manila with the object of getting more accurate information regarding trade in the Philippines. In an interview

the Officer in Charge stated that the United States, whose trade with South America and Europe is at present diminishing on account of exchange conditions, is turning its attention to the development of trade with the Far East, for which Manila is a good centre. The Department of Commerce has approved a scheme for the development of the port, and is committed to the project of a free zone there.

In view of the difficulty of dealing adequately with calls for tenders by public bodies in ITALY, when the tendering firm is of foreign origin, the question of establishing a native house for the purpose has recently been considered by the Commercial Counsellor to H.M. Embassy at Rome. In the opinion of the legal adviser to the Embassy, United Kingdom contracting firms might find it advantageous to consider the question of establishing branch houses (*filiali*) in Italy, the directors of which can be either British or Italian. Further particulars may be obtained from the Department of Overseas Trade.

Catalogues, Price Lists, &c.

RAYNER & HEALD, LTD., have issued their monthly stock list of two- and three-phase squirrel-cage and slip-ring induction motors.

A booklet describing their end tightened reaction blading has been issued by C. A. PARSONS & COMPANY, LTD., Heaton Works, Newcastle-on-Tyne.

No. 29 of the Heat Treatment Bulletins, published by AUTOMATIC AND ELECTRIC FURNACES, LTD., has been issued under the title of "The Perfect Hardening of Carbon Steel."

A new sectional catalogue—Industrial Section, No. 4—has been issued by HYATT LTD., and is full of information about the firm's roller bearings for trucks, trams, and tubs.

GUY CHANTRILL & COMPANY have issued a price list of their "Viking" 50-cycle three-phase oil-cooled transformers for any standard low-tension voltage. Prices for other periodicities, also for single-phase, Scott connected, and furnace transformers may be obtained on application.

A 72-page catalogue on Industrial Lighting has been received from the EDISON SWAN ELECTRIC COMPANY. The general information and advice which the book contains, in addition to the tables of dimensions of the numerous apparatus illustrated, will prove of the greatest service to all who are contemplating bringing their lighting arrangements up to date.

HIGGS BROS. have published a price list of their a.c. and d.c. electric motors, dynamos, and starting gear. It is intended purely for reference with regard to outputs and prices. A special book is to be issued containing the specifications of their machines. The firm point out that they stock 50 per cent. of the machines shown in the list, and of those not in stock delivery can be given in from seven to ten days.

We have received from SIMPLEX CONDUITS LTD. an advance copy of a four-page leaflet they are shortly issuing regarding their "Triple Purpose" electric signs. The illustrations show many designs which have been produced by the company, but the sign department will at any time be pleased to give advice and assistance in providing exactly the right sign required. All they ask is that a complete set of particulars shall be sent.

TANGYES, LTD., Cornwall Works, Birmingham, have a large and varied selection of lantern slides of their manufacture available for loan to engineering lecturers and technical instructors. The slides comprise gas engines and suction producers, oil engines, steam and power pumps, hydraulic machinery, machine tools, &c. The firm also have an assortment of slides of historical interest dealing with these subjects. A list of slides will be sent free to applicants.

THE APPLICATIONS OF ALUMINIUM are now so numerous that there is need for up-to-date information as to its uses and properties. The series of booklets, issued by the British Aluminium Company, entitled "Hints on Working Aluminium," have proved of considerable utility to engineers in the past on account of their technical information, tables, &c., and it is interesting to learn that five of the booklets have now reached a revised edition. These deal with aluminium ingots, sheet, circles, tubes, and sections.

The latest addition to the GENERAL ELECTRIC COMPANY'S publications deals with automatic circuit breakers for direct and alternating current for voltages up to 600 V, and for currents up to 5,000 A. In addition "Salford Junior" circuit breakers are illustrated and details are given of "Salford" ironclad breakers, for mining and other similar work. The "Witton" type of circuit breakers and automatic time switches also find a place. A supplement gives revised prices of this apparatus, adjusted to include all advances to date.

R. B. HODGSON & COMPANY (SHEFFIELD), LTD., have produced an artistic booklet of some forty pages dealing with their "Pinnacle" crucible steels. Owing to the fact that the firm manufacture distinct grades and qualities of steels to meet the individual requirements of special tools and particular classes of work, instead of simply varying the carbon contents or temper, they have been able to grade and standardise the steels in series, and details of them are included in the catalogue, in addition to eight pages relating to heat treatments. Pages 36 to 40 comprise a Steel and Tool Reference—an original summary and index of the tempers, tempering colours, and steels applicable to the very large number of different tools included.

Tenders Invited and Accepted.

WEST DERRY Guardians require tenders by Sept. 24 for electrical supplies, engine packings, &c. Particulars from the Clerk, Brougham-terrace, Liverpool.

BORISLOUGH (Co. Tipperary) Electric Light Company require tenders by Sept. 30 for wiring consumers' premises. Specification, &c., from Messrs. J. P. Tierney & Company, 44, Kildare-street, Dublin.

Tenders are required by Oct. 1 for the supply of electric fittings, &c., to the Midlothian and Peebles District Asylum, ROSSLYNLEE. Forms of tender from the Clerk and Treasurer, 19, Heriot-row, Edinburgh.

BUENOS AIRES STATE RAILWAYS invite tenders by October 21 for one year's supply of electrical stores. Specifications are expected to arrive at the Department of Overseas Trade at the end of September.

WALSALL Electric Supply Committee want tenders by Sept. 26 for the supply of 320 tons and the laying of 300 tons of c.i. pipes. Specification, etc., from Mr. E. M. Lacey, 12, Victoria-street, London, S.W. 1.

THE COMMISSIONERS OF H.M. WORKS, &c., require tenders, by Sept. 30, for supply of electric light wire and cable. Forms of tender, &c., from the Controller of Supplies, King Charles-street, Westminster, S.W. 1.

EDINBURGH Corporation want tenders by Oct. 10 for electric light wiring and fitting of the City Collectors' Offices, Waterloo-place, Edinburgh. Specification, &c., from the City Engineer, Dewar-place, Edinburgh, by Oct. 10.

EASTBOURNE Corporation require tenders by Sept. 26 for a water-tube boiler, fan and chimney, feed pump and piping, and a 2 500-kW turbo-alternator, with condensing plant and pipework. Specifications from the Borough Electrical Engineer.

THE DIRECTORS OF THE LANCASHIRE AND YORKSHIRE RAILWAY require tenders by Sept. 29 for the supply of signal, telegraph, and electric wires and fittings, rubber, ironmongery, &c. Forms of tender, &c., from Mr. Sharp, Stores Department, Osborne-street, Manchester.

Tenders are invited by Oct. 5 for the supply of bronze wire (schedule 536) to the Postmaster-General's Dept., State of QUEENSLAND. Specifications, &c., from the office of the High Commissioner for Australia, Room E 5, Australia House, Strand, W.C. 2.

THE BULGARIAN DEPARTMENT OF POSTS, TELEGRAPHS, AND TELEPHONES wants tenders by Oct. 7 for the supply of 100 000 porcelain insulators. Particulars from the Department of Overseas Trade, 35, Old Queen-street, S.W. 1.

THE BULGARIAN MINISTER OF RAILWAYS, TELEGRAPHS, AND TELEPHONES requires tenders, by Oct. 12, for brackets, bolts, and other hardware furniture of telegraph and telephone lines. Specifications can be seen at the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1.

LOUGHBOROUGH Corporation invite tenders for the following extensions of their electrical undertaking: (a) by October 31, steam raising plant; (b) by October 17, high and low pressure mains networks. Particulars from Mr. C. H. Wordingham, at 7, Victoria Street, Westminster, S.W. 1, or 11, Mosley Street, Manchester.

PRETORIA (Transvaal) Municipality requires tenders by Oct. 4 for coal handling plant (contract No. 6), 6 600 V cables (contract No. 7), induced draught and ash-handling plant (contract No. 8), and feed pumps, steam, air, and water piping, &c. (contract No. 9), for the electric light and power department. Specifications, &c., from the General Manager, or Mr. G. M. Clark, 40-42, Meische-buildings, Johannesburg.

NOTTINGHAM CORPORATION invite tenders for the following works in connection with the North Wilford power station:—Manufacture, erection, and maintenance of (a) three 10 000 kW turbo alternators (for 1500 r.p.m.), with exciters, condensers, auxiliary plant, &c., and one 1 000 kW turbo-generator alternator, with condenser, auxiliary plant, &c., and (b) six water-tube boilers, with mechanical superheaters, forced-draught fans, &c. Specifications, &c., from Messrs. Preece, Cardew, and Rider, 8, Queen Anne's-gate, Westminster, S.W. 1. Tenders to the Town Clerk, Mr. W. J. Clark, by 10 a.m., Oct. 21.

AYLESBURY Town Council have accepted the tender of E. T. Mackrill & Sons for electrical pumping plant for the sewage works at a cost of £2273.

DONCASTER Town Council have accepted the tender of Brackett & Company, Colchester, for a circulating water screen for condensing plant, £394 10s.

HAY Urban Council have accepted the tender of the Electric Light Company for public lighting from Oct. 1, 1921, to April 1, 1922, at £2 per lamp, plus £78 for new standards and installation.

NEWCASTLE-ON-TYNE Corporation have accepted the tender of C. A. Parsons & Company for the supply of a 4 000 kW turbo-alternator and surface condensing plant for the Manors Station, at £33 700.

THE METROPOLITAN ASYLUMS BOARD received twenty-nine tenders, varying from £1 276 10s. 6d. to £2 795 18s., for the electric lighting installation required for the Grove Hospital. The lowest tender, that of W. O. Clutton, has been recommended for acceptance.

STRETFORD Electricity Committee have accepted the tenders of W. T. Glover & Company for supply, drawing in and jointing of cable, £1 850 11s. 3d.; Smith & Briggs, for laying underground conduit line, &c., £637 10s.; Doulton & Company, for stoneware conduits, £810 1s. 3d.

ERITH Urban Council have accepted the following tenders:—English Electric Company, Ltd., power station switchgear, £551; cubicle, £180; Metropolitan-Vickers' Electrical Company, Ltd., sub-station equipment, £292 18s.; British Electric Transformer Company, Ltd., transformers, £4 747; Callender's Cable and Construction Company, Ltd., three-core cable, lead sheathed and steel armoured.

The following tenders have been accepted by BRADFORD Electricity Committee for the supply of plant to Valley-road generating station:—Stanton Ironworks Company, water pipes; Barrett & Sons, steel piers for supporting cooling towers; Bertram Thomas, switch-board for boiler-house and extension to switchboard for transformer chamber; Electromobiles, Ltd., electric side-tipping truck; Holden & Brook, automatic centrifugal sump pump.

Companies' Reports, &c.

SHAWINIGAN WATER AND POWER have declared a dividend of 8½% on the common stock.

MACRAE COMPANIES have declared a quarterly dividend of 1½ per cent. on the common stock.

THE WESTERN UNION TELEGRAPH COMPANY has declared a quarterly dividend of \$1.75.

THE MANILA ELECTRIC RAILROAD AND LIGHTING CORPORATION announce a quarterly dividend of 1½ per cent. on the common stock.

THE BRITISH ALUMINIUM COMPANY announces a dividend at the rate of 5 per cent. per annum, less tax, on the ordinary shares for six months ended June 30.

A block of £130 000 5½ per cent. debenture stock of the YORKSHIRE ELECTRIC POWER COMPANY has just been privately placed. This makes the total amount of the stock outstanding £360 000.

The balance of the ordinary capital, amounting to 72 999 shares, of the RANGOON ELECTRIC TRAMWAY AND SUPPLY COMPANY, recently offered for subscription at par, has been duly allotted.

A dividend of 3 per cent., tax free, for the half year, making 6 per cent. for the year, is recommended by the HALIFAX AND BERNARDS CABLE COMPANY.

A dividend at the rate of 5 per cent. per annum, less tax, has been paid by the SOUTH LONDON ELECTRIC SUPPLY CORPORATION on the ordinary shares for the half year.

A dividend of 9d. per share on the ordinary shares is announced by BRITISH INSULATED AND HELSBY CABLES. This is the same as a year ago.

THE MIDLAND ELECTRIC CORPORATION FOR POWER DISTRIBUTION has declared a dividend of 4 per cent. actual for the half year ended June 30.

THE DIRECT WEST INDIA CABLE COMPANY recommends a dividend of 3 per cent., tax free, for the half year, making 6 per cent. for the year.

FOR the half year ended June 30 the BRITISH ELECTRIC TRANSFORMER COMPANY made profit of £51 983, as compared with £35 344 during the same period last year.

Interim dividends for the half year ended June 30, at the rate of 6 per cent. per annum on the preference shares and at the rate of 10 per cent. per annum on the preferred ordinary shares, have been declared by STEWARTS AND LLOYDS, LTD.

The subscription list for the issue of £400 000 7½ per cent. prior lien debenture stock by the LANCASHIRE ELECTRIC LIGHT AND POWER COMPANY was closed on Monday at 11.30 a.m., having opened only the same morning.

The directors of DUMBARTON BURGH AND COUNTY TRAMWAYS COMPANY LTD., announce a dividend on the preference shares of 3 per cent. After appropriating £2 125 for debenture stock redemption sinking fund and £107 for loss on realisation of investments, £1 412 remains to be carried forward.

THE GENERAL ELECTRIC COMPANY (U.S.A.) announce dividend of \$2 per share on capital stock. The directors propose to alter the present payment of stock dividends in order, as far as possible, to avoid fractions. The new plan will substitute a dividend of 5 per cent., payable annually in shares of \$10, not participating in future stock dividends, but entitled to fixed cash dividends at 6 per cent. per annum. On Jan. 15, 1922, the present arrangement of 2 per cent. in stock and the usual cash dividend will, however, be paid.

The report of the SOUTHERN BRAZIL ELECTRIC COMPANY for 1920 states that during the year the company acquired further interests in Empresa de Melhoramentos Urbanos (Piracicaba) and Companhia Mogiana de Luz e Força. The revenue from these undertakings is proceeding on a satisfactory scale. For the purpose of repaying loans outstanding and for acquiring the additional interests in Brazil, the directors have issued the remaining £80 000 of debentures and have further issued 8 per cent. ten-year notes for £174 500. These issues are not included in the accounts. The profit and loss shows a debit balance to be carried forward of £37 850. The adverse result is due to the heavy losses incurred through the fall in Brazilian exchange and to increased charges for interest on loans, &c.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Partnership Dissolved.

McCULLOCK, Harry, and NEWITT, Homer, carrying on business as electrical and general engineers, at 44, New Park-street, London, under the style of McCulloch & Newitt, by mutual consent as from Aug. 31, 1921. Debts received or paid by H. McCulloch, who will continue the business.

Bankruptcy Information.

WATKINSON, Matthew, 22, Palmer-road, Sheffield, engineer; WATKINSON, Harold, 344, South-road, Sheffield, engineer; and WATKINSON, Arthur, 38, Palmer-road, Sheffield, engineer; trading in co-partnership as Watt & Co., at 22 and 24, Palmer-road, Sheffield, electrical and mechanical engineers. First meeting, Sept. 23, 12 noon, Official Receiver's Office, Freetree-lane, Sheffield. Public examination, Oct. 20, 2.30 p.m., County Court Hall, Bank-street, Sheffield.

Notice of Dividend.

JONES, John, and JONES, John Richard, carrying on business in co-partnership under the style of J. Jones & Son, at 7, Chapel-street, Penzance, electrical engineers. Last day for receiving proofs, Oct. 3. Trustee, William Carne Pezzack, Public-buildings, Penzance.

Company Winding-up.

MAXIM LAMP WORKS, LTD. A petition for winding-up was presented on Aug. 23, and is to be heard at the Royal Courts of Justice on Tuesday, Oct. 18. Any person who intends to appear on the hearing of the petition must give notice in writing of his intention, Hatchett, Jones, & Co., of 48, Mark-lane, London, E.C. 3, solicitors for the petitioners.

Companies Winding-up Voluntarily.

CITY ELECTRIC WELDING COMPANY (NEWCASTLE). LTD. Mr. John Crown Graham, Junr., accountant, 16a, Grainger-street, Newcastle-upon-Tyne, appointed liquidator. Meeting of creditors at the liquidator's office on Tuesday, Oct. 4, at 11 a.m.

SPENSERS LTD. Mr. F. A. Caddick, F.C.A., of Sharp, Parsons & Co., appointed liquidator.

Liquidators' Notices.

COMMERCIAL ELECTRICAL ACCESSORIES, LTD. (In voluntary liquidation.) Third dividend of 1s. in the £, payable at offices of Carter, Son, & White, 79, Wool-exchange, E.C. 2, Sept. 23.

LITTLE WONDER BATTERY COMPANY, LTD. (In voluntary liquidation.) General meeting of company at 26, Budget-row, E.C. 4, on Oct. 21 at 12 noon, to receive liquidator's report of winding-up.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors, we do not report subsequent county court judgments against him.]

CHARNOCK, M. J. 339, Icknield Park-road, Birmingham, electrical engineer. £22 1s. 7d. July 21.

ELECTRICAL MAINTENANCE COMPANY, LIVERPOOL. LTD., 142a, London-road, Liverpool, electrical engineers. £104 3s. 10d. July 20.

GOODSON, BEN, 63, Castillan-mansions, Maida Vale, electrician. £34 9s. 10d. Aug. 4.

GRATZ, LTD., 44 and 46, Whitefield-street, W. 1, electrical engineers. £31 9s. 10d. July 27.

RITCHIE, Ernest, 136, New-road, Battersea, electrical engineer. £14 12s. 4d. July 27.

SULLIVAN, W., trading as Royal Sovereign Lamp Works, 131, Oxford-road, Manchester, electric lamp manufacturer. £16 7s. 10d. July 21.

WORMMULL, F. A. S., trading as Lewisham Electrical Wiring Company, 273, High-street, Lewisham, electrical engineer. £18 10s. 1d. July 26.

Bills of Sale.

[The undermentioned information is from the Official Registry. It includes Bills of Sale registered under the Act of 1882 and under the Act of 1878. Both kinds require registration every five years. Up to the date the information was obtained it was registered as given below; but payment may have been made in some of the cases, although no notice had been entered on the Register.]

PETERSEN, Carl Albert, Summerhill, 13, Eglinton-road, Chingford, telegraph electrician and engineer for cable company. Sept. 12. £150.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

ELECTROLITE, LTD., London, E.C., engineers.—Registered Sept. 6, charge, to F. Durrant, 21, Russell-hill, Purley, merchant, securing advances made and to be made and other moneys which the charge may be called upon to pay under various guarantees: general charge. *£2,000. Dec. 13, 1920.

RAMSDEN GREEN, LTD., London, S.E.—Registered Sept. 6, £500 debentures; general charge. *£11,000. Sept. 17, 1920.

Deed of Arrangement.

PALMER, Chas. Edwd., and AFFORD, Sydney Allestree, trading at 32, St. Giles-street, Northampton, as Palmer & Company, electrical engineers. Trustee, F. Kilby, Drury Chambers, Market-square, Northampton, I.A. (Filed Sept. 14.) Secured creditors, £40; liabilities unsecured, £742; assets, less secured claims, £347. Creditors include:—Braulik, G. London, £17; Daniel, H. W., London, £96; Ediswan Electric Company, Ltd., London, £72; Electrical Supplies Company, London, £49; Freemans Accessories Company, London, £12; Holophane Ltd., London, £12; Siemens Bros. Company, Ltd., London, £22; Sloan Electrical Company, Ltd., London, £10; Times Electric Company, Ltd., London, £10; Electrical Specialties Company, Liverpool, £15; Day, F. S., Northampton, £14; Johnson & Wright, Ltd., Northampton, £18; Premier Accumulator Company, Ltd., Northampton, £42.

Books Received.

"The Electrical Contractors' Year Book, 1921-22." (London: Electrical Contractors' Association.) Pp. 274.

"Aggregation and Flow of Solids." By Sir George Beilby, F.R.S. (London: Macmillan and Co.) Pp. xv.+256, 34 plates. 20s. net.

"The Transition Spiral and its Introduction to Railway Curves, with Field Exercises in Construction and Alignment." By A. L. Higgins, M.Sc. (London: Constable and Co.) Pp. viii.+111. 6s. net.

"Aluminium and Its Alloys." By C. Grand. Translated by C. M. Phillips and H. W. L. Phillips. (London: Constable and Co.) Pp. xxiii.+184. 17s. 6d. net.

Prices of Metals, Chemicals, &c.

			TUESDAY, SEPT. 20.		
			Price.	Inc.	Dec.
Copper—	Best selected	per ton	£69 10 0	£1 5 0	—
	Electro Wirebars	..	£74 10 0	£1 10 0	—
	H.C. wire, basis	per lb.	0s. 11½d.	¾d.	—
	Sheet	..	0s. 11½d.	¾d.	—
Phosphor Bronze Wire (Telephone)					
Phosphor-bronze					
	wire, basis	..	1s. 3½d.	4.	—
Brass 60/40					
	Rod, basis	..	0s. 8d.	—	—
	Sheet, basis	..	0s. 10½d.	—	—
	Wire, basis	..	0s. 11½d.	—	—
Pig Iron					
	Cleveland Warrants	per ton	£6 15 0	—	—
	Galvanised steel	..	—	—	—
	wire, basis S&GW	..	£23 0 0	—	—
Lead Pig					
	English	..	£24 0 0	10s. 0d.	—
	Foreign or Colonial	..	£22 17 6	—	15s. 0d.
Tin—					
	Ingot	..	£154 12 6	£12 6	—
	Wire, basis	per lb.	2s. 1½d.	1d.	—
	Sal ammoniac.—Per cwt. 65s.-60s.	..	—	—	—
	Sulphur (Flowers).—Ton £13.	..	—	—	—
	" (Roll-Brimstone).—Per ton	..	£65.	—	—
	" £13.	..	—	—	—
	Sulphuric Acid (Pyrites, 168°).—	..	—	—	—
	Per ton, £9 17s. 6d.	..	—	—	—
	Rubber.—Para fine, 1s. 0½d.; plantation 1st latex, 8½d. lb.	..	—	—	—

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber prices by W. T. Henley's Telegraph Works Co.

The Editorial, Advertisement and Publishing Offices of "THE ELECTRICIAN" are at 8, Bouverie Street, London, E.C. 4. Telegrams: Benbroctio, Fleet, London. Telephone: City 9852 (5 lines).

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Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by MISSAS. M. WILKIN, ELITE & Co., Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.2.

COMPLETE SPECIFICATIONS.

- 10511 14 MOULIN. Electro-thermal apparatus for limiting the charge of accumulators. (13/13.)
 132 458 FRISHER ARTGES R. Electric water heaters. (9/12/16.)
 138 642 FRISHER ARTGES R. Electric lamp with luminous discharge. (26/4/18.) Addition to 135 485.
 138 866 COMBONI, G. Electric switches. (30/1/20.) (Convention date not granted.)
 141 046 WISSENER ELMETER (G. LTD. Electric oscillation generators. (1/6/15.)
 141 360 EUBAN, R. Electro-magnetic couplings. (13/3/19.)
 141 706 SIEMENS-SCHUCKERTWERKE GBS. Vacuum tubes. (27/1/17.)
 141 711 TURCAT, L. Automatic telephony. (10/4/19.)
 143 507 Soc. INDUSTRIELLE DES TELEPHONES. Self-induction coils for telephone circuits. (22/5/19.)
 143 680 MARCONI'S WIRELESS TELEGRAPH CO., LTD. Vacuum tube apparatus and method of controlling same. (14/6/19.)
 146 528 RADIO CORPORATION. Method and apparatus for radio signalling. (6/1/16.)
 147 432 GBS. FÜR DRAHTLOSE TELEGRAPHIE. Telegraphy. (9/11/16.)
 148 330 HUTER, GBS. DR. E. F. ROSENBAUM B. & ROTTGARDT, K. Dynamo-electric machines for use on aircraft. (1/2/16.)
 149 944 COUAILLET, A. Electric vehicles with storage batteries. (19/8/19.)
 151 650 PHILADELPHIA STORAGE BATTERY CO. Separators for the elements of electric storage batteries. (17/5/15.) (Divided Application on 143 493.)
 152 321 SENEZE, M. P. Sparking-plugs for internal-combustion engines. (18/7/19.)
 154 536 HANSON, E. C. Telephone apparatus for the deaf. (11/6/19.)
 156 637 FROESE, W. Electrodes for introducing medicaments into the human skin. (16/5/19.)
 158 806 VICKERS, L. S. & FIELD, A. B. Cooling of dynamo-electric machines. (19/6/18.)
 158 814 GRAHAM, E. A. Telephonic systems. (14/1/19.)
 158 920 CREED, F. G. & CREED & CO., LTD. Telegraphic receiving apparatus. (19/9/19.)
 158 921 CREED, F. G. & CREED & CO., LTD. Telegraphic receiving apparatus. (25/3/19.)
 158 822 MORDEY, W. M. Electro-magnetic separation or concentration of minerals. (13/1/19.)
 158 823 MARSH, C. W. Electrolytic cells. (23/4/19.)
 158 824 ROYND, H. J. Thermionic transmitting devices for wireless telegraphy and telephony. (5/5/19.)
 158 931 MARSH, C. W. (Taft-Pierce Manufacturing Co.). Magnetic chucks. (2/7/20.)
 158 880 DAWSON, SIR A. T., & BOCKHAM, SIR G. T. Electrical switches. (3/1/20.)
 158 888 BRYDON, S. Controlling electric instruments or apparatus by means of vacuum tubes. (29/1/20.)
 158 889 MACROBIE, A. K. & SHEARING, G. Electrically-operated relays for use with valve sets for transmitting wireless signals. (2/2/20.)
 158 892 HATHED, H. S. & IMPERIAL TRUST FOR THE ENCOURAGEMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH. Method and apparatus for the electrostatic separation of materials. (7/2/20.) (Cognate Application 31242/20.)
 159 901 FELDAMP, F. Electric incandescent lamps. (2/3/20.)
 159 903 OGDEN, A. Sparking-plugs for electrical ignition systems. (3/3/20.)
 159 917 HODGES, H. C. Electric switches. (22/3/20.)
 159 922 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). Protective devices for electric circuits and apparatus. (26/3/20.)
 159 936 SCHROEDER, G. Cooling of electrical apparatus. (1/4/20.)
 159 937 SCHROEDER, G. Means for carrying off heat generated in electrical apparatus. (1/4/20.)
 159 938 BRITISH THOMSON-HOUSTON CO., LTD., & YOUNG, A. P. Magneto-electric machines. (1/4/20.) (Addition to 142 744.)
 159 945 BRITISH LITING & LUMINOUS CO., LTD., & TRUVER, E. O. Dynamo-electric systems for use on automobiles. (6/4/20.)
 159 955 DENNIS, G. P. Means for supporting porcelain, or the like electric light fittings. (8/4/20.)
 159 957 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). Ventilating systems for dynamo-electric machines. (8/4/20.)
 159 959 ROYND, H. J., & McLELLAN, A. Wireless signalling systems. (8/4/20.)
 159 961 BRITISH THOMSON-HOUSTON CO., LTD., & WHITAKER, F. P. Dynamo-electric machines. (9/4/20.)
 159 970 POTTER, E. B. Thermo-electric systems for the production of electrical energy. (12/4/20.)
 159 971 LAMBERT, A. Automatic telephone and the like systems. (13/4/20.)
 159 977 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). Protective devices for electric circuits and apparatus. (19/4/20.)
 159 985 IONIAN ELECTRIC CO., LTD. (Cutler-Hammer Manufacturing Co.). Method of and apparatus for utilising an electric current to produce a modified current or a correspondingly modified magnetic flux. (22/4/20.)
 159 986 IONIAN ELECTRIC CO., LTD. (Cutler-Hammer Manufacturing Co.). Apparatus for utilising an alternating current of a given frequency to produce an alternating current or alternating magnetic flux of a different frequency. (22/4/20.)
 159 994 CROWTHER, H. McDONALD, L. A. AIRET, H. MORRIS, & JEVING, G. H. Wireless telephony and telegraphy. (27/4/20.)
 160 008 DIERGEN, F. C. Preventing oxidation and volatilisation of the contacting points of electrical and like apparatus. (30/4/20.)
 160 027 SIEMENS BROS. & CO., LTD., & BAKER, F. Impulse transmitters for telephone systems and the like. (8/6/20.)
 160 078 OSTING, G. F. Electric switches. (9/11/20.)
 160 084 HIRST, J. A., & BROOK, P. S. Switch-gear for controlling electric motors. (10/7/19.) (Divided Application on 155 614.)

APPLICATIONS FOR PATENTS

April 15, 1921.

- 10 900 QUILLIAM. (Electric Railway Improvement Co.) Rheostats.
 10 977 VELAYVIN. Electric generators
 11 007 EURA. Transmission systems with electric diaphragms for sound boxes of talking machines. (19/4/20, Belgium.)
 11 026 REDDIE. (Consorzio per Elettrotecnica.) Suspension of electric contact wires.
 11 035 PHILLIPS. Machines for slotting insulation between commutator bars.
 11 049 B. T. H. Co. (G. E. Co.) Electro-metalurgy.
 11 061 RADIO COMMUNICATION CO. & SCOTT-TAGGART. Signalling systems, particularly wireless modulation systems.

- 11 065 FEROLITE, LTD., & CLAPP. Gas producers, electric furnaces, &c.
 11 069 BOWER. High-frequency apparatus.
 11 070 HUNT. Switch.

April 16, 1921.

- 11 091 NOBLE. Trolley head for electric trams, &c.
 11 120 ALLMÄNNNA SVENSKA ELEKTRISKA AKTIEBOLAGET. Reducing capacity ground current in h.t. transmission systems. (16/4/20, Sweden.)
 11 121 ALLMÄNNNA SVENSKA ELEKTRISKA AKTIEBOLAGET. Arrangement of neutral-point resistances for h.t. transmission systems. (16/4/20, Sweden.)
 11 125 GELBART & GRIFFITHS. Electric switches.
 11 127 C. L. MANUFACTURING CO. & WATSON. Electric lighting and ignition systems for motor vehicles.
 11 131 EDISON SWAN ELECTRIC CO. & SIERGOLD. Quick make and break switches.
 April 18, 1921.
 11 152 BUTLERS, LTD., & REEVES. Switches.
 11 167 RAWSON. Apparatus for recording telephone calls.
 11 182 VALEN. Combined electric safety devices and insulators. (16/4/20, Norway.)
 11 192 PLATZCHICK. Fusible cut-outs for motors.
 11 235 OLDHAM. Electric lamps to be carried on the person.
 11 236 OLDHAM. Galvanic batteries.
 11 237 OLDHAM. Cut-outs and resistances.
 11 239 SUTTON. Switches.

April 19, 1921.

- 11 273 THOMAS. Transformer regulating switches.
 11 274 TOOTH & WILLMOT. Telegraph keyboard perforators.
 11 286 THWAITES. Oscillating brush gear for electrical machines.
 11 289 PLETENYER, ELEKTRISCHES GLÜHLAMPEN. Tungsten arc lamps. (28/4/20, Germany.)
 11 299 SCLATER. Automatically controlled generating plants.
 11 301 DURHEIM. Contact plugs. (19/4/20, Switzerland.)
 11 323 BRAY. Electrically actuated mechanism for producing sliding or rotary motion.
 11 326 COMPRESSION STARTER & SWITCHGEAR CO. & LOMAX. Switches.
 11 335 PETERSEN. Copying telegraphs. (17/6/20, Norway.)
 11 340 BATHY. System of pole-changing for polyphase induction motors. (19/4/20, Hungary.)
 11 356 HORVATH & VON MARTONYI. Switch. (8/5/20, Hungary.)
 11 363 BECTON. Apparatus for converting heat into electrical energy.

April 20, 1921.

- 11 312 WESTERN ELECTRIC CO. Telephone repeaters.
 11 375 WAGNER. Battery.
 11 388 FREW, MACMILLAN & GRAHAM. Telephone sterilizer.
 11 392 THOMPSON. Anti-vibration devices for incandescent lamps.
 11 395 FORSTER. Electric machines.
 11 398 HUNPHRY. Switch.
 11 402 & 11 403 TAYLOR. Improving current-carrying capacity of three-phase cable systems.
 11 427 WESTERN ELECTRIC CO. Hand sets.
 11 433 SIMS. Electric horns for motor cars, &c.
 11 441 GERARD. Oscillation deadening device.
 11 446 WESTINGHOUSE BRAKE & SAKBY SIGNAL CO. Control of electrically operated hand compressors. (31/8/20, U.S.)
 11 467 CASE. Electric device for treating air.
 11 469 ANDREW. Electric geyseis.
 11 473 BAYERISCHE VEREINSBANK. Electric fire, burglar, &c., alarms. (20/4/20, Germany.)

April 21, 1921.

- 11 475 HITCH. Increasing efficiency of electro-magnetic radiation.
 11 511 COX. Containers for batteries.
 11 516 JUDGE-ZUMBAHL. Automatic cut-out or switch for electrically heated apparatus.
 11 517 NEW ECCLYS RHYMES WORKS, LTD. Containers for batteries, &c.
 11 550 METROPOLITAN-VICKERS ELECTRICAL CO. Electro-magnetic switches or contactors. (23/4/20, U.S.)
 11 562 ARGILL. Lead for arc lamps.
 11 565 BERRY & MARKHAM. Electric irons.
 11 568 KNEOKORSKY. Electric cooking devices (14/5/20, Czechoslovakia.)
 11 569 HUGHES. Tinned high-frequency amplifiers.
 11 599 DENMORE. Electric devices for heating fluids.

April 22, 1921.

- 11 602 CHRISTMAS. Magnetos.
 11 609 LAMBOT. Transmitting apparatus for automatic telephones, &c.
 11 647 BAYLEY & McREYNOLDS. Electrical show case and advertisement holder.
 11 660 BRUNELL, MUNRO & ROGERS. Slipper trolley heads.
 11 660 HAYHURST. Electric heaters.
 11 667 FERRANTI, LTD., & HIGGS. Current transformers.
 11 673 Soc. DES TELEGRAPHES MULTIPLEX (Système E. Merodier-H. Merodier). Amplifier for electric circuits. (24/4/20, France.)
 11 678 BRUGAROLAS. Aerial conductors.
 11 679 ANSAS. Arc lamps.
 11 682 BRITISH THOMSON-HOUSTON CO. Protective devices.
 11 700 RANSDORF. Nijlroloze Vereniging Nederlandische Radio Industrie). High-frequency telephones.
 11 706 NAAIMLOOZE VENNOOTSCHAP PHILIPS GLOELAMPFABRIEKEN. Lamps for road vehicles. (1/5/20, Holland.)

April 23, 1921.

- 11 732 WOODBURN. Electrodes for resistance welding processes.
 11 782 Controlling or regulating arc lamps, &c.

April 25, 1921.

- 11 799 WORTHINGTON. Method of compressing water for power purposes and generating electricity.
 11 807 MIDLAND ELECTRIC MANUFACTURING CO. & BARBER. Fuse boards, fuse boxes, &c.
 11 816 ELADON. Electric lamps.
 11 821 HALL. Electric connections.
 11 821 WOOTTON. Accumulator charging board.
 11 829 BARNARD. Flexible electric machines with cooling vanes for electric machines. (4/4/19, France.)
 11 837 CALLENDER'S CABLE & CONSTRUCTION CO., WARBURG & GIBSON. Insulated electric wires, &c.
 11 844 BARLOCHER. Electric motor controllers.
 11 857 METROPOLITAN-VICKERS ELECTRICAL CO. & JOHLEN. Electric machines.
 11 863 FOSTER. Measurement of temperature by electrical resistance thermometers.
 11 865 VANDY, LTD., & KILLEEA. Dimming electric head-lamps.
 11 890 PARSONS. Electric heating. (26/4/20, Sweden.)
 April 26, 1921.
 11 807 SOUTTER. Electric kettles.
 11 911 NIBLETT. Primary and secondary batteries.
 11 920 MARSHMAN. Flexible electric conductor.
 11 932 STUDEN GBS. FÜR ELEKTRISCHE BELEUCHTUNG. Method of operating discharge tubes or electric gas lamps with glow discharge.
 11 943 KIRK. Electric burglar alarms.

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Notes of the Week.

Building for To-day or To-morrow?

THERE has always been a conflict of opinion among engineers, architects and those other classes of the community whose business it is to erect edifices of a more or less lasting character, whether it is best to build for posterity or deliberately to shorten the life and, incidentally, to cheapen the erections, in the sure and certain hope that before they have outlived their usefulness improvements will have rendered their design and construction out of date. This point has recently been raised in an interesting form in connection with some timber buildings which have been erected at the Gresham School, Holt, Norfolk, for art classrooms and biological laboratories. It is claimed that these more or less temporary buildings, which can, of course, be put up at a very much lower cost than a more permanent structure, will have outlived their usefulness by the time they have fallen into decay owing to the constant development of educational thought and methods, and that to adopt this form of construction is, therefore, in accordance with the highest economic policy. The same thought occurred to us in reading of a wireless mast made of concrete. A fine idea this, no doubt, but a mast made on these lines may with pardonable exaggeration be said to have a life running into centuries. Do we want a wireless mast that will last for centuries? We think not, for, as was shown in an article by Mr. S. P. WING, published in THE ELECTRICIAN a week or so ago, little is known about one of the most important factors in wireless mast design, and we may even be said to be almost wholly ignorant of the lines upon which the construction of this important item of equipment should be most efficiently carried out. Building wireless masts to last for ever is, therefore, bad policy, and it would be better to go slowly rather than to expend much time, ingenuity and money in erecting some permanent form of construction which in a few years time the march of events will render quite out of date.

Standardisation and Proving.

THE point which we have just made, that caution must be exercised in making the construction of our apparatus too permanent, may as well be applied to the standardisation of electrical apparatus as to the construction of wireless masts. We are glad to see that it has been so applied in the specification for air break circuit breakers which has recently been issued by the British Engineering Standards Association. This specification, it is well to note, is prefaced by a slip pointing out that before certain conditions in the construction of circuit breakers can be laid down with accuracy much research is necessary, and that this research work is being undertaken by the Electrical Research Association. It must, in fact, be realised that these specifications of the British Engineering Standards Association, illuminative and useful as they are, are not to be considered as the goal of our journeyings, but merely as mile posts on the long road of progress. An example of this in the design and standardisation of breakers of all types, and particularly of oil circuit breakers, is the difficulty of assigning an ultimate breaking capacity. It is very easy to state the terms in which breaking capacity shall be referred to, but there is nothing which enables this value to be determined for any given design, and manufacturers even do not yet possess complete data for their own apparatus. The specification in question may, therefore, be considered a further argument, if further argument is needed, in favour of the early establishment of an electrical proving house. If such a proving house were available it would be at least possible for its staff to determine the breaking capacity of any particular piece of apparatus.

Dielectric Tests Confusion.

ONE point that requires emphasis in connection with these documents is that in the specifications for knife switches, brush switches, and circuit breakers the dielectric tests are the same, and that these tests are inconsistent with those in the other specifications issued by the Association. It is really an occasion for drastic revision.

For example, in the case of integrating meters the insulation test specified is twice the rated voltage with a minimum of 1 000 V. But face plate starters over 1 h.p. are required to be tested at twice the rated voltage plus 1 000 V, while indicating and graphic instruments with working pressures between 25 and 1 000 V must conform to a test of twice the rated voltage plus 500 V. These discrepancies lead to some curious results, which, though perhaps not causing practical difficulties, are worth calling attention to in the interests of standardisation. It is possible, for instance, that all the various classes of apparatus we have just mentioned might be mounted together on one switchboard. If such a switchboard were intended for a working voltage of 550 V, the switches or circuit breakers would have to be tested at 2 100 V, the integrating meters at 1 100 V and the indicating or graphic instruments at 1 600 V, and in carrying out this series of tests the standard specification would have been complied with in each particular case. It is, therefore, obviously desirable that the various interests should come together with a view to ensuring that in future specifications standard dielectric tests common to all equipment, which may be mounted together, shall be laid down, otherwise the Comic Spirit, whose presence is undesirable on such occasions, will gain an ascendancy.

Electricity Supply in South-East Lancashire.

THE South-East Lancashire Electricity Committee possesses the distinction of being the first to put forward a scheme for electricity supply after that period of inaction and recuperation known as the vacation. Now that breathing space has passed it is evident that the Electricity Commissioners will soon find the demands on their time, necessitated by a consideration of the schemes into which they have already held enquiries and by similar investigation into those which have yet to see light, almost more than they can efficiently deal with. The South-East Lancashire Electricity Committee have, therefore, done well to be first in the field. The scheme which they put forward is interesting in two ways. In the first place, with true Lancashire caution, the formation of an Advisory Committee only is suggested to begin with, and such matters as the finance and management of the electricity undertakings will for the time being be left in their present hands. In due course, however, the formation of a Joint Electricity Authority may come about when propaganda, education and success show that course to be possible without engendering too many municipal jealousies. In the second place, as is only right in a commercial area such as South-East Lancashire, the Committee base their case for extended co-operation on some very striking figures, which show the savings that will be obtainable by adopting combination rather than parish pump methods.

How Combination Will Save.

FROM these figures it appears that to meet the demands for electricity supply which may be reasonably expected within the next five years a capital expenditure of £8 178 000 will be necessary, if present methods of generation and distribution continue to be used. Under the scheme suggested by the Committee this sum would be reduced to £6 801 880, a saving of £1 376 120 in capital and £137 612 in interest at 10 per cent. In addition, there would be a considerable reduction in coal consumption amounting in money to £34 704 per annum, and the economies under these two headings would be further increased during the five years from 1926 to 1931 as

capital stations were built and the small and inefficient generating plant relegated to the scrap-heap. Very little has yet been published about technical details, but we have no doubt that these will follow the usual lines; indeed, such matters may be well left in the hands of the Electricity Committee. One peculiar point in this connection is, however, that Stalybridge may be left out of the scheme because its system differs from the normal. We hope that this is not seriously meant, as were such a policy to be generally followed the difficulty of obtaining a standardised system through any one area would be largely increased. To co-ordinate differences in systems is undoubtedly a difficult problem, but the difficulty will not be decreased as time goes on. It must be settled some time, and the sooner the better.

An Illogical Impost.

AT a time when the country is struggling under adverse conditions to regain its former trade prosperity it is almost axiomatic to say that the Government's first duty should be to ease the path of the trader in every possible way, so that not only may it be possible to open up fresh markets by reducing the price of commodities and increasing their production, but so that a steady flow of capital shall be available for the development which is necessary to the well-being of every trading undertaking. We are not among those who consider that taxation is an unmitigated evil, but when taxation stands at its present high figure the question of its incidence becomes of great importance if widespread harm is not to result. For if taxation is high and its incidence is almost penally oppressive it follows that trade and industry are hampered from the very beginning, and that their proper development becomes almost impossible. As we have pointed out before, the Corporation Tax, considered from these points of view, is both bad and illogical. At any time the big trader is better able to look after himself than is the small, and the wind of taxation should be tempered accordingly, yet the Corporation Tax presses most heavily on the small class of traders it should have been the first duty of the Government to encourage, as, although their operations are often conducted with singular short-sightedness to their own interests, they are still the backbone of national industry.

Encouraging the Small Trader in France.

IT is interesting to note that this has been long recognised in France, where the Government offer small investors national bonds of low denomination. This policy has encouraged the small manufacturer, the shopkeeper and smallholder, and has resulted in a consolidation and welding together of those classes into a large body of small proprietors imbued with a spirit of thrift. A similar consolidation is very necessary in the British electrical industry, where the unstable financial conditions of many small firms is a drag on the progress of all. This French lesson is one which our own Government might therefore well take to heart, and one they must take to heart if proper representations are made. We therefore hope that before long facts and figures will be put forward by trading associations in union showing the Chancellor of the Exchequer that in continuing the operation of the Corporation Tax he is bringing about a state of affairs in the country from which the Government must eventually suffer profoundly. But it is a time for action, grumbling by itself is not sufficient, and the necessary relief which is essential will not be obtained unless something is done and done quickly.

A Significant Combination.

A PARTNERSHIP which will be of great interest to the engineering world is announced between Sir CHARLES BRIGHT, Mr. A. HUGH SEABROOK, Mr. A. J. STUBBS and Lieut.-Colonel H. W. WOODALL, under the style of Sir Charles Bright & Partners, Electrical Engineers, with offices at 146, Bishopsgate, London, E.C. 2. With perhaps the exception of Lieut.-Colonel Woodall, the names and achievements of the partners in this new firm are familiar to readers of THE ELECTRICIAN. Sir CHARLES BRIGHT, the senior partner, like his father before him (who was knighted at the early age of 26 for the laying of the first Atlantic cable), has been active for many years in the development of land, submarine and wireless telegraphy, and is also closely identified with progress in aeronautics and the air service. Mr. A. H. SEABROOK was among the pioneers, and certainly one of the most energetic exponents of the domestic electric idea. He was a founder-member of that transient and exclusive society, the "Point Fives," which we hope to see re-created at an early date. Since that time Mr. SEABROOK has led a far from cloistered existence, and his wide experiences of engineering matters will stand him in good stead in his new venture. Mr. A. J. STUBBS until quite recently was assistant engineer-in-chief of the Post Office, while Colonel H. W. WOODALL, though trained as an electrical engineer, is now a director and consulting engineer to a number of gas and water companies. Surely an unusual galaxy of talent in one firm. We understand that in addition to advising upon the installation and operation of telegraphs, telephones and wireless telegraphy, the firm will also undertake work in connection with electrical, gas, water and colliery engineering, especially in connection with fuel conservation in its relation to the design and construction of power plants and in the utilisation of low-grade fuels and carbonaceous materials hitherto regarded as waste products. In carrying out this work they will handle both electrical and gas matters, combining the two in much the same way as do the Edison Commonwealth Corporation in Chicago. We wish the new venture every success.

Signs and Wonders.

WITHIN the last few days a change, which we shall not attempt to explain, has been visible in the attitude of the daily Press towards electrical matters generally. It has long been the custom of our contemporaries, of the pomp and circulation of journalism, to regard electrical phenomena as being fit matter, on the one hand, for inclusion in the realm of Utopia, and, on the other hand, as part of the weird policies of the kingdom of Laputa. As both these aspects are equally diverse from real fact, it is not surprising that they have been equally successful in giving the general public an entirely wrong idea of what electricity can do and what the electrical engineering industry really is. However, as we say, that has been changed, we hope, permanently. The change is emphasised by a moderate and well-written article on the Electricity Commissioners' great task which appeared in a recent issue of the "Westminster Gazette," and by the no less moderate and well-written article on the woman's view of electricity in domestic life which appeared in a recent issue of the "Times." The latter article deals in a just and unexaggerated manner with the part that electricity can play in domestic life, and, though extenuating nothing as to cost and design of the apparatus, at any rate it sets down nothing in malice, which is just what every electrical engineer worth his salt wants at the present time.

Is the B.A. Responsible?

WE are not certain whether we should not ascribe this change, which we regard as most important, to the influence of the British Association. If they are truly responsible we lose no time in offering them our sincere congratulations. That their influence has something to do with it is evident from an article which appears in the current issue of the "Newspaper World," where a journalist describes his experiences of scientists telling him what a good thing it would be for journalism if the very foolish statements on scientific subjects which frequently pass the editorial eye were prevented from publication. According to this correspondent, both astronomers and chemists complained of the perverted views of the progress of their science that is constantly put before readers of the daily papers, and the electrical engineer has no less just cause for complaint on this score. For this perversion is really unnecessary, especially as the truth would be just as interesting as the fiction. It is not a question of money. The resources at the disposal of our leading newspapers at the present day enable them to go to the very fountain head of knowledge, and to obtain from those who really know just and accurate pronouncements on any matter of scientific interest. Now, at this time of day matters of scientific interest are also of public interest, and it is axiomatic that the public interest is what newspapers are most anxious to serve.

A Pseudo-Engineering Society.

WHEN we received a pamphlet setting out the aims and objects of the British Society of Engineers we naturally expected that it had been resolved to form one more of those institutions which grow up, mushroom-like, on the fair expanse of science and technology. The British Society of Engineers is, however, of quite another kidney. It is true it invites members to hold meetings, lectures and demonstrations, but its avowed life's work is the eradication of alien finance from Great Britain and the publication of information regarding the growing peril of Jewish domination in Great Britain and the Colonies. We know a little of the baleful influence of alien finance in the development of British industry, and we also know a little of the influence and enterprise, whether they be baleful or otherwise, of the extraordinary nation against which the British Society of Engineers is to wield its puny lance. To eradicate both these influences is obviously a matter with which it is competent for any society to deal; but neither of them is an engineering question, and it is something akin to a misrepresentation of an honourable term to use the word "engineer" in the title of a society which is primarily intended for political propaganda. We care little whether the British Society of Engineers achieves its objects or not, but we think it right to utter a word of warning to those who might consider applying for membership without knowing for what its promoters are really working.

The Relief of Unemployment

UNDETERRED by the lessons of last winter, when, had they had vision, they would have read the meaning of certain signs and portents in the industrial sky, the Government and the trades unions have so far failed to determine a course of action which shall bring a solution of the difficult problems of unemployment. Consideration of this vital question has been postponed and postponed

until, at a time when matters may be reasonably expected to get worse rather than better, a panic unwontedly disturbing the calm of the holiday season has broken out.

Doing Less Than Nothing.

All the parties most intimately concerned with this problem have, in fact, done less than nothing, for both their policy and their actions have made a state of affairs that was already bad worse than pure neglect could have done. On the one hand, the delay in the removal of bureaucratic control erected a vast obstacle to commercial development, and this obstacle was developed by the squandering of the nation's resources. On the other hand, the long cessation in the production of coal, at a time when our trade showed some signs of revival, reacted unfavourably not only on the miners themselves, but on every other worker in the country, and reduced British industry almost to bankruptcy. At least £70 000 000 has been directly lost by the dispute, and the indirect losses are incalculable. This cessation of production, combined with the state of the exchanges and the financial exhaustion in other countries, has caused our export trade almost to vanish, and has made the rebuilding of our commercial prosperity a matter of extreme difficulty by the forcing up of the cost of production, which has been its natural corollary. There is also a general lack of recognition of the fact that all trade, and so all employment, depends on the cost of production, and that the cost of production depends ultimately on the willingness, or ability, of the consumer to pay. High prices and low production will never bring trade recovery. Low prices and high production, which does not mean low wages, will. At present stagnation is universal condition, and unemployment follows as a matter of course. Here, then, is the problem which requires immediate solution. How can it best be solved?

The Results of Inertia.

Without accusing either persons or parties, we must state it as our opinion that had the perfectly patent warnings that were published recently as to the results of certain courses of action been heeded the present state of affairs need never have come to pass. The removal of some, at least, of the Government restrictions in the spring of the year left trade more or less free to expand, though this expansion could only have been of full effect had it been accompanied by a reduction in price and by an increase in production. But the inertia resulting from Government control caused a delay in the general adoption of a business-like policy with regard to sales development, prices and profits on the one hand, and, on the other, led Labour to believe that wages could be maintained at an uneconomically high level without disaster to themselves. Had a reduction in price and an increase in production been accompanied by an intensive selling campaign, and had taxation been less oppressive, the rot that was setting in might well have been stopped before it was too late, though even then the way to recovery would have been hard and difficult owing to world-wide financial exhaustion. Once again, however, Labour worked, in a sense, contrary to its own best interests, and it is, therefore, not unnatural that the coal dispute caused both an almost complete strangulation of trade, and the growth of a feeling of pessimism akin to despair in the trading community. This despair, added to the inertia which we have just mentioned and a desire to continue war-time methods of doing business, has done much to postpone the recovery of our trade.

It was doubtless hard after the easy money of the war for traders to get down to real hard work, but to do so was necessary before the coal strike, and is even more necessary now. But it must not be forgotten that recovery can only be achieved in combination with Labour, and that that combination can only be brought about by a change of heart on the part of all concerned, of which change, with certain exceptions, there is, unfortunately, little sign.

The Wider Problem.

That is the wider problem. Real recovery of trade will not be achieved until it is solved. But, unfortunately, to build up trade is not so easy as to destroy it. At best it can only be a slow process, and, meanwhile, there is the imminent difficulty of widespread unemployment urgently waiting to be solved. So urgent is this problem that it is perhaps natural that courses that can only be dictated by panic are being suggested for its removal, and that is a superlative reason for pleading that the measures that will certainly have to be taken shall really assist in removing the cause of the evil, and not merely temporarily alleviate it, for the disease to break out afresh, like a forest fire, in some new place. Temporary measures, in fact, must be taken along the road to permanent solution so that the canker of unemployment may be removed once and for all.

The Employer and Employee in Partnership.

In writing on this subject some months ago we said that the only real remedy for unemployment was the resumption of trade and industrial activity. We still hold to that view, and to the further opinion that the real solution will emerge more quickly from joint action than in any other way. As Mr. AUSTIN HOPKINSON recently said in erecting an extraordinarily wrong argument on some sound premises, there is no conflict of interest between the employer and the employed. It is, in fact, to the real interest of both that the prosperity of the undertaking with which both are connected should increase, and, contrary to the Marxian doctrine, this can most easily be achieved by both employer and employed working their hardest for the common end.

Unemployment a Problem for Individual Industries.

The real remedy for unemployment lies directly with each industry and with each undertaking in that industry. It lies not in doles or in relief work, which must at their best be uneconomical, and at their worst must attract those who might be in useful employment to labour which they are often not fitted to perform. So little is it a Government problem that we agree with Lord ASQUITH that the real remedy, not the mere palliative, lies in each industry taking care of its own unemployment. We have no wish to treat man as a machine. But while insurance against fire, loss, and other commercial risks is undertaken by all firms as part of their ordinary trading operations, and it would be rightly considered ridiculous that such risks should be met by the State subsidies, yet insurance against unemployment is generally considered a matter with which the individual employer or industry need not deal, and its alleviation is thought to be a matter for the State or the local authorities to deal with by means of any sort of patent medicine that is popular at the moment. This hand-to-mouth method of treating the matter is, we think, largely due to a neglect to perceive a change that has been taking place in commercial values. Not so long ago machinery was expensive and labour was cheap. Now labour is less cheap than machinery.

It has become a most valuable commodity, and it should be insured accordingly. And as employees are most directly concerned in their own employment, they must rightly take a share in providing against the risks they have to run.

The First Essentials.

Such a policy is, however, not of immediate application. For the moment production, economy, and sales propaganda are the first essentials for bringing about an improved state of things in the labour market and for reducing unemployment to a minimum. For the Government to buy stores which they do not want at the taxpayers' expense, or to control profits, or to shorten the working week, is no real solution. It is no time for Socialism, but for individual working for the common good. It is no time for theory. It is the time for the most definite practice. For unemployment is not a necessary component of industrial existence, certainly not at the moment. For the world is sorely in need of goods. In supplying that need all the labour available, and more, could easily be absorbed. It only requires that the price of the articles placed on the market shall be such as will enable the impoverished countries to buy, and that can only be brought about by closely following economic laws, however unpalatable such a course may be. As the PRIME MINISTER has truly said, it is a matter for the co-operation in the interests of the country of the Government, the local authorities, the manufacturers, the traders, the bankers and of organised Labour, and we are glad to learn that conferences with this end in view are to be arranged, and that the official policy is to be to assist industry rather than to relieve unemployment. It is not a time when any individual or section of the industry can afford to idle and to demand help. It is a time when every individual and every section must help itself.

The Third Party in Industry.

WE have never concealed our opinion that the organisation of the salaried classes is a matter which should be taken in hand without delay, not only in the interests of the individuals forming those classes, but as a safeguard to industrial peace. But, as we have pointed out on a previous occasion, the building up of such an organisation is attended by more than the usual number of difficulties. If care is not taken a society which draws its membership from the salaried classes runs the risk of becoming merely a camouflaged employers' association on the one hand, or, on the other, of being enlisted openly or covertly under the Trades Union banner. In either event it must be a failure—a failure, that is, so far as it is designed to protect the interests of the salaried classes against an invasion of their territory from above or below. For, though in some ways its interests are indistinguishable from the interests of employers of labour, and, on the other, are closely allied with what is conveniently called Labour, the salaried class in the engineering industry has certain definite concerns of its own whose growth would be stunted, if not killed, by a formal alliance with one side or the other. It is, therefore, of the highest importance, that the third party in industry should be a definite entity with organisation, policy and aims quite separate from anything that at present exists.

The Society of Technical Engineers.

This being the case, it is obvious that great care must be taken in the establishment, organisation and conduct of any body that desires to work for these ends, and that it

must, above all, have a well-designed constitution and a policy which shall ever bear in mind the ideals for which it has been formed. Now, such fundamentals cannot emerge from the theoretical into the concrete without careful thought and much hard work, and it is evident that both thought and hard work have been freely expended by those who are responsible for conducting the affairs of the Society of Technical Engineers, and that, in spite of criticisms as to slowness and accusations that reactionaries are being allowed too much say in directing the affairs of that body, the end that has now been reached justifies the care which has been taken to attain it. For after much careful consideration, as set out in the current issue of the "Journal," the policy of the Society of Engineers has now been determined.

The Policy of the Society.

This policy may be summarised as being the care of matters connected with the interests of its members and the engineering profession, the advancement of the British engineering industries, and the consideration, in securing these objects, of the effect of any action taken on the firms to which members of the Society belong and on the industry in general. In carrying out this policy the greatest care will be taken to steer a middle course between the Scylla of the Employers' Organisations on the one hand and the Charybdis of the Trades Unions, on the other. To do this will, we think, be a real difficulty, but it is equally a real necessity, and the Society of Technical Engineers are to be congratulated on the firm stand they have taken on this matter and on the clearness with which they have grasped the need for holding fast to this safeguard, not only as a necessity for their present well-being, but as a guarantee for their future prosperity, in spite of many difficulties and temptations.

The Need for an Extended Membership.

It may be thought that the criteria we have laid down for the conduct of an organisation such as the Society of Technical Engineers are obvious, and would control the operations of all the many bodies that have been established for protecting the interests of salaried classes. But this is not the case; in fact, experience shows that few such associations have attained this aloofness compared with those which have lent either to one side or the other with, we might add, unfortunate results to themselves. But it is also obvious that to carry out such a policy health and strength will be required, and that to attain that health and strength a large and active membership is a necessity.

The Essentials for Prosperity.

WE are, therefore, glad to see that a campaign is to be begun by the Society of Technical Engineers to increase the membership in order that as soon as possible it may justly claim to represent the majority of engineers in any department of engineering. This task should be easier in that, as we have shown above, the Society can offer to prospective members a clear-cut statement of what they intend to do and an assurance that membership will mean an increase in the well-being not only of the individual, but of British Engineering Industry generally. That prosperity is so essential at the present and the help the Society can give towards its attainment is so obvious that the campaign cannot fail to be a success. The governing body of the Society may have been slow in getting to work, but then the soundest foundations are those that are built slowly, and the superstructure need not for that reason fail either in strength or in beauty.

The Testing of Thermionic Valves.

By Lieut. H. J. LUCAS, R.A.F.

The development of the three-electrode thermionic valve took place within a short time of the outbreak of war. In the early period of the war, these valves were not produced in any great quantity, and until considerable experience of their functioning and a more exact knowledge of the requirements had been gained, no rigid specification or tests were called for. The method usually adopted was an operation test in a receiving or transmitting circuit.

The last two years of the war, however, saw these valves being produced in large quantities by various manufacturers for use in the combatant services. The flexibility of the early receivers and their simple requirements gave place to the multi-stage amplifier and transmitter sets, with valves operating in parallel, and other conditions requiring a considerable degree of uniformity in the valves employed.

The development of the specifications to meet these new conditions has been described, in the case of naval valves, by Gossling, in his Paper on "The Development of Thermionic Valves for Naval Uses," before the Institution of Electrical Engineers, August, 1920.*

The testing of valves in large quantities to these specifications had to be placed in the hands of a comparatively

dimensions, the emission being a function of the temperature in the case of pure tungsten.

Slope.—This is the slope of the grid-voltage—anode-current characteristic: i.e., the measure of $\frac{dI_a}{dV_g}$. The characteristic

of the "R" valve in the neighbourhood of zero grid potential is a straight line; the test, therefore, merely involves taking two different current readings for two differing grid voltages. The latter are taken at -2 and $+2$ V, and the current increase must not be less than 0.45 mA.

Vacuum.—The anode voltage is raised to a comparatively high value, in this case 160 V. The negative grid current is then read off on a microammeter or calibrated galvanometer placed in the grid circuit, a potential of -2 V being applied to the grid. An upper limit of one microampere is imposed.

The principle involved is that, if any trace of gas remains in the valve, ionisation by collision occurs, with the consequent production of positive ions. As the grid is negative, no electronic current from filament is picked up by the grid, but positive ions are attracted to the negative grid. Hence, the negative current flowing in the grid circuit, is directly

proportional to the number of collisions which occur, and, in turn, is an indication of the degree of vacuum.

This method of obtaining the degree of vacuum was criticised at the discussion following Mr. Gossling's Paper mentioned above. It was, however, subsequently pointed out that the criticism is only valid in a certain particular case, and, in the test under discussion, the grid voltage is selected to give a reliable indication of the evacuation of the valve.

Grid Current.—The test is the same as in (4), with positive 2 V on grid, which gives the normal grid current near rectifying conditions.

Some Practical Test Problems.

It will be noted that the submission of valves to these five tests would involve a complicated wiring system with various switches for effecting the changes, or, alternatively, five independent test boards, with a considerable quantity of delicate measuring instruments, necessitating the employment of skilled personnel. The

problem which faced the test department was to evolve some method of carrying out these five tests in the minimum amount of time and with a minimum number of switching operations, and with apparatus capable of being manipulated by unskilled persons, whose only duty would be to read the indicating instruments and work with switches.

The final solution was largely the work of Lieut. B. Hesketh, R.A.F., who designed a single board wired up, as shown in Fig. 1. One multiple point switch, working over six points, engraved respectively, zero, emission, slope -2 , slope $+2$, backlash and positive grid current, carries out the work of switching in the different circuits. The whole of the necessary operations are carried out by the various arms and points on the switch.

The protective devices consist of the following:—Shunts on milliammeter, operated by push button and acting as a protective device in the event of the grid making contact with the filament during test; the protection of the reflecting galvanometer or microammeter, used in the "backlash" test, is a bank of metal filament lamps in series; in the event of the passage of any appreciable current beyond a few micro amperes, the galvanometer is effectively protected by the fall of voltage across the lamps with an added fall due to the temperature co-efficient.

The most effective material for the fuse in the anode circuit,

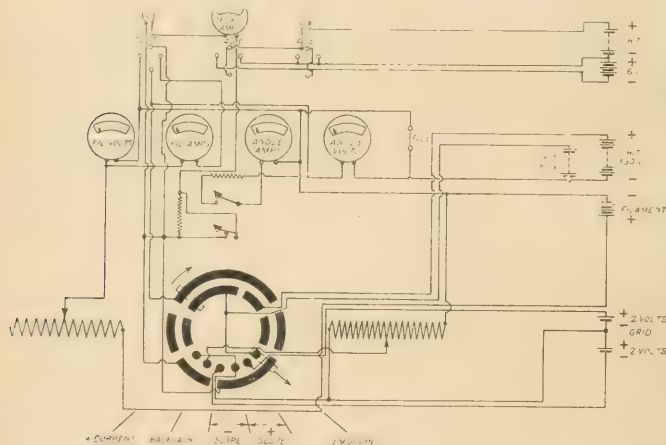


FIG. 1.

unskilled personnel, mainly female, as far as the Royal Air Force was concerned, and this article deals with the methods adopted to ensure accurate results.

Details of the Tests.

The number of types of valves, receiving and transmitting, which were received for test, was about twelve. Of these, a typical example, that of the French or "R" valve, will be discussed, as this particular valve had to be dealt with in much larger quantities than any other type.

The electrical static tests covered the following:

Filament.—For a given fixed voltage applied to the end of the filament, the current had to lie between two fixed limits. This test is necessary, as, in multi-stage amplifiers, valves have usually to work off a single rheostat control. Also, if any filament has been seriously affected by the evacuation bombardment, it usually shows up on this test, as over-bombardment increases the filament resistance.

Emission.—To obtain the measure of the total electronic current emitted from the filament, the grid and anode are connected, and working conditions are applied to the filament and anode-grid, and the total current is read off on a milliammeter in the anode circuit. Such reading must not be less than 5 mA. This serves as a secondary check on the filament

* *THE ELECTRICIAN*, Vol. LXXXV., p. 494, Oct. 29, 1920.

was found to be certain qualities of the "silvered paper" used to pack small quantities of tobacco. It was found that, when this material was cut into narrow strips one mm. wide, the metallic deposit on this paper fused at about from 10 to 20 mA., and proved to be extremely effective.

The time taken to test an "R" valve under these conditions was reduced from 5 minutes to 1 minute, and the

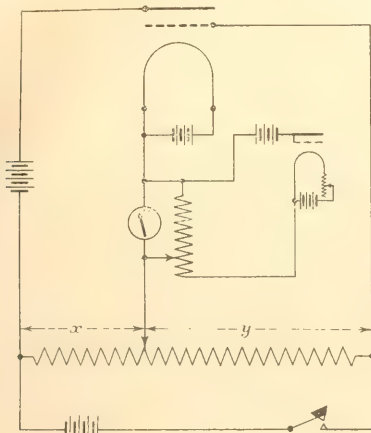


Fig. 2.

weekly total of valves tested ran into four figures. The whole system has been in use for three years, and has given satisfactory service.

Rating Transmitting Valves.

The usual method of rating for test purposes is to measure the amount of energy that can safely be expended at the anode as heat, the valve being in a non-oscillating condition. If the heating is carried too far, occluded gases are evolved and the vacuum deteriorates.

The transmitting valves tested during the period under discussion, were mainly 30 W and 250 W types. Transmitting valves in general were not used in such considerable quantities as were the receiving valves, so that the need for rapid testing, and the development of special apparatus designed for large outputs, did not arise. Furthermore, the tests for these valves included periods of four to ten minutes during which they required watching by operators of a higher degree of skill than was necessary in the case of the receiving valves. Moreover, as potentials of from 600 to 2500 V are used it was desirable to have them tested by male operators.

Here, again, the reasons for uniformity put forward in the case of receiving valves, apply with even more force. When working in parallel in transmitting sets, and if the characteristics vary to any marked degree, the load is distributed unequally, and the overloaded valve rapidly deteriorates.

The tests for the 30 W valve were generally as follows, with variations for the sub-divisions of the class. Filament and emission tests were similar to those for receiving valves and the dissipation test.

Dissipation Test.

In the dissipation test the filament is adjusted to normal working conditions, a full anode potential of 1500 V is applied, the grid potential being adjusted until 30 W is dissipated at the anode, when 20 mA flows through the valve. These conditions are maintained for 5 minutes, the grid adjustments keeping the load constant. A microammeter in the grid circuit registers the negative "backlash" current, for which the limit allowed is 150 micro amperes. Limits are also laid down for the grid voltage, in order to dissipate 30 W. These limits govern the disposition of the grid. If the grid spacing is too open, the reference point falls beyond the negative end of the limit: if the spacing is too close, the reading falls to the positive side. The position of this reference point is also, to

a certain extent, governed by the state of the vacuum. If any sign of blue glow appears, the valve is rejected, as this indicates considerable ionisation.

During the test, the anode, under the bombardment of the electronic stream, becomes a bright red, and, if, owing to insufficient bombardment during evacuation, any occluded gases still remain in the metal portions of the valve, they are released and cause ionisation. It will be observed that this test covers a number of points, such as, general vacuum, disposition of electrodes, presence of occluded gases, &c.

Details of Test Apparatus.

The circuit calls for no detailed comment, beyond the protective devices for the instruments. Common faults with valves on test are, short circuit between the filament and grid, and between anode and grid or filament, and these produce short circuits of 1500 V across the instruments. The two shunts are so arranged as to show an appreciable deflection on the microammeter with the 1500 V across it. One is a ten multiplier. In the anode circuit a bank of metal filament lamps is included and also a resistance of 10 000 Ω . The voltage drop for 30 mA is known and compensated for. In the event of an abnormal current rise in anode circuit, the lamps restrict this by the temperature co-efficient, supplemented by the increased voltage drop across them. To this must be added the increase of voltage drop on the 10 000 Ω resistance. These devices have proved to be quite adequate.

Another principle is involved in the dissipation test. If the vacuum is in any way defective, positive ions are generated as a consequence of ionisation by collision. These neutralise the space charge and decrease the resistance of the valve, thus causing progressive increase of the current to the anode, which has to be compensated for by increase of negative voltage at grid.

Results of Improved Manufacture.

As the manufacturers improved their methods of evacuation, it was observed that less and less compensating grid voltage had to be added. In the more recent valves, it was observed that, after the first few seconds of test, the grid

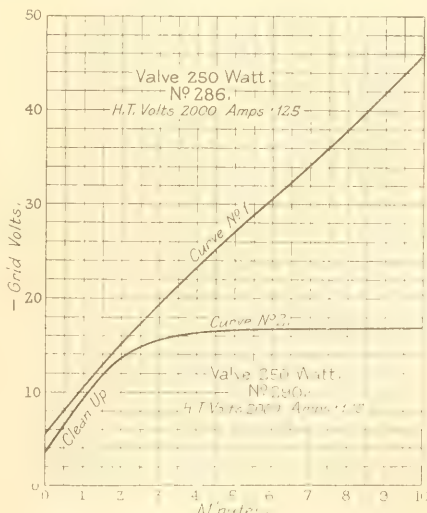


FIG. 3.

voltage remained constant. This suggested a fresh method of observing the behaviour of extremely hard valves, which was applied to the test of the larger valve (250 W).

The grid voltage is plotted against time with constant load. In a really well evacuated valve, this "grid creep" takes the form of Fig. 3, curve 2. It will be observed that after the preliminary "clean up" on switching on, the curve flattens

out and remains constant. This test could be incorporated in the specification by allowing a percentage variation of grid voltage for a certain period of time after switching on, for a constant load. This test is decidedly more severe than the old method. Valves which would not pass this test would

anode-current characteristic is practically a constant over a large portion of the curve.

Method 2.

Two grid-voltage-anode-current characteristics, plotted to the same scale, at different anode voltages, are selected—in the case of transmitting valves at, say, 1 000 and 1 500 V.

These should be parallel over the "straight line" portion. Any point is selected on this "straight line" portion, and the increase of current, δi_a , is read off by passing from one characteristic to the other at the same grid-voltage. Let this increase be effected by a change of x anode volts. In the particular case under consideration, $x = 500$. Next, the amount of increase of grid-volts required to effect the same δi_a on the original curve is read off. Let this value be y volts.

Then,

$$m = \frac{y}{x}.$$

Both methods are, to a certain extent, open to criticism, but they have been found reliable enough for practical working. Other methods have been developed to read this quantity " m " direct, notably by Eccles, Appleton, and the Research Department of the Royal Air Force.

A variation of Appleton's method is shown in Fig. 2. A sensitive galvanometer is used with a Fleming valve arranged as a high resistance variable second shunt.

Let i = anode current; V = anode volts; v = grid-volts. a , b , and c are constants.

$$m = \frac{\left(\frac{di}{dv}\right)_V}{\left(\frac{di}{dV}\right)_v} \quad \text{I.}$$

$$\text{and } i = f(vV) \quad \text{II.}$$

$$\text{By partial differentiation } \frac{\left(\frac{di}{dv}\right)_V}{\left(\frac{di}{dV}\right)_v} = \left(\frac{dV}{dv}\right)_i \quad \text{III.}$$

As characteristics with varying v and V are largely straight line, the surface equation is:

$$i = av + bV + c \quad \text{IV.}$$

$$\text{where } \left(\frac{di}{dv}\right) = a \text{ and } \frac{di}{dV} = b. \quad \text{V.}$$

$$\text{so III. becomes } \left(\frac{dV}{dv}\right)_i = \frac{a}{b}.$$

It will be obvious that all the tests outlined above must be preceded by close checking of material and sizes before proceeding with manufacture.

Electrical Development in Japan.

According to an article in the "Electrical World" by Mr. Y. ISHIKAWA, of the Tokyo Electric Company, more than half the people of Japan live in electrically lighted houses, a percentage claimed to be higher than in any other country. The growth of the electric supply industry in the Island Empire has been remarkable in the last fifteen years, the number of electric supply companies having increased from 500 in 1903 to 3 400 in 1918, and the installed rating of the plants from 90 000 kW to 1 820 000 kW. At present the installed generator rating is over 2 100 000 kW. There are about 6 000 000 wired houses, but the average installation is between two and three lamps, and in Tokyo it is only four lamps per house. In Yokohama 92 per cent., in Nagoya 85, and in Kobe 80 per cent. of the houses are wired, but in the latter case the average number of lamps per house is only 12. Successful efforts are being made to increase the number of lamps and to improve the illumination.

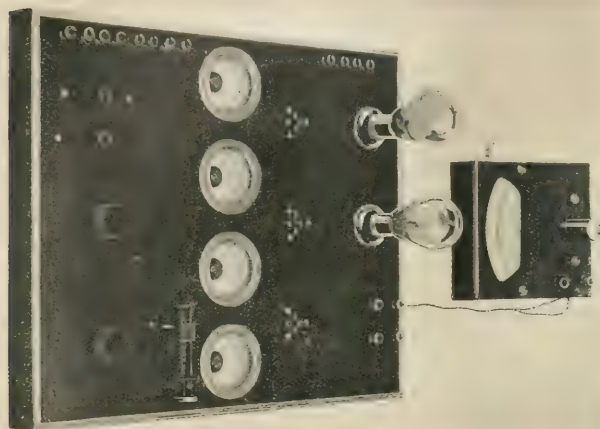


FIG. 4.

pass the normal. The valve (Fig. 3, Curve 1) passed normal test and gave good service, but would not pass the "grid creep" limitation test. Its behaviour on oscillatory test was satisfactory, but other things being equal, the Fig. 3, Curve 2 valve would have a longer life, as the filament in Fig. 3, Curve 1, would undoubtedly be submitted to considerably more ionic bombardment than that of Fig. 3, Curve 1.

The Grid Loop.

Another method has been investigated, and consists of plotting the full grid voltage—anode-current characteristic with a rising grid voltage—and, then, without break, plotting same with a falling grid voltage. The result is a closed loop. The softer the valve, the greater the area of this loop, owing to the reabsorption of occluded gases taking place with a distinct time lag.

Voltage Amplification Factor.

The voltage amplification factor is referred to in this article by the letter m . In routine test work it has been found unnecessary to take account of this quantity, as it is primarily governed by the dimensions of the grid and these are checked in the tests described previously. For new and experimental valves, however, it is one of the most important quantities to determine, and, as in these particular cases full characteristics are taken under varying conditions, " m " is read off from these curves. Two methods are primarily used.

Method 1.

From the various formulae of Gutton, Vallauri, and Langmuir, it can be deduced that

$$m = \frac{\frac{di}{dv}}{\frac{di}{dV}}$$

so from the grid-voltage/anode-current characteristic and the anode-voltage/anode-current characteristic, m can be determined:

$$m = \frac{\tan a_1}{\tan a_2}$$

a_1 and a_2 being the angles which the geometrical tangents of the two respective curves at any selected point, make with the grid-voltage axis. The tangent of the grid-voltage—

New Electricity Station at Edinburgh.*

By S. B. DONKIN.

In 1891 the Corporation obtained a Provisional Order from the Board of Trade to enable them to supply electricity in the Burgh of Edinburgh, and in 1895 the supply of electricity was commenced. The growth of the undertaking was rapid, and the original Dewar-place station was extended from time to time until 1899, when it was found necessary to build a new station at McDonald-road. This station was also extended, until its present buildings were completely filled with generating plant in the winter of 1912-13. The limits of distribution direct from the existing generating stations had then been reached. It was, therefore, economically desirable for new plant to be erected to produce H.T. 3-phase alternating current which could be distributed by means of less costly feeders to various sub-stations in the supply area.

Accordingly a new station to generate H.T. 3-phase current at the seaside at Portobello was decided upon. This is only 25 ft. above the sea level, and adjacent to the seashore. There was sufficient space for a generating station having an ultimate capacity of 100 000 kW, and there were adjacent sites which could be utilised for coal sidings or by-product recovery plant. In June, 1919, the Board of Trade allowed the work of this station to be initiated, with a view to large scale bulk supply. Three 10 000 kW turbo-alternator sets were to be installed, with requisite boiler plant, &c. Since the passing of the new Electricity Act of 1919, the Electricity Commissioners have considered the area to be supplied from the new station. Roughly speaking, the suggested area is bounded by Linlithgow and Bathgate on the West, by North Berwick or Dunbar on the East, and by Penicuik and Gorebridge on the South.

Details of Power Station.

The author presented views showing the general arrangement of the power station on the Westbank site, together with the sidings, the sea work for condensing water, and the coaling scheme, ashes, and ash duct. Coal is brought on to the sidings provided on the clay pit site and the trucks will be emptied by means of a rotary tippler into a hopper below ground level. This hopper feeds a belt conveyor running in a tunnel from the clay pit site to the power house. On the power house site this conveyor will discharge the coal on to another belt conveyor, and this in turn discharges it into hoppers feeding gravity bucket conveyors, which carry the coal into the bunkers over each boiler house. The boilers are of the Stirling Boiler Company's tri-drum type, with superposed steel tube economisers. Three types of stokers will be adopted, the Babcock and Wilcox chain grate, the Erith Riley grate, and the Underfeed Stoker Company's self-contained travelling grate, all fitted with forced and induced draft fans driven by motors. Steam will be supplied at 300 lb. per square inch and at a temperature of 700°F. Six boilers are being provided at present, though two suffice to provide sufficient steam for 10 000 kW turbo-alternator. One short steel chimney, designed with a dust-catching device at its base, is provided for every two boilers. This device is necessary with induced draft if the poorer classes of coal are used.

The Generating Plant.

The turbo-alternators are of Messrs. Brown, Boveri & Co.'s manufacture, and the condensing plant is by Messrs. W. H. Allen, Sons & Co. The three sets, each of 10 000 kW normal output, have a maximum continuous rating of 14 700 kVA. A 70-ton travelling crane is provided in the turbine house, made by Messrs. Marshall, Fleming & Co., and all the high tension switch gear is being provided by the British Thomson-Houston Co. The steel-work for the buildings has been carried out by Messrs. Redpath, Brown & Co., and the building superstructure by Messrs. J. Angus & Co. With a normal full load the overall thermal efficiency of the station should be 21.0 per cent., and the coal consumption equivalent to 16 300 B.T.U. per kilowatt hour.

Boiler House Equipment.

At present a labourer earns nearly £4 per week—the equivalent of £260 per annum. If this salary is capitalised at 10 per cent., any mechanical apparatus which saves the employment of one man will show a saving in the cost of operation, if purchased for less than £2 000. Now the boiler house plant is almost the only part of a modern power station where one can produce economies. Recording instruments and suitable control are of great importance. The system of boiler house control, based on the scheme devised by Mr. Myers, has somewhat novel features. Instruments necessary for the general control of a boiler house have been divided into two main groups—recording and indicating instruments. The former are placed in a specially built cabin (one cabin for every two boilers), the latter are collected wherever possible on one board, and placed

in a convenient position in front of each pair of boilers. The following instruments are proposed for each boiler:—

Indicators.	Recorders.
1. Steam Flow meter indicator.	Recorder with chart.
2. Feed Water meter indicator.	Recorder with chart.
3. Coal Meter.	Recorder with chart.
4. CO ₂ Indicator.	Recorder with chart.
5. Draft gauge indicator for forced and induced draft.	Recorders with chart.
6. Steam pressure gauge.	Pressure gauge recorder with chart.
7. Steam temperature indicator.	Steam temperature recorder with chart.
8. Differential draft gauge connection above and below each grate.	Recording thermometers in economiser inlet, economiser outlet on water side and on flue gas side.

Generally for each group of boilers in one boiler house there will be:—one blow down recorder with chart, one densimeter for the blow down, one feed water recording thermometer. For every group of two boilers feeding one turbine there will also be a kilowatt meter to indicate the load. Coal consumption indicators and recorders will be of the Lea Recorder Company's type, and will measure the rate of flow of coal passing on to any grate in a given time with means for adjusting the ratio for weight to volume to suit any type of coal in use. A telephone will connect each boiler house with the switchboard. There will also be a signal in each boiler house worked from the main switch control room. A bell in each cabin will draw the attention of the boiler attendants to the boiler house shift engineer, who can then communicate his orders through the window provided in each cabin. Full provision has been made for the possible adaptation in future of the carbonisation of coal and the use of by-product recovery plant which can be undertaken without much alteration to the boiler plant.

Sea Work and Pumps.

The author next described the circulating water system starting from the sea to the pump house and the pipe system through the condensers and back to the sea. Two tunnels will be normally used for suction and one as discharge. Either one of the two suctions can be stopped and changed over to act as a discharge, and the pipe previously discharging can then be made as a second suction. Grids will prevent the entry of fish or seaweed, and can be washed clean by reversal of flow, the material being then carried back to the sea. Explaining the system adopted of running subterranean tunnels out to sea for taking the sea water into the station and carrying it back to the sea, the author said that past experience on the banks of the River Thames, in carrying out somewhat similar tunnel schemes, proved that the cost of the tunnelling scheme was less than the cost of laying pipes down the foreshore into the water, because so much of the system had to be carried out below low tide level, involving a dam to keep the water back while the work of construction and the laying of the pipes was being carried out. The construction of a light jetty and the carrying of the pipes connecting with the sea along this jetty was estimated to cost nearly three times the cost of the tunnelling scheme, which works out at £28 per yard run, excluding cost of shafts.

Sea Work Shafts and Tunnels.

The sea work shafts and tunnels are being carried out by Messrs. C. Brand & Son and Mr. H. H. Dalrymple Hay has been joint engineer with Sir Alexander Kennedy and the author in connection with the design and construction of the work. The three land shafts were first sunk to their required depth and completed with their concrete bases. From the bottoms of these shafts the tunnels were driven. The subsoil at the level of the tunnels consists of boulder clay, and two of the tunnels have been completed and the junction made with the sea shafts without working with compressed air. In the third tunnel some porous seams of sand were encountered and the use of compressed air was necessary.

Efforts have been made to find a means of preventing the accumulation of mussels on the inside of the sea shafts and of the tunnels, and research work on the subject is being carried out for the Corporation by Dr. Ritchie, of the Edinburgh Museum. The best solution is to raise the temperature of the outgoing water to such a degree, possibly to 110° to 120°F, as to kill the mussel spat in a few minutes. Such increase in temperature may be made once a week during the spawning season which may last a month or two. Other possible alternatives are under consideration. In any case the system is designed so that at present any shaft or tunnel can be laid off for cleaning. The stagings or beacons erected at the sea end of the tunnels and over the sea shafts are put there as required by the Board of Trade, not only to guard the mouths of the shafts, but also to enable the cap for sealing the end to be lifted and lowered and to lift and lower a coarse grid which will keep out bathers or sea monsters and to remove sand from the pocket at bottom of each sea shaft.

* Abstract of a Paper entitled "Some Notes on the New Electricity Station of the Edinburgh Corporation," read before Section G of the British Association.

Long Distance Transmission and Tidal Power.*

B. T. F. WALL, D.Sc., D.Eng., Assoc. M.Inst.C.E.

Introductory.

The utilisation of tidal power for the generation of electricity involves a peculiar and difficult problem arising from the extremely large variation of speed of the turbines under the varying head of water.

According to the reports issued in the press, the proposals of the Ministry of Transport for the Severn scheme provide for an average generation of 500 000 h.p. over a 10 hours day. The scheme involves the use of special direct current generators driven by the water turbines, these generators being so designed that each machine will develop about 1 300 kW at a constant pressure of 525 V and at a speed varying from 300 to 500 revs. per min. The direct current so generated would then be supplied to rotary converters giving 320 V alternating current and by means of static transformers this pressure would be raised to 60 000 V which would be the pressure of transmission to the Midlands. Transmission to London—a distance of 115 miles—is suggested at a pressure of 120 000 V.

Owing to the varying speed of the turbines, the use of alternating current generators driven by the turbines is, in the ordinary way, not practicable, since the generated E.M.F. would be of varying frequency—viz., for the speed range given above, the maximum value of the frequency would be 1.66 times the minimum value. Moreover, unless elaborate automatic arrangements were made, the generated E.M.F. would also vary in magnitude more or less in proportion with the speed variation.

Such large variations of frequency and E.M.F. would be impracticable for feeding a distribution system for the obvious reasons that motors such as induction motors or synchronous motors would have a similar speed variations independently of the requirements of the consumer and lighting and heating appliances cannot be operated from a system on which the pressure is widely varying.

A Large Number of Machines.

It is clear that the proposal to generate 500 000 h.p. by means of 1 300 kW d.c. units and then to convert to a.c. by means of rotary converters would involve an immense number of machines. The duplication of machines necessary owing to the generation in the first instance as d.c. and then conversion to a.c. is a very serious matter and the capital outlay on these machines alone would probably be sufficiently large to imperil the feasibility of the scheme. From criticisms and discussions of the proposals which have appeared from time to time it is clear that the immense capital outlay involved in realising the installation very likely would be fatal to the success of this otherwise most attractive project.

Factors in the Exploitation of Tidal Power.

The successful exploitation of tidal power will depend on the solution of the peculiar electrical engineering difficulties inherent in such an undertaking, and electrical engineers should be prepared to strike out on new lines as may be necessary to meet these requirements. The purpose of the present paper is to give very briefly, a preliminary outline of an alternative system obviating the difficulty of varying the speeds of the turbines. The system permits of the use of alternating current generators driven directly from the turbines, and it is expected that an appreciable saving in capital outlay will result. The system also represents other advantageous features.

Briefly stated, the scheme involves the generation of alternating current at such a frequency that the length of the transmission line at one turbine speed (viz., the lowest) will be equal to or approximately equal to one-quarter the wave length of the travelling waves of P.D. and current which will be established in the line. As the speed of the turbines increase, the frequency of the generated A.C. will increase correspondingly, and if the excitation is constant, the generated E.M.F. will also increase correspondingly. As the frequency increases the wave length decreases so that, if at the lowest speed the length of the line is one-quarter wave length, then at double this speed the length of the line will be one-half wave length. Assuming constant current at the receiving end of the line, it is shown that, notwithstanding the rise of the generator voltage as the speed rises, the voltage at the receiver's end of the line will remain constant.

Constant Voltage A.C. Supply.

The arrangement thus results in an A.C. supply at the receiver's end of the line of constant voltage and variable frequency.

So long as the P.D. is constant and the frequency is high, a variable frequency is not objectionable for heating and lighting apparatus.

In order to obtain a supply suitable for driving motors, &c., it is proposed to convert by means of mercury arc rectifiers to direct current, and it is shown that by such means a constant A.C. voltage of variable frequency generated and transmitted in the manner

already described may be transformed to a d.c. supply of constant current and very approximately constant voltage.

Generation and Transmission.

The following equations express the relationships between the line constants and the voltage and current vectors at the receiving end and the generator end of the line respectively, viz.:

$$V_1 = \frac{1}{2} \left[\left(V_2 + I_2 Z_0 \right) e^{al} + \left(V_2 - I_2 Z_0 \right) e^{-al} \right] e^{j\beta l}$$

$$I_1 = \frac{1}{2} \left[\left(I_2 + \frac{V_2}{Z_0} \right) e^{al} + \left(I_2 - \frac{V_2}{Z_0} \right) e^{-al} \right] e^{-j\beta l}$$

where V_1 represents the vector of P.D. at the generator end, I_1 the vector of current at the generator end, V_2 the vector of P.D. at the receiving end, I_2 the vector of current at the receiving end, and l the length of the transmission line, a the attenuation constant, β represents the wave length constant, e is the base of natural logarithms, viz.: $e = 2.718$, and $j = \sqrt{-1}$.

Further,

$$a^2 = \frac{1}{2} \left[\sqrt{(g^2 + b^2)} (R^2 + x^2) + (gR - bx) \right]$$

$$\beta^2 = \frac{1}{2} \left[\sqrt{(g^2 + b^2)} (R^2 + x^2) - (gR - bx) \right]$$

in which g is the insulation resistance per unit length of the line, $-b$ is the capacity susceptance per unit length of the line, R is the resistance of the line per unit length, x is the reactance of the line per unit length.

Also

$$b = \omega C = 2\pi f C,$$

$$x = \omega L = 2\pi f L$$

in which C farads is the line capacity per unit length, L henrys is the line inductance per unit length, f is the frequency.

The vector $Y = g + jb$ is the vector of admittance, per unit length of line, and the vector $Z = R + jx$ is the vector of impedance per unit length of line.

For the high frequency necessary for this proposed system, R is negligibly small and for well insulated overhead transmission lines working at a pressure below that corresponding to "corona" effects, the value of g will also be negligibly small. When $g = 0$, and $R = 0$, the value of the attenuation constant a will also be zero, and the wave length constant will be

$$\beta = \sqrt{bx} = 2\pi f \sqrt{LC}$$

The wave length of the travelling waves of P.D. and current along the line is given by

$$\lambda = \frac{2\pi}{\beta} = \frac{2\pi}{2\pi f \sqrt{LC}}$$

Further, the vector Z_0 is defined by

$$Z_0 = \sqrt{\frac{Z}{Y}} = \sqrt{\frac{x}{b}}$$

and is termed the "initial sending and impedance."

Since $a = 0$, $e^{al} = 1$, and the equations expressing the relationships between the vectors of P.D. and current at the generator end and the receiver's end respectively, may be written

$$V_1 = \frac{1}{2} (V_2 + I_2 Z_0) e^{j\beta l} + \frac{1}{2} (V_2 - I_2 Z_0) e^{-j\beta l}$$

$$I_1 = \frac{1}{2} \left(I_2 + \frac{V_2}{Z_0} \right) e^{j\beta l} + \frac{1}{2} \left(I_2 - \frac{V_2}{Z_0} \right) e^{-j\beta l}$$

For one-quarter wave length conditions,

$$l = \frac{1}{4} \lambda = \left(\frac{2\pi}{\beta} \right)$$

$$\beta l = \frac{\pi}{2}$$

$$V_1 = (I_2 Z_0) e^{j\frac{\pi}{2}}$$

that is,

$$V_1 = j(I_2 Z_0) = j \sqrt{\frac{x}{b}} I_2$$

Similarly,

$$I_1 = j \left(\frac{V_2}{Z_0} \right) = j V_2 \sqrt{\frac{b}{x}}$$

* Abstract of a Paper read before the British Association.

For *one-half wave length conditions*,

$$l = \frac{1}{2}\lambda.$$

$$\beta l = \pi.$$

$$V_1 = (V_2)^{e^{j\pi}}$$

that is,

$$V_1 = -V_2.$$

Similarly,

$$I_1 = -I_2.$$

For *three-quarter length conditions*,

$$l = \frac{3}{4}\lambda; \beta l = \frac{3}{2}\pi;$$

$$V_1 = \frac{1}{2} \left(V_2 + I_2 Z_0 \right) e^{j\frac{3}{2}\pi} + \frac{1}{2} \left(V_2 - I_2 Z_0 \right) e^{-j\frac{3}{2}\pi}$$

$$I_1 = \frac{1}{2} \left(I_2 + \frac{V_2}{Z_0} \right) e^{j\frac{3}{2}\pi} + \frac{1}{2} \left(I_2 - \frac{V_2}{Z_0} \right) e^{-j\frac{3}{2}\pi}$$

Example of Application of Formula.

As an example consider the following case, viz., A three-phase transmission of which the lines are symmetrically arranged and having a spacing of 10 ft. between any two lines. The conductors are of 0.42 in. diameter. The pressure at the receiving end of the line is 90 000 V between the lines and the power supplied to the receiver is 15 000 kW at unity power factor. The line is 115 miles long.

From these data the following results may be deduced. The equivalent star capacity of the three-phase line is 0.014 micro-farad per phase per mile; the inductance is 0.0021 henry per phase per mile; the phase pressure at the receiving end is 52 000 V; the line current at the receiving end is 96 A.

The wave length constant is

$$\beta = 2\pi \sqrt{LC} = 2\pi \left(\frac{1}{10^6} \right)$$

The wave length is

$$\lambda = \frac{2\pi}{\beta} = \frac{1}{f \sqrt{LC}} = \frac{10^6}{54.4 f} \text{ miles.}$$

The frequency f , at which length of the line will be one-quarter wave length is given by

$$115 \text{ miles} = \frac{1}{4}\lambda = \frac{1}{4} \left(\frac{10^6}{54.4 f} \right)$$

that is, the frequency is 400 cycles per second, and $\beta l = \frac{\pi}{2}$

Similarly, for $\frac{3}{4}$ th wave length the frequency is 600 cycles and $\beta l = \frac{3\pi}{2}$.

For one-half wave length the frequency is 800 cycles per second and $\beta l = \pi$.

The pressure per phase at the receiver end of the line is 52 000 V. The current per line at the receiver end of the line is 96 A.

The value of Z_0 is $\sqrt{\frac{L}{C}}$, that is, $Z_0 = 388$.

Hence the following results are obtained, viz :

For a frequency $f = 400$ cycles per second, that is $\beta l = \frac{\pi}{2}$,

$$V_1 = j \left(I_2 Z_0 \right) = j (37 200) \text{ V.}$$

$$I_1 = j \left(\frac{V_2}{Z_0} \right) = j (132) \text{ A.}$$

The magnitude of V_1 in this case is thus 37 200 V and the magnitude of I_1 is 132 A.

For a frequency $f = 600$ cycles per second, $\beta l = \frac{3\pi}{2}$.

Assuming that $\cos \phi_2 = 1$, that is the vectors V_2 and I_2 are in phase, then

$$V_1 = \frac{1}{2} \left(V_2 + I_2 Z_0 \right) e^{j\frac{3}{2}\pi} + \frac{1}{2} \left(V_2 - I_2 Z_0 \right) e^{-j\frac{3}{2}\pi}$$

that is,

$$V_1 = (45 500) e^{j\frac{3}{2}\pi}$$

and

$$I_1 = \left(I_2 + \frac{V_2}{Z_0} \right) e^{j\frac{3}{2}\pi} + \left(I_2 - \frac{V_2}{Z_0} \right) e^{-j\frac{3}{2}\pi}$$

that is,

$$I_1 = (116) e^{j\frac{3}{2}\pi}$$

The magnitude of V_1 in this case is 45 500 V and the magnitude of I_1 is 116 A.

For a frequency $f = 800$ cycles per second, $\beta l = \pi$

$$V_1 = -V_2$$

$$I_1 = -I_2$$

Hence the magnitude of V_1 in this case is 52 000 V and the magnitude of I_1 is 96 A.

Relation of Received Voltage and Generated Voltages.

It thus appears that the magnitudes of the voltage and the current at the receiver end of the line will remain constant if the voltage at the generator end of the line is increased with the frequency as follows :

Frequency.	Voltage at the generator end of the Line.
400	37 200 V
600	45 500
800	52 000

If the excitation of the generators is maintained constant the induced E.M.F. of the generators will rise at a higher rate than that shown in the above table and consequently allowing for pressure

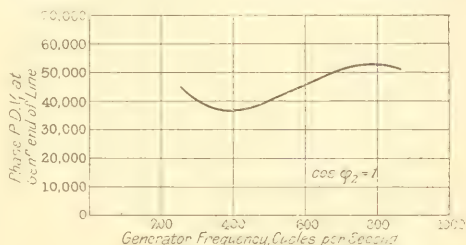


FIG. 1.

drop in transformers and machines, it will be possible to obtain an available pressure rise at the generator end of the line which will be of the amount necessary to maintain the voltage at the receiver

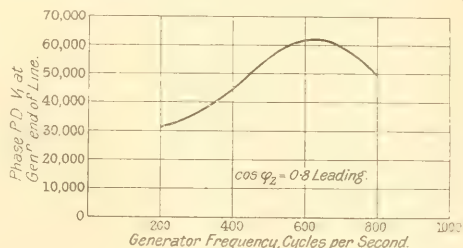


FIG. 2.

end constant. If so desired, the voltage at the receiver end may be allowed to rise by a definite percentage with the increase of frequency.

As regards the assumption that $\cos \phi_2$ is unity when the frequency

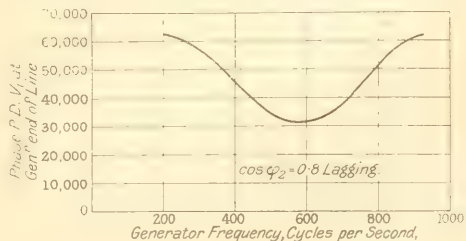


FIG. 3.

is 600 cycles per second, it may be noticed that for the proposed system of mercury arc rectification the power factor of the arc would normally be about 0.8. In order to obtain unity power factor static

condensers may be used and on account of the high frequency employed in the system the amount of such capacity necessary would be quite small. For example, if the low tension side of the transformers at the receiving end of the line is operated at 2 000 V and the power of 5 000 kW per phase at unity power factor is obtained by connecting condensers in parallel with the load it follows that the condensers must take a current of about 1 870 A per phase. At 2 000 V and for a frequency of 600 cycles per second the amount of capacity necessary will be 250 micro-farads per phase.

Calculations similar to those already given show that if the power factor $\cos \phi_2$ at the receiving end of the line is leading, the effect described in the foregoing may be obtained with smaller values of the frequencies. Thus for $\cos \phi_2 = 0.8$ leading, the lower limit of the frequency range may be about 200 cycles per second.

These results are summarised in the curves given in Figs. 1, 2, and 3, which show the phase P.D. which is necessary at the generator end of the line in order that the phase P.D. at the receiver end of the line shall remain constant with varying generator frequency. In each case it is assumed that the load at the receiving end of the line is constant and equal to 15 000 kW. Fig. 1 shows the conditions for unity power factor at the receiving end of the line, that is, $\cos \phi_2 = 1$: line current = 96 A. Fig. 2 shows the conditions for $\cos \phi_2 = 0.8$ leading: line current = 120 A. Fig. 3 shows the conditions for $\cos \phi_2 = 0.8$ lagging: line current = 120 A.

Mercury Arc Rectification at the Receiving End.

The use of mercury arc rectifiers for large powers has in recent years become of great practical importance and considerable experience in the manufacture and use of large power units is now available. The theory of this apparatus has been worked out in great detail by Dr. C. P. Steinmetz. Assuming that the rectified load per phase is 5 000 kW, viz.: 2 500 A at 2 000 V, and assuming values for the reactance and resistance of the rectifier circuit and load, the following values have been calculated for the P.D. which is necessary at the secondary terminals of the transformer to which the rectifier is connected. The calculations are based on the assumption that the d.c. voltage and current are kept constant at the values given above.

Frequency of the A.C. supplied to the Rectifier.	P.D. at the secondary terminal of the transformer to which the rectifier is connected.
400 cycles per second.	5 500 V
600	5 450
800	5 900

It thus appears that for 100 per cent. variation in the frequency, viz.: from 400 to 800 cycles per second, it is only necessary that the P.D. should vary by 7 per cent. in order that the rectified current and pressure should remain constant. A considerable number of alternating current machines for frequencies up to 600 cycles per second have been built within the last few years for special purposes so that there is a good deal of information available with respect to the design and performance of these machines.

Compensation for Voltage Drop.

As already stated, for lighting and heating purposes it would not be necessary to rectify the variable frequency alternating current. If the voltage drop with increase of frequency were troublesome in the distribution system this could be compensated for by allowing the voltage at the receiving end of the line to rise by a definite percentage as the frequency increases, instead of maintaining this voltage constant.

Apart, therefore, from lighting and heating load requirements, the main distribution supply system would be direct current according to the present proposals. For many requirements a direct current supply would be necessary even if the alternating current transmission were at constant frequency. For a large number of other purposes a direct current supply offers advantages over an alternating current supply.

It will be observed that the present proposals involve the existence of a consumers' load of constant magnitude. If a large industrial area is supplied, such constancy of load is not difficult to obtain and by the establishment of electro-chemical and metallurgical industries in or near the areas supplied, a practically constant load could be ensured. The extremely good load factor so obtained would ensure practically ideal conditions as regards minimum cost of supply.

Air Filtration Technically Considered.

Some interesting tests have recently been carried out by Messrs. HEENAN and FROUDE on two of their air filters which are installed in a large generating station. These filters, which have a capacity of 70 000 cubic feet of air per minute, are used for

cooling 15 000kW turbo-alternators. The installation is an interesting one, not only on account of its size, but owing to the solution it offers to the problem of employing generating plant in the most economical way. Its performance is, therefore, a point of some importance, and some account of the official tests which recently took place is worth giving.

Construction of the Filters.

A general view of the filters in question is given in Fig. 1. It will be seen that they are rectangular in shape and are built up of steel plates stiffened where necessary with angles. They are suitably mounted on a substantial base, the latter forming a tank. The filtering effect is obtained by drawing (or forcing) the air through two sets of screens fitted one behind the other in the front part of the filter. These screens are formed of metallic wool of standard size and thickness, which is held together between frames of heavily galvanized expanded metal. To ensure that the air is thoroughly cleansed, a flow of water is continually passed over the screens, being maintained by a small centrifugal pump fitted at the side of the filter, which delivers the water to the top of the screens. The water, after percolating through the screen, falls into the tank at the bottom of the filter, where it passes through a strainer and returns to the pump to be recirculated.

The screens are quite accessible and are easily removed for cleaning purposes, but experience shows that this is seldom necessary, owing to the fact that they are continually washed with water, the dirt, &c., being carried with the water to the bottom of the filter, whence it can be removed through sludge doors. The air after passing through the screen, traverses a series of fixed eliminators, fitted at a suitable distance from the screens, which catch any small particles of loose moisture that may have passed the second screen. The total resistance to passage of air through the machine does not exceed 0.75 in. water gauge.

In addition to cleansing the air, this process, of course, has a great cooling effect, reducing the temperature of the air to within a few degrees of the prevailing wet bulb temperature, and experiments have shown that the danger of loose moisture being carried into an alternator is eliminated entirely in this type of filter. The water level in the base or tank is maintained by an ordinary float valve connected to the water supply, the amount of water used being the amount lost by evaporation in passing through the filter.

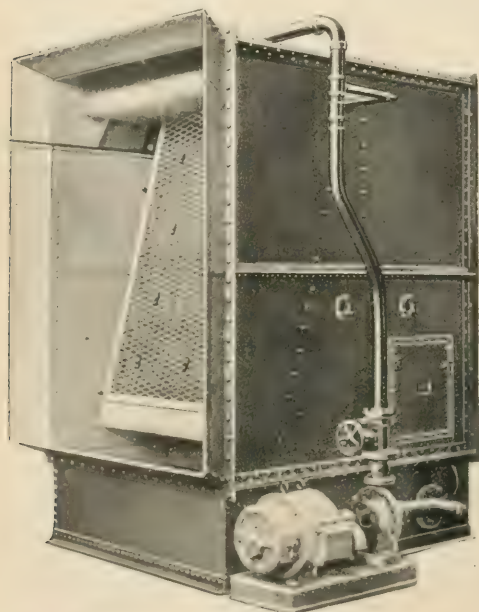


FIG. 1.—"HEENAN" PATENT AIR FILTER "M.S." TYPE.

The Official Tests.

On the occasion of the official tests, all thermometer readings were taken by a different section of the testing staff every half hour—dry and wet bulb thermometers being placed in the underground outlet duct and in front of the filter under test.

The test tubes were dried out, weighed and placed in position at 11 a.m., and were withdrawn at 4.30 p.m. after they had passed

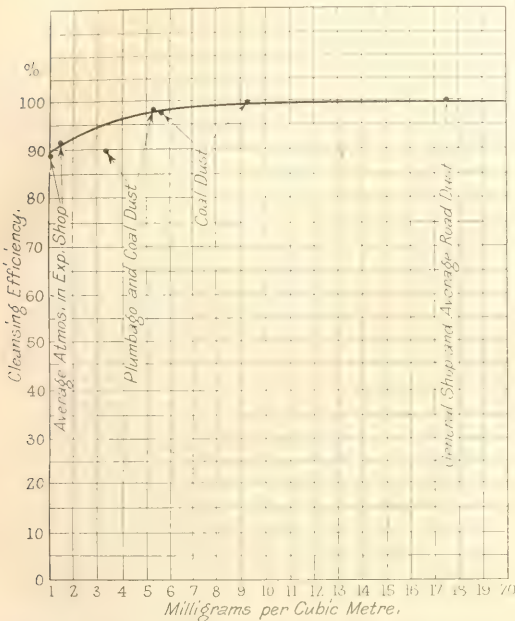


FIG. 2 "HEENAN" M.S. TYPE AIR FILTER. CURVE SHOWING CLEANSING EFFICIENCY WHEN DEALING WITH AIR CONTAINING VARIOUS QUANTITIES AND KINDS OF DUST

300 cubic ft. of air. They were again placed in the drying oven and afterwards weighed. Megger readings were taken in the discharge duct by a separate section of the testing staff every hour.

The following is a summary of the results obtained:—

Test Tubes. Weights.

Tube.	Before Test.	After Test.	Difference.
Inlet.	38.928 gr.	39.372 gr.	0.444 gr.
Outlet.	37.583 gr.	37.584 gr.	0.001 gr.

Air Meters. Volumes in cubic feet.

At.	Commence.	Finish.	Difference.
Inlet.	73110	73410	300
Outlet.	Zero.	00300	300

Cleansing Efficiency—99 per cent.

Megger Readings.

Time.	Coil A.	Coil B.
9.30 a.m.	6.0	8.0
10.30 a.m.	6.0	7.5
11.30 a.m.	6.5	8.0
12.30 p.m.	7.0	7.5
1.30 p.m.	6.0	8.0
2.30 p.m.	6.0	7.5
3.30 p.m.	6.0	7.5
4.30 p.m.	5.9	7.0

Filtering Efficiency.

It will be gathered from these figures that the results obtainable with these filters are thoroughly satisfactory, and it may be said that this is not a little due to methods recently introduced into

the Research Department of Heenan and Froude's works, where a series of experiments have recently been conducted to discover the filtering efficiency of the latest M.S. type "Heenan" air filter. These experiments consisted of taking careful and accurate measurements of the weight of dust contained in a certain quantity of air entering the filter under test, and comparing the figures with the quantities of dust contained in a similar amount of air at the filter outlet during the same time.

It has been found that the filtering efficiency increases as the inlet air contains more dust, rising from approximately 90 per cent. when the air is initially in a comparatively very clean condition up to over 99 per cent. when the dirtiness of the air is multiplied tenfold or twentyfold.

Ninety Per Cent. Extracted.

Fig. 2 is typical curve so obtained from which it will be seen that from air containing initially 1 mg. of dust per cubic metre, approximately 90 per cent. of the dust can be extracted, while from air containing initially 10 mg. of dust per cubic metre, approximately 99 per cent. can be extracted.

In manufacturing districts, especially under certain weather conditions, the amount of dust contained in the unfiltered air is probably more than 10 mg. per cubic metre, but as so far there has been no opportunity of carrying out investigations at other towns where the atmosphere is less dirty than in Worcester, it is impossible to say definitely whether this is likely to be the case. The nature of the dust has been varied during the tests to include the following:—(1) Dust from the ordinary atmosphere of the experimental shop; (2) coal dust; (3) coal and plumbago dust mixed; and (4) road, workshop, and foundry dust mixed.

Insulation Resistance of Test Coil.

Tests extending over some months have also recently been concluded at the Worcester works, with a view to standardizing the resistance which should be indicated under varying conditions of atmosphere. In the first place it was necessary to calibrate the test coil in such a way as to exclude any possibility of loose moisture in a very finely divided state affecting the readings. Secondly, it

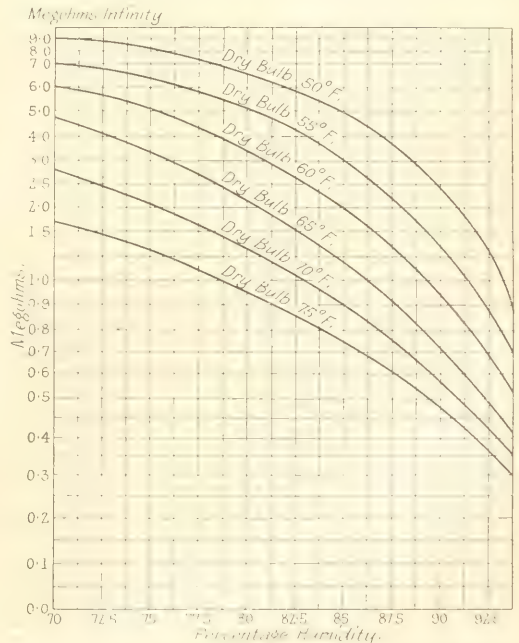


FIG. 3 CURVES AND INSULATION RESISTANCE, H. AND F. M.S. TYPE AIR FILTER. TEST COIL OF BLACK FIBRE, BRASS AND SILK FACE. CALIBRATED AT AIR VELOCITY OF 20 ft. READINGS FIRST DAY OF IMMERSION ARE IGNORED. EVERSHED AND VIGNOLES' MEGGER USED

was necessary to adopt some form of insulating material which would be sensitive to changes in humidity.

The first readings obtained were scrapped owing to the fact that the test coil used in the experiment was so sluggish in action that it was difficult to say when the readings had settled down to a

static condition, so that a test coil of modified design was adopted, and this appears to have given very consistent results. The insulating material is silk, interposed between a bare copper wire and a brass plate.

In order to exclude traces of loose moisture which might have been present in the air leaving the filter, there was interposed an arrangement of thick cloth, stretched over bars, between the filter outlet and the test coil. The air in passing through the fibres of the cloth, was judged to have left behind all traces of loose moisture. Arrangements were made to maintain a constant velocity of air past the test coil throughout the tests, so as to cut out one factor which might have caused a variation in the readings. An "Evershed & Vignoles" Megger, of the variable pressure pattern, was used for testing the insulation resistance.

Test Results.

Tests extending over a period of some months, during which time the humidity and temperature of the air have undergone wide variations, have produced results which are plotted in Fig. 3.

It will be observed that the insulation resistance falls as the humidity of the air rises, so that at an air temperature of 60°F. when the humidity stands at 75 per cent., the Megger shows a reading of 5 megohms, while at the same temperature, but at 90 per cent. humidity, the resistance has dropped to less than 1 megohm. The air temperature also has an influence on the results, the resistance falling as the air temperature rises.

Taking another example, the resistance corresponding with an air temperature of 50°F. 80 per cent. humidity, is 6.5 megohms, but at 75°F. 80 per cent. humidity, it is only 0.95 megohm.

These curves certainly indicate that even given the absence of loose moisture, the natural humidity of the air is bound to affect the insulation resistance of the alternator windings, so that in hot humid weather the resistance would be lower than it is on a cold dry day in winter.

As a check against the efficiency of the "Heenan" M.S. type air filter for discharging air which is free from any trace of loose moisture, the cloth air filter was removed and readings obtained with the same test coil at the same air velocities, temperatures, and humidity. Up to the present time no difference from the readings shown in the curves has been discovered.

Cooling Effect.

An important subsidiary point about air filters is their cooling effect, and the following table shows the approximate cooling effect given by "Heenan" filters of the M.S. type, under various atmospheric conditions:—

Air entering Filter.		Air leaving Filter.		Relative humidity leaving Filter per cent.	Water evaporated, g.p.h. for 1 000 cub. ft. per minute.
Dry bulb. Dregs. F.	Wet bulb. Dregs. F.	Dry bulb. Dregs. F.	Wet bulb. Dregs. F.		
100	78	86.5	78	68	1.50
90	72	79	72	71	1.25
80	68	72.5	68	80	0.90
70	62	65	62	85	0.55
60	55	57	55	88	0.32
50	47	48.2	47	92	0.23

In conclusion, it is interesting to note that the filtering efficiency of the "Heenan" air filter depends upon the amount of dust and similar mechanical impurities contained in the air entering the filter. A higher proportion of the dust can be extracted when the air is initially dirty than when it is relatively clean. The following table shows the proportion of dust contained in the air entering the filter, which has been extracted by the standard M.S. type "Heenan" air filter, the impurities being understood to consist of road, coal, ash, and general workshop dust, or dust of similar nature.

Weight of dust contained in each cubic metre of air entering Filter.	Percentage of dust removed by Filter.
1 milligramme	88 per cent.
5 "	96 "
10 "	98 "
15 "	98.5 "
20 "	99 "

At the meeting in CHRISTIANIA last month of the Scandinavian Commission which is discussing the question of the TRANSMISSION OF ELECTRIC POWER FROM NORWAY TO DENMARK, a number of lectures were given dealing with the economics and engineering of hydro-electric problems in these countries, and visits were paid to a number of Norwegian power stations, including Vannua, Solbergfos, Morkfos, and Nore. The possibility of the scheme being realised in a not too remote future is now considered to be much greater than it was before.

Phenomena of Arc Welding.*

By O. H. ESCHHOIZ.

The most important phenomena in arc welding are those relating to (1) metal deposition, (2) fusion, and (3) stability of the arc.

A satisfactory deposition rate, consistent with thorough fusion, is achieved by employing a cathode current density in the neighbourhood of 8 000 A per square inch. The transfer of metal appears to be accomplished in part by:—

1. Vaporisation and condensation of electrode material.
2. Expulsion of vaporised and liquefied metal by the expansion of gases confined or generated in the electrode ends.
3. Transport of liquefied metal due to the forces of molecular attraction, gravity, surface tension, adhesion, and cohesion.

The author estimates that the energy expended is utilised to the extent of 60 per cent. in liquefaction, 26 per cent. in vaporisation, and 14 per cent. in radiation and other losses.

Effect of Occluded Gas.

It is well-known that metals absorb gases readily, and iron has been found under certain conditions to contain fifty times its volume of gas. Upon striking an arc with electrodes high in occluded gas the resulting pressures result in a propulsive force on the metal. Again, some electrode wires contain relatively large quantities of iron oxide and slag. When heat is applied, these impurities disintegrate and liberate oxygen, thus adding to the expansion effect. This condition may be affected by the pasty condition of the metal, which results, to an appreciable degree, when welding with a long arc. The expansion of occluded, or generated, gases occurs only to a slight degree when holding a short arc with wires that comply with the specification drawn by the American Welding Society. The effect obtained is not explosive in action, but may be described as a slow enlargement of the globular-electrode terminal. Expansive forces of this order appear to aid metal deposition by decreasing the forces of cohesion and surface tension which retain the globule on the end of the wire electrode.

The observed phenomena depend somewhat upon whether the welding is carried out downward or overhead, and whether with a long arc or short arc. Globular formation at the electrode terminal is characteristic of bare, coated, and covered wires. Bare electrodes have been examined by the author and may be classified into four groups.

Globular Formations.

In Group 1 the globular formation is most evident upon welding with steel rod. As this steel is made by the crucible process, it is low in impurities and in gas content. The high carbon content serves to generate a thick envelope of carbon-oxide gases which greatly reduces the further oxidation of the electrode surface, maintaining it in the approximate form visible during the welding.

In Group 2 mild carbon steel is frequently employed as welding wire. Upon forming a globular end and breaking the arc, atmospheric oxygen rapidly attacks the unprotected incandescent iron, often leaving only a perforated iron oxide shell. During welding, however, the metal is exposed to a much slower rate of oxidation, due to the surrounding gases.

Group 3 has reference to steels and iron made by the Bessemer and puddling processes, and, therefore, the presence of occluded gases is practically unavoidable. The expansion of such gases produces characteristic cavities in the wires examined.

Group 4 has reference to a long arc, working with a low carbon-content wire electrode. Upon breaking a long arc an interesting modification in globular structure is obtained. Commercially pure iron passes through a critical temperature range, in the neighbourhood of 950° C., in which the metal assumes a pasty form. This condition facilitates the penetration of atmospheric gases and the consequent expansion within the fluid globular body of carbon oxide gases. This expansion causes the globule to enlarge.

The cycle of deposition seems to be as follows:—

1. After forming the arc, appreciable time is required to liquefy the electrode end.
2. The liquefied end assumes a globular form, enlarges, decreasing the arc length and arc voltage, while increasing arc current.
3. When the globule has enlarged sufficiently to bridge or short-circuit the arc stream, the arc voltage drops practically to zero and the arc current increases to short-circuit value.
4. The short-circuit condition exists until the globule is no longer in contact with the wire electrode.
5. At the instant of detachment the current decreases while the

* Abstract of a Paper read before the American Electrochemical Society.

A large rises sufficiently to re-establish the flow of the welding current in the partially de-ionised arc gases.

Overhead Deposition.

Overhead deposition is chiefly dependent on arc phenomena overcoming gravitational force acting upon the material of the pencil electrode. Surface tension and cohesion between the solid wire and its molten end are decreased by the presence of solid, liquid, and gaseous impurities at the boundary. Experience has shown that these forces are reduced when small quantities of iron oxide, iron carbide, manganese, etc., are present. The total surface tension and the total cohesive force are proportional to the area of contact between the liquid and the solid or plastic metal. The lifting force is also dependent on the "wetting" characteristic, which facilitates the adhesion and spread of the electrode globule on making contact with the puddled surface. Heating an overhead joint locally helps to start layer deposition, since it facilitates the initial production on a cold plate of a "wetted" surface to which the globule must be attached by the forces of surface tension and adhesion.

The cycle of deposition seems to be as follows:—

1. Metal at each terminal is liquefied upon striking an arc.
2. The molten electrode end assumes an approximately spherical form, due to the well-known phenomena of surface tension causing a fluid material to contract into the smallest volume.
3. This globule enlarges with continued application of energy, until, with the aid of electrode manipulation, its upper surface is brought into contact with the overhead pool, thereby short-circuiting the arc stream and causing the lifting forces to act upon it.
4. Forces of surface tension and adhesion at the contact area between the overhead plate and the globule cause the globule to change its form and spread over the plate surface.
5. As the metal spreads, the area in contact with the plate increases, and therefore the lifting forces are also increased, causing an acceleration in metal transfer. These forces act until the globule is lifted off the wire electrode end, when the short circuit is broken and the arc re-established.

Welding and Cutting Arcs.

Immediately after drawing a short arc, the plate metal first liquefied appears to be blown from the crater terminal, which continues to penetrate deeper into the anode material. Under proper conditions it is therefore possible to convert the welding arc into a cutting arc. While the source of this blowing action has not been definitely established, the following effects appear to be contributory:—

1. Impact of ions, cathode vapour, gases, and globules.
2. Atmospheric convection currents.
3. Sudden liberation of gases confined in anode material.
4. Pressure on anode surface of gases formed by combination of incandescent metal constituents with atmospheric gases.

In the past, investigators of arc phenomena have confined their attention chiefly to the behaviour of low-current arcs. The problems, however, confronting the welding, searchlight, fuse, and circuit-breaker engineer can only be solved with a proper knowledge of high-current arc phenomena. While certain fundamental characteristics are common to both types of arc, it is evident that the complexity of the phenomena may increase with increase in current, rendering more difficult their proper interpretation and retarding their most effective utilisation.

Scientific Basis of Traction Design.*

By Dr. E. SEEFEHLNER.

It is plain that the first elemental fact is that the wheels of the rolling stock should roll on the rails, *i.e.*, there should be no sliding motion. In this way the weight of adhesion is used to the best advantage, and rolling friction is also known to be less than sliding friction. From this point of view, it seems that these conditions can only be met by making the rail flat and the tyre cylindrical. Any change in respect of these matters would appear to result in loss; if the tyre is slightly conical, one portion appears to roll on the rail, while all the others slide. Sliding friction being greater than rolling friction, a loss of efficiency naturally results from any sliding motion, and shows itself in the form of wear and heat. Cars with conical tyres cannot, therefore, reach the ideal efficiency: the load that can be drawn is lessened, and at the same time there is wear on tyres and rails. Under unfavourable conditions, a good deal of sand has to be used, and this further accentuates the wear. It may be said that the cylindrical shape cannot be maintained indefinitely; on the other hand, there seems to be an advantage in starting with this form, which most nearly meets theoretical requirements.

If the surfaces of the tyre and rail wear away at equal rates, there seems no reason why the cylindrical shape should not be preserved for a comparatively long time. This means, of course, that the breadths of tyre and rail should be properly adjusted. If the one is too broad for the other, the tyre may wear hollow, and has also an excrescence on the outer edge. If the tyre is too narrow, it wears into a conical shape, and the top of the rail ceases to be horizontal. If the tyre is too broad, good results can be obtained by turning it up conically on one side. The cylindrical shape for the surface of the tyre is a great advantage; and it is desirable that some method of testing for it should be devised without the necessity of detaching the wheel.

Braking Effect and Tyres.

From this it seems to follow, as a matter of course, that it is undesirable to produce the braking effect by pressing brake-shoes against the surface of the tyre. In the first place it tends to wear the costly surface of the tyre, and, secondly, it undoubtedly results in the deformation of the cylindrical surface. Moreover, the wheel friction decreases by an alteration of the running surface, and probably owing to the heat.

From the constructive point of view, a low coefficient of friction between the shoe and the wheel means a comparatively stiff brake-rod, and a high braking force. A change in the coefficient of friction between the shoe and the wheel is also undesirable, as it makes braking uncertain in bad weather.

All these difficulties disappear if a brake-drum is used. A grooved surface to the brake-drum has certain advantages, and it can be arranged so as to be easily replaced. The arrangements in connection with the brake-rod can be improved on this plan, as no very heavy pressure is needed. Hand-brakes can be used for comparatively heavy cars. If the brake-drum is enclosed, braking conditions will be little affected by the weather.

Room for Improvement in Design.

The design of the cars, as practised on the Continent, leaves room for improvement. The size of the wheels makes it necessary to have three step steps at the ends; even with an entrance in the middle of the car, the time for halts is in excess of what is actually necessary, owing to the fact that constructional defects cause a considerable time to elapse before all the passengers have either mounted or dismounted.

As for gearing, the fundamental kinematic law says that the common normal at the point of contact of the teeth must pass through the point of contact of the pitch circles. In this way a steady motion is transmitted. The geometrical principles are quite simple, and the art has been brought to such a pitch of perfection that teeth, almost theoretically exact, can be produced. Yet it is well known in practice that gearwheels almost always produce a great deal of noise, especially at high speeds; humming gears are almost regarded as an unavoidable evil. In the midst of the many noises of the streets, they do perhaps little harm; but this humming is the audible expression of internal vibrations, which mean loss of efficiency. If there were no friction in gearing, there would be no vibration; but friction alters the magnitude and direction of the transmitted force. Only at one point of contact do the two surfaces actually roll on one another; at the first moment of contact, the sliding motion is considerable.

The Cause of Vibrations.

At the end the sliding motion is in the opposite direction to that at the beginning. Consequently the force, due to friction, alters its direction. These variations set up vibrations, and at certain speeds these may result in vibrations in the spindles. Variations in the radial forces produce bending phenomena; in fact, one kind of disturbance or distortion produces another. Obviously lubrication is the first remedy. But Maag's system of gearwheels is another remedy, inasmuch as it reduces the amount of sliding motion. The system of cutting the teeth obliquely certainly obviates some troubles, but causes axial pressure, and a greater tooth-pressure; moreover, it prevents endplay, which is desirable for steady wear on the commutator.

The use of two sets of gearwheels, one being half a space in advance of the other, has also its advantages. Long experience with the Abt rack, which is constructed on these lines, shows what may be expected. Even if the initial period of contact is shortened, and carefully ground wheels, prepared by special methods, are employed, no better results can be obtained than by the use of gearwheels on the Abt system. The humming of the gearwheels is specially noticeable when the motors are short-circuited for braking purposes. This is, as already explained, a vibratory phenomenon, which would disappear if there were effective damping. At full speed it is not so marked, because the car is connected to a large power-station, which keeps the voltage steady, and only supplies the proper current to the motors. When the motors are short-circuited the car is left to itself; the motors have little electrical or mechanical inertia, so that any variation in the forces produces external effects.

* Abstract from the "Elektrotechnik und Maschinenbau."

Recent Extensions at Sunderland.

In common with most other manufacturing towns in the country, Sunderland found it necessary to make arrangements for considerably adding to its generating and converting plant during the war. The additions included a 10 000 kVA alternator for the main Corporation Generating Works at Hylton-road, while in the neighbouring Dunning-street sub-station there were installed two 1 500 kW motor generator sets, two "Kapp" phase advancers, and a 20-panel low tension switchboard, for general low tension d.c. supply. The whole of the electrical plant for these extensions was obtained from the GENERAL ELECTRIC COMPANY, LTD., and was manufactured at that company's Witton Works.

Turbo-Alternator Details.

According to the specification, the turbo-alternator (see Fig. 1) was to have a full load output of 10 000 kVA at a speed of

material were arranged round the windings, the clamps on opposite sides of the winding being rigidly bolted together. Further, the whole of the clamps formed a continuous structure, and a cast-iron ring surrounded the whole clamping system so as to afford further strength.

It is essential that a turbo-rotor should be absolutely rigid, compact, and well balanced, and these qualities are, it is claimed, obtained in the "solid" rotor which the G.E.C. have always adopted in their machines. This practice was, of course, followed in the case of the rotor for the Sunderland machine, the slots being milled from a steel forging of high tensile strength. The slots were then insulated with mica, and the copper strip winding dropped into position. Each layer was separated by mica. Metal wedges were then driven into the top of the slots, the end connections being firmly encased with steel shrouds shrunk on when moderately

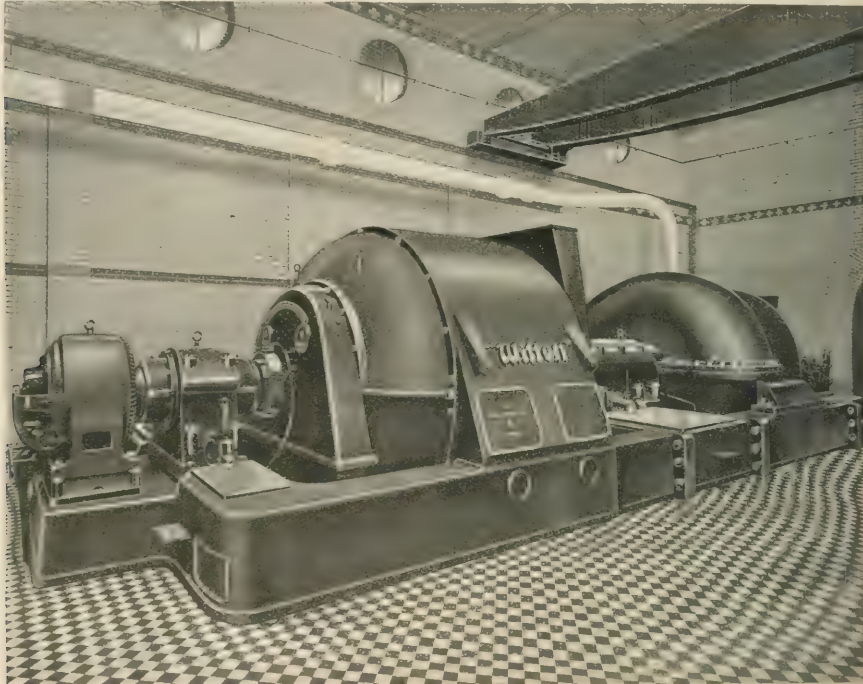


FIG. 1. THE NEW 10 000 kVA TURBO ALTERNATOR SET AT SUNDERLAND.

1 500 revs. per min. on a 5 300 V 50-cycle three phase circuit. Although the modern high-speed alternator is continually being improved in detail, one main consideration, namely, great mechanical strength must always govern its design and manufacture. Scarcely less important is the question of ventilation. Naturally these requirements were given careful attention in the production of the machine which we are considering. This will be evident from a brief description.

The shell of the stator was a massive casting, with stout internal ribs of such dimensions as to be rigid under all conditions of working. The laminations were secured to the shell by dovetail keys, and firmly bolted between strong clamping plates, to prevent all risk of movement. It should be particularly noted that the stampings were produced by carefully ground tools, and not by punching. This latter process, it is found, tends to increase the iron losses.

Stator Winding.

The stator winding comprised bars which were insulated from each other by means of high-grade mica, the complete coil being encased in a seamless micanite tube before insertion into the slots. The overhanging ends of the coils have always presented difficulty, due to the severe strains set up in them by heavy short circuits on the system. To prevent any movement on such occasions heavy bronze clamps with spacing blocks of a special incombustible

warm. Provision was made for an ample supply of cooling air by a system of combined axial and tangential ventilation, so arranged that at no stage during its passage through the machine could the air which cools the rotor be brought into contact with that for cooling the stator.

The main regulator for this alternator is of interest, being motor operated by means of push-button control.

High Output Motor Generators.

The Dunning-street sub-station, where the new plant was installed, is situated near the centre of the town. The reason which decided the corporation in selecting motor generators for such high outputs in comparison with rotary converters was the fact that the voltage of the d.c. side could be raised gradually from a low value of a few volts up to full voltage. This, of course, is not possible with rotary converters, but is of the greatest importance in cases where a total shut-down of a large lighting system is to be taken into account, and where a gradual replacing of the supply without turning out of consumers' apparatus is a necessity.

The two motor generator sets are generally in accordance with standard practice. The motors are rated at 2 120 H.P., 5 300 V, 50 cycles, and are run at 300 revs. per min., the generators being 1 500 kW 220 V. In view of the heavy currents to be dealt with,

the commutators are divided into two halves, so as to avoid undue heating in the individual sections.

"Kapp" Phase Advancers.

But the phase advancers, the switch for which is seen in Fig. 2, are probably the most interesting items of plant in the sub-station. These are of the "Kapp" type, being, as is well known, based on the principle that when a conductor carrying alternating current moves in a magnetic field, a current is induced in the conductor which leads the E.M.F. by 90 deg. The main component parts of the phase advancer are very similar to those of a d.c. machine. Usually for each phase of the alternating current supply a two-pole magnet system with armature and commutator is provided, but in view of the size of the motors, in the present case, two such units per phase were decided upon. The main frame of the phase advancer is a rectangular casting to which are bolted the poles, the armatures and commutators being supported by bearing brackets, which are also bolted to the frame. It will at once be realised that this construction affords a very simple machine mechanically.

The field poles are excited from a local d.c. supply. The armatures are connected in series with the rotor of the induction motor and the main supply. By this arrangement the alternating current in the armature conductors leads the E.M.F. The armature

rigid construction of moving parts is possible, due to the small number of armature conductors and commutator bars. Thus the risk of electrical or mechanical breakdown is practically non-existent. 2. It is not mechanically connected with the motor, consequently a chain or belt drive is not required. 3. It can be placed in any convenient out-of-the-way situation; it requires little floor space.

4. The induction motor with phase advancer preserves its asynchronous characteristics, and the possibility of hunting or

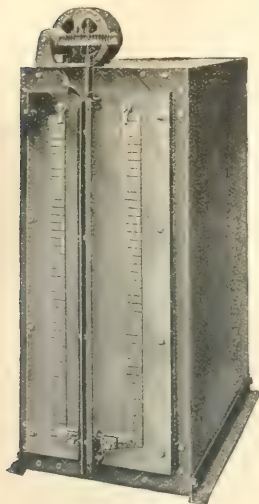


FIG. 2.—REGULATING SWITCH FOR KAPP PHASE ADVANCER.

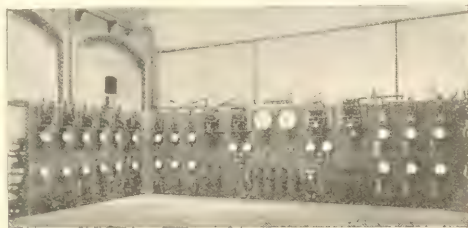


FIG. 3.—7 000 A 220 V. D.C. SWITCHBOARD IN THE DUNNING ROAD SUBSTATION, SUNDERLAND.

falling out of step with fluctuations of the supply, which is a drawback to the synchronous motor, is avoided. 5. The power consumption of the advancer is about $\frac{1}{2}$ per cent. of the full load power of the motor. This small amount of power is far more than compensated for by the increased efficiency of the motor. 6. The advancer acts entirely automatically, no adjustments being required during running. Generally speaking, the excitation of the phase advancer can be adjusted once and for all.

Low Tension Switchboard.

The 220 V switchboard, which is illustrated in Figs. 3 and 4, controls the two 1 500 kW generators, fourteen 1 000 A feeders, with one leakage and earth panel, while two panels are left blank. The back view (Fig. 4) shows that the heavy bus bars necessary are erected in a very neat and efficient way. The bars are clamped to plates which are carried on extended stems. Heavy flat bends

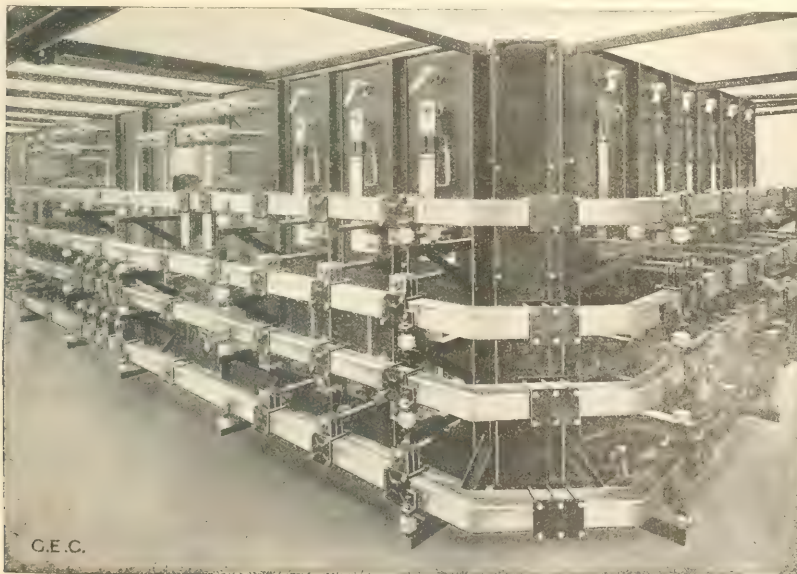


FIG. 4.—BACK VIEW OF THE 7 000 A BOARD SHOWING MASSIVE BUSBAR CONSTRUCTION.

does not rotate, but oscillates with a frequency depending upon the slip of the induction motor.

The "Kapp" phase advancer has, it is claimed, very definite advantages over other types. Amongst these may be mentioned:—

1. There are no high-speed moving parts. In addition, a very

are thus done away with. In consequence, cleaning operations are much facilitated, and the smaller connections can be run to much greater advantage than would otherwise be possible.

In conclusion, our thanks are due to Mr. A. S. Blackman, the Borough Electrical Engineer, for allowing this article to be published.

Reviews.

Automatic Telephone Systems. By WILLIAM AITKEN.
Vol. I.—Circuits and Apparatus as Used in the Public Services.
(London: Benn Bros. Ltd.) Pp. xv. 282. 25s. net.

When consideration is given to the rapid developments that are taking place in automatic telephony, it is hardly surprising that the literature of the subject is somewhat scanty, for a book dealing with it will very quickly tend to become out-of-date in some portions. It is all to the good of the art, as well as to the convenience of its followers, however, that progress should be recorded, and, therefore, the appearance of "Automatic Telephone Systems," by Mr. William Aitken, is very welcome. It is the first British book to deal with the subject in a comprehensive manner, though one covering the same field has appeared in America and others dealing with one system in this country.

The present work is being published in two volumes, of which only Vol. I., "Circuits and Apparatus as Used in the Public Services," has appeared so far. It comprises detailed descriptions of all the principal systems that have been introduced in Britain and America, and some others, not so important, which are included for their historical interest. The danger of obsolescence mentioned previously has, of course, been realised by the author. It is for this reason, as he explains in the preface, that "instead of the usual chapters the book is divided into short sections. A section is merely a division which may contain one or several pages, and may describe one feature or a system. It will contain such matter that may readily be replaced by new, if it should become of little value or be abandoned." Though undoubtedly a good method of dealing with the difficulty, this course rather tends to make the sections absolutely distinct and unconnected. This partial lack of co-ordination is not conducive to a comprehensive grasp of the whole subject, but is perhaps not serious to a student who is prepared to study each system on its own and afterwards to make comparisons between systems in any manner he desires.

The information contained in the various sections is very complete, and includes practically all the recent developments. In a few places the descriptions are not as clear as they might be, but this is due partly, at any rate, to the necessity for keeping them to a reasonable length.

An important feature in any book dealing with telephony is the preparation of the diagrams. This has engaged the special attention of the author, who has adopted the method known as bus-routing. This consists in numbering the circuits in order of operation, and placing the circuit number on the diagram in sufficient places to indicate its course. Such a method enables the student to follow the operation of a circuit without continual reference to the letter-press.

It is gratifying to see (in Section 83) the "Interim British Standard Terms and Definitions for use in Automatic Telephone Systems" which has been published by the British Engineering Standards Association.

The general get-up of the work is deserving of a few words. A large size of page has been adopted, which allows of many diagrams being reproduced without folding, while the remainder fold only in one direction. In these respects the book is an improvement on some others dealing with the subject.

G. F. O'DELL.

Artificial Light: Its Influence upon Civilization.
By M. TUCKER. (London: Hodder & Stoughton, Ltd.) Pp. xiv. 366. Price 12s. 6d. net.

The sun is played out. There need be no more windows, for artificial light is better than daylight, and artificial ventilation can be better arranged than the breezes of nature. No longer need valuable ground space be sacrificed in the provision of light-courts, but buildings may be built solid from back to front and from one side to the other. Productiveness in the factory, as well as productivity, both animal and vegetable, can be increased out of all knowledge by the skilfully-directed use of artificial light. Moreover,

by much light, or selected light, or no light at all, we are enabled to prevent the nefarious activities of germs which otherwise would lie in wait to attack us; so that with more abundant life and less fear of death, the community, led forward by the Illuminator, may advance fearlessly and with confident mien towards that 100 per cent. efficiency for the attainment of which all are urged to strive might and main. Not only so, but, untrammelled by the restrictions of form, mobile light, melodic, harmonic, and symphonic, may ultimately become "responsible for the development of spiritual civilisation to its highest level."

Yet, writing these notes while speeding through the West of England in a summer as glorious as any in history, we are thankful that Nature expresses herself in both form and colour. Colour without form would be more meaningless than form without colour. The blue heaven, formless as it must be, nevertheless presents itself in the form of a dome, while the ever-differing forms of the clouds lend beauty to their infinite variety equally with the colours of morning and evening and the high noontide.

We have in this book an excellent example of a hobby-horse that has been allowed to assume control and run away with its rider. From the opening pages, where the area given to light-courts and the wall space devoted to windows are adduced as showing that daylight is expensive, through the dozen or so of times that the evolution of modern artificial lighting is traced from its beginning in the wild man's fire, down to the scarcely coherent rhapsodising of the final chapter, the subject of artificial lighting, important though it must be acknowledged to be, is treated with a lack of any sense of proportion. It is true that light has been an instrument for the advancement of civilisation, and some of us have, on occasion, named it as the predominant wish of our hearts. Nevertheless, it is well to avoid intemperance, in writing as in other things.

The book is readable, if a trifle monotonous, and contains but few mistakes. We noticed "allow" for "alloy" on p. 195; "cadelabra" on p. 332; "Siemens" in the index, p. 365; and a certain Archbishop of Canterbury is referred to as Pechham on p. 195, and as Peckham in the index, p. 364. The index itself is a thing of joy. It contains references to Aaron, Moses, St. Paul, Sir Walter Scott, Abraham Lincoln, Masterlinck, and other unexpected individuals, as well as to Sir Humphrey Davy, Newton, Faraday, Mrs. O'Leary, and others who have attained celebrity in the advancement of lighting. Obesity, happiness, mythology, sleep, rheumatism, and boy scouts are also referred to.

The work is described as one of the "New Century Books of Useful Science," and as such we hope it may have a certain field of utility. That field, however, will not be among men of science.

A. J. C.

Shorter Review.

Electric-Deposition of Copper. By CLAUDE W. DENNY, A.M.I.E.E. (London: Sir Isaac Pitman & Sons, Ltd.) Pp. xii. 108. 2s. 6d. net.

The object of this little book is "to touch lightly on the principles of electro-deposition from a practical point of view, and to give special attention to the rapid strides made during the past five or six years." The author was chief of the copper depositing plant at the Ponders' End shell works, and had considerable experience in the manufacture of finished articles requiring little or no complicated plant and machinery. It is chiefly about these new processes and methods that the author has written. After his opening chapters dealing with general principles, testing of solutions (he assumes that the reader has been in a chemical laboratory), preparation of work, &c., the author deals with reinforced copper, small electro-deposited copper tubes, electro-deposited radiators, driving bands for projectiles, the reclamation of scrap copper, the coppering of armour-piercing bullets and aero propellers, the deposition of water jackets, and the use of electro-deposition in the production of gramophone records. It is an interesting, practical, and suggestive little book.

The reviewer of Mr. A. M. A. Struben's book on "Tidal Power," a notice of which appeared in our last issue, asks us to point out that the criticism contained in the last sentence of his review was made under a misapprehension.

Correspondence.

THE ACCURATE MEASUREMENT OF ALTERNATING AND MULTIPHASE CURRENTS.

To the Editor of THE ELECTRICIAN.

SIR: In a recent volume of the Physical Society's "Proceedings" I see that Mr. Hubert Parry describes a new method of using the electrometer, which seems to have excited considerable interest and favourable comment. Now the whole theory of this instrument is fully described in a paper that I read before the International Electrical Congress, Paris, 1900, on "The Accurate Measurement of Alternating and Polyphase Currents," while later I wrote two articles on the "Electrostatic Wattmeter; Its Calibration and Adaptation for Polyphase Measurements." In the course of these articles I stated: "I think this method of reading watts may turn out to be important for standardising work in laboratories, but it is probably not so suited for general use."

The articles were afterwards reprinted by you for private circulation. No reference was made to this at the Physical Society's meeting. I do not wish to detract from Mr. Parry's credit, but it seems that it would not be unfair if attention were drawn to my pioneer work in this matter, and it is also some credit to your journal to have published the articles at the time. I am, &c.,

G. L. ADDENBROOKE.

Kensington, W., September 22nd.

THE RESTORATION OF THE PENNY FARE.

To the Editor of THE ELECTRICIAN.

SIR: You will be aware that the Municipal Tramways Association has been holding a Convention at Salford this week, when many references were made to the dark financial outlook of tramway undertakings throughout the country.

It appears to me that the time has come when passengers will refuse to pay the increased fares which they readily met while money was plentiful, and the cry is already going up in various parts of the country for the restoration of the pre-war penny fares.

I believe such restoration will be financially impossible, but if the token value of the penny itself could be increased so as to make it represent one-tenth instead of one-twelfth of a shilling the popular single coin 1d. fare could be restored in many places, where the choice now rests between empty cars at 1½d., and the subsequent loss, or full cars at 1d., with revenues below the cost of operation.

The return to the popular penny fare would be regarded by the passenger as a substantial concession, and the managers of the various undertakings would be comforted by the consideration that every such penny fare would bring in 20 per cent. more revenue than in pre-war days. I am, &c.,

HARRY ALLCOCK.

Manchester, September 2nd.

Air Extractors: Their Advantages and Defects

Compactness, simplicity, and absence of all moving parts are the most attractive features of the steam jet air extraction principle, which, in addition to its application to condensing plants for turbines and steam engines, has been used in nearly every case where a vacuum is required. Simplicity, however, has only been arrived at after exhaustive experiments, owing to the extremely complex physical phenomena governing the design. These have given rise to instability of working, in some cases to such an extent as to cause failure in operation.

Many designers, therefore, in order to stabilize their extractors, have previously introduced air at atmospheric pressure at certain points where the internal pressure is below that of the atmosphere.

An Incomplete and Illogical Method.

This method is incomplete and illogical for the following reasons:—(1) It is incomplete because, to steady the action of the extractor, the inflow of air will be intermittent. (2) It is illogical because in both cases a certain amount of work, which is necessary for the recompression of the stabilizing air to atmospheric pressure, is

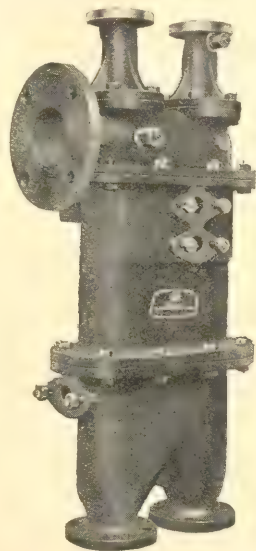
required and has to be supplied by the steam in the nozzles. This additional work reduces the efficiency of the apparatus and necessitates an increase in steam consumption.

The invention of the C.M. & M. Delas system (COLE, MARCHANT & MORLEY, LTD.) has, it is claimed, solved this problem, and by a direct application of fundamental principles has obviated all risk of failure in these extractors. An explanation will, perhaps, help to emphasise this.

It is known that, other things being equal, the degree of vacuum depends on the distance between the throat of the diffuser and the end of the steam nozzle. By increasing this distance the friction surface and the weight of air withdrawn is increased and a higher vacuum created. If the distance becomes too great a drop in vacuum is noticed, with at the same time an ever-increasing rise in the temperature of the convergent resulting in the failure of the extractor.

The Course of the Invention.

The inventor was thus led to believe that failure started with this increase in temperature, and would be obviated if the convergent were kept cold. He proved this in the following manner:—An extractor was fitted with a water jacket encircling the convergent,



VIEW OF THE C. M. AND M. DELAS AIR EXTRACTOR

and was at first started up without the water being introduced. The distance between the steam nozzle and the throat of the diffuser was gradually increased until the apparatus failed, when the vacuum registered only 11 in. The circulating water was then introduced, and at once the vacuum rose to 28 in. Normal working commenced with perfect stability, and, better still, when the nozzle was further removed, an even greater weight of air was withdrawn, which caused a corresponding increase in the vacuum.

It will thus be seen that the inventor solved the problem of instability by the simple method of introducing external cold water circulation instead of the usual method of introducing atmospheric air into the divergent. This modification, we are informed, has also simplified manufacture and enabled a very high vacuum with absolute stability to be obtained, and at the same time an almost isothermic and economical working of the extractors.

It will be obvious from the above, and it has also been proved by careful experiments under varying conditions of steam pressure and air extraction, that a water-cooled convergent parallel diffuser has a degree of stability which makes failure practically impossible, even with very low steam pressures at the nozzles and a largely increased amount of air extracted.

Three types of Delas air extractors are manufactured. The first is a single stage extractor, the second a double compression stage extractor with a single nozzle on each stage and total recuperation of heat units in the feed water, while the third is used with an intermediate condenser, and with two compression stages and a single nozzle at each stage, the heat of the second stage always being recoverable.

Camouflage at Olympia.

Not even the most hardened and blasé of exhibition frequenters could, we think, have passed the B.T.H. stand at the Shipping Exhibition without examining a most fascinating display as was there to be found. The stand (No. 207) was on the right of the main entrance, and even had it been elsewhere its position, brilliance, and interesting appearance would have precluded the slightest possibility of its being missed. In every respect—the construction, decoration, and lighting of the stand, the selection and arrange-



FIG. 1.—GENERAL VIEW OF THE MAZDA STAND AT THE OLYMPIA EXHIBITION.

ment of the exhibits, and, we may add, the courtesy and informativeness of the *personnel*—the stand bore the impress of organising genius and infinite care.

A list of the exhibits has already been published. These, it will be remembered, included motors, control gear, wireless receiving sets, rivet heaters, Mazda lamps, and a host of other appliances of use, either directly or indirectly, in the construction and equipment of ships. A special type of Mazda lamp—the "Navy Bulb"—



FIG. 2.—HOW SHIP LIGHTING WAS DEALT WITH ON THE MAZDA STAND.

lamp—is supplied for marine service, and this lamp formed the central feature in the lighting section of the B.T.H. exhibit.

The subject of ship lighting was treated in a decidedly novel and artistic manner. The back of the stand was divided into three panels. These panels were occupied by painted canvases depicting respectively the promenade deck, the dining saloon, and the lounge

of a modern liner. The panels were painted by a scenic artist and have a most realistic appearance from the front of the stand. Appropriate electric light fittings equipped with lighted lamps are painted into the pictures. In front of each picture, and so fixed as to appear part of the picture, was a metal and lacquered embodiment of the painted fittings. The actual fitting was, of course, illuminated.

A corner window of the stand was occupied by the Mazda window display—a most attractive conglomeration of revolving shades, showcards, a plaster model, and other accessories.

B.T.H. floodlight projectors for marine service and various industrial applications formed another interesting item in the exhibit, especially to those who have seen the large Mazda hoarding outside the Olympia, which at night was flooded with light by these wonderful appliances.

Needless to say, the stand was brilliantly illuminated, and, situated as it was just to the right of the main entrance, provided an early and irresistible attraction to a large proportion of the visitors.

Standard Switchgear Specifications.

Two British Standard Specifications which have recently been published by the BRITISH ENGINEERING STANDARDS ASSOCIATION deal respectively with air-break knife switches and laminated brush switches for pressures not exceeding 660 V. and air break circuit breakers for pressures not exceeding 660 V.

These specifications form part of a series which are at present under consideration by the Association. During their preparation it was found that many of the conditions could not be laid down with any certainty until a large amount of research work had been done, particularly with regard to rupturing capacity for large sizes and safety of insulation. A comprehensive research is therefore being undertaken by the Electrical Research Association, and when the results of this work are available it may be possible to extend the specifications. In the meantime, however, it is thought that they will be of considerable use to the industry.

Breaking Capacity.

It is recognised that the breaking capacity of switchgear is dependent on many factors other than the kilo-volt-amperes to be broken, and it is necessary to take in consideration all these factors in deciding on the size of control gear to be employed. The specifications do not include switches and circuit breakers for use with series motors, circuits of high inductance or traction circuits, all of which may require a higher breaking capacity than is specified therein.

Nomenclature and Definitions.

□ A distinction between an isolating switch, a switch, and a circuit breaker is laid down as follows:—"An isolating switch is intended only for interrupting the circuit when there is no load-current. A switch is suitable for breaking a load-current; and a circuit breaker is suitable for interrupting a short circuit."

A number of terms used in modern switchgear practice have been defined, and a series of standard sizes has been included. Dimensions of back connections and the distance apart of the stud centres of knife switches have been agreed upon so as to secure a reasonable amount of interchangeability without interfering with details of design. Since it is not practicable to make a complete range of tests on every switch or circuit breaker, the tests have been divided into two categories, i.e., tests which are carried out on every switch or circuit breaker and those which are carried out only on a switch or circuit breaker of a type.

✓ The issue of these specifications marks, it will be agreed, a distinct step forward towards the simplification of switchgear generally. As usual, the co-operation of the interested electrical associations has been secured in the preparation of the specifications, as well as that of the Government Departments, the Institution of Electrical Engineers, the Electricity Commissioners, and the National Physical Laboratory. The Committee have also had the benefit of the assistance of Mr. E. B. Wedmore (Director, British Electrical and Allied Industries Research Association) and of Mr. C. H. Wordingham.

Large Addition to Radium Supply.

Two grammes of RADIUM (about 0.070 oz.), the largest amount ever transported, and valued at £70,000, was brought to London from Prague on Sunday by Professor Soddy, the radiologist of Oxford University. The radium has been acquired by the Imperial and Foreign Corporation of London, for whom Professor Soddy acts as scientific adviser. It has been rented by the Corporation from the Czecho-Slovakia State mines for a period of fifteen years. At the end of that time it may be returned. The Corporation will in turn rent it to people in this country, scientists and others, who have special use for the radium. The present cost of hiring 25 millicuries (a term derived from the name of Mme. Curie, who discovered radium) is six guineas for twenty-four hours.

S.E. Lancashire Electricity Scheme.

After considerable delay the South-East Lancashire Electricity Committee has put forward a scheme for electricity supply in the area which was provisionally delimited by the Electricity Commissioners in July, 1920. Electrically speaking, the area will be one of the most important outside London, and it is made more interesting by the proposals which are suggested for dealing with the problem of control. The extent of the area is shown in the accompanying map. It is largely industrial and contains such important electrical entities as Manchester, Bolton, Bury, and Salford, together with the area supplied by the Lancashire Electric Power Company.

The Duties of the Advisory Board.

The adoption of the scheme will, of course, involve the closing of some stations and the extension of others, but no immediate joint action is anticipated on this matter, except the formation of an Advisory Board. This Board will give expert advice on any proposals by electricity undertakings within the district, using as their guide the scheme which has been drawn up by the Electricity Committee. The Board will, however, have no power either to order or to authorise the outlay of capital; it will not be able to order the closing of any undertaking; but it will be recognised as a competent and legal body by the Electricity Commissioners, who will entrust to it the organisation of power supply in the district and the duty of deciding on any proposal which may be made locally. It should be understood that the Board will have neither funds nor borrowing powers. The finance of expansion and extension will, therefore, devolve on the local authority which proposes such expansion, and will naturally depend on the consent of the Electricity Commissioners.

A Joint Authority Envisaged.

Should general opinion in the district desire it, however, the Board could, by an amending order in Parliament, be changed for a Joint Electricity Authority, which would have borrowing powers, being responsible only to its members and to the Electricity Commissioners. Either of these bodies would be composed of experts from the individual undertakings under the scheme, but the constitution of the joint authority would differ from that of the Board. Each undertaking will pay a fee—five guineas or ten guineas for the smaller, and according to capacity for the larger—for administrative purposes, and it is expected that within five years the scheme will effect a saving of £175 000 and that within ten years the saving will be close on £250 000.

Stations to be Retained.

As usual, certain of the existing stations are scheduled for extension, while certain others will gradually be shut down. In the former class are the stations at Stockport, Ashton-under-Lyne, Bury, Bolton, Outwood, Wigan, Altrincham, and Alderley; and the new stations, which are either being built or are planned, at Stockport, Oldham, Kearsley, Wigan, Agcroft, Barton, and Carrington, while in the latter are Bury (Rochdale Road), Eccles, Glossop (Urban Electric Supply Company, Ltd.), Heywood, Manchester (Dickinson St.), Radcliffe, Sale, and Stretford (Longford Bridge).

The stations at Haydock and Lymm have been left out of the scheme on account of locality; while that at Stalybridge, for the same reason, and also because the plant differs from the normal, may eventually secede.

Electricity supply for traction has been left out of the Committee's consideration, as it is thought that the Lancashire and Yorkshire Railway's station at Kearsley will be capable for some time to come of dealing with the demand for this purpose.

Savings for Combination.

Some interesting figures which indicate clearly the saving that will be possible by the adoption of such a scheme of amalgamation are given in the report. It is estimated that continuing to use the present individual method the demands of electricity supply in the area would necessitate a capital expenditure of £8 178 000 within the next five years. Under the scheme this sum would be reduced to £6 801 000, a saving of £1 376 120 in capital and

£137 612 in interest at 10 per cent. The coal consumption during the same periods with "parish pump" methods would be 1 007 990 tons, and this could be reduced to 988 159 tons by combination, with a saving of about £34 704 per annum. These savings would be further increased during the years 1926-31 as the supply became more consolidated.

The scheme of the South-East Lancashire Committee has yet to



MAP SHOWING THE PROPOSED SOUTH-EAST LANCASHIRE DISTRICT.

be considered by the municipal electricity committees concerned, by city councils, or local authorities; and it has yet to be the subject of an inquiry which is arranged to begin on October 31.

Hiring Cookers at Glasgow.

While electricity has established itself as the ideal illuminant, it cannot, unfortunately, be said that the value of its services in other parts of the domestic sphere are recognised as they should be. As a means of heating it is also now greatly taken advantage of, but it has not attained its full development so far as cooking is concerned. This is no doubt due—so far at least as the smaller householder is concerned—to the comparatively high cost of purchasing and installing the necessary apparatus. This will no longer be an obstacle, at any rate, in Glasgow, for the corporation at a recent meeting agreed to the recommendation of the Electricity Committee, that the engineer and manager be authorised to purchase 100 electric cookers of the latest design, to be let to consumers on hire or hire purchase. The price at which the cookers will be let has not yet been decided, but it will probably be in the region of £2 per annum or 10s. per quarter.

This new venture on the part of the Electricity Department deserves every encouragement, and cookers of the type to be hired can be seen on the department's stand at the Ideal Homes Exhibition, now being held in the Kelvin Hall, where demonstrations of the use of the apparatus are being given.

As is well known, one of the easiest type of fires to start and one of the most difficult to control is that caused by oil or spirit. For equally obvious reasons the ordinary means cannot be adopted for putting out such fires, and a great deal of ingenuity has been expended in the manufacture of so-called chemical extinguishers to deal with the problem. Among the most successful of these is the Firefoam extinguisher, made by FOAMITE FIREFOAM, LTD., whose capabilities we recently had the opportunity of inspecting. These extinguishers seem capable of dealing with fires of any size, and are made in a variety of patterns. The mixture used is said to be a basic salt, which is extremely rich in carbonic acid gas, combined with a colloidal precipitate which assists in the formation of a durable foam. This mixture on release spreads over the surface of the fire, causing it to be extinguished in an exceedingly short time.

Provincial Electric Supply Committee of the United Kingdom.

At the annual meeting of this committee on Tuesday, Sir Harry Renwick, K.B.E., chairman, presided, and among those present were: Sir William Shipley, Messrs. A. A. Campbell Swinton, F.R.S., G. J. Somerville, Napier Prentice, F. C. McQuown, W. A. Scott, K. A. Scott-Moncrieff, J. C. Wigham, F. E. Gripper, H. G. Alger, Sir Henry Mance, H. B. Harvey, G. S. Scott, J. Jeffrey, G. W. Jackson, W. B. Esson, M. Farrer, F. Cursons, W. Bentham, and T. W. Cole (secretary).

The CHAIRMAN, reviewing the work of the past year, said with regard to the joint electricity schemes, generally speaking, there was one point on which he thought all agreed, namely, that the chief concern of most of the provincial companies was whether they would be able to get a cheap bulk supply without having any other rights infringed by competition or otherwise. If many of the smaller companies, whether in London or in the provinces, could safely get bulk supply at a cheap price it would be the best thing that could happen to them, and in many cases would prove their salvation. With regard to labour, at present there was a period of quietness, so far as the electric supply industry was immediately concerned, all questions as regards workmen being settled by the Industrial Councils, and the adjustment of salaries of technical staffs coming under a continuing agreement made by the National Joint Board.

He explained the reconstruction of the National Council, and said that the committee felt it was the feeling of the majority of its member companies that they should fall in with the new proposals. The committee had assisted the Ministry of Labour scheme for providing suitable employment for disabled soldiers by acting on the committee.

The committee had been in negotiation with the Ministry of Transport with a view to an Increase of Charges Bill being introduced to cover the cases where an increase of maximum price was necessary, but did not come within the scope of the present Electric Lighting Acts, but that in view of the special revision clause in the Electricity Supply Bill which had been brought forward this had to be dropped.

The assistance which the committee had been able to give to individual companies on matters of domestic character had been much appreciated. They had acted in concert with various other associations, such as the I.E.E. and B.E.D.A.

On the resolution of Mr. W. A. Scott, supported by Mr Campbell Swinton, the executive committee were re-elected *en bloc*. A resolution was passed that the Unemployment Committee should be asked to receive a deputation from the Provincial Committee with a view to obtaining financial support for the smaller electric supply companies for the purpose of extending their supply, and thus finding work for the unemployed.

"Ideal Homes" Exhibition at Glasgow.

The Ideal Homes Exhibition PROMOTED BY THE GLASGOW CORPORATION, was opened in the Kelvin Hall of Industry on Monday, September 19, and will remain open until Saturday, October 8. About 150 firms are represented, and the exhibits, which are classified into sections, include building materials, furnishings (lighting, heating, labour saving, and cleaning appliances), sanitary appliances, decoration, recreation, foodstuffs, and appliances for home nursing. In the section embodying electrical furnishings, there is the usual display of lamps, heating and cooking appliances, and apparatus for the saving of domestic drudgery. A novel feature is a display of shop-window lighting by means of coloured screen reflectors, an American idea now shown for the first time in this country. For these reflectors, single-point lighting units are used. The screens are interchangeable, and are of varied colours to suit any particular class of goods which it is desired to display.

An interesting portion of the exhibition is that in which are erected two full-sized homes in the form of cottages. One of these cottages is constructed of home timber, and has a gas installation—the other is built of artificial stone-faced blocks, and has an electrical installation. The electrical equipment consists of cooker and wash-boiler (in scullery), with electric fires in the bedrooms, the domestic hot-water supply being heated by means of a coal fire in the living-room. The electrical equipment in this house has been supplied by the Glasgow Electricity Department, and the point is emphasised that by the adoption of electric cooking and heating in a new house a saving in building costs of at least £40 per house can be effected, due to the fact that fireplaces and chimneys are uncalled for. In view of the present keen rivalry between the electrical and gas interests in advocating the supply of their respective services to the housing areas now being developed in the neighbourhood, it is to be regretted that greater advantage was not taken by electrical traders of the opportunity afforded by the exhibition of putting their wares before the public, and credit is due to these concerns who were enterprising enough to secure stalls.

Messrs. Benn Brothers will publish early in October a new (fourth) edition of Mr. Walter Atkins' well-known "COMMON BATTERY TELEPHONY SIMPLIFIED." Telephone development is now rapidly expanding, and this new edition has given the author an opportunity of revising the book, omitting all obsolete matter and incorporating modern practice.

A Debate on Capitalism.

A conference of employers and employees, organised by the YORKSHIRE CENTRE OF THE INDUSTRIAL LEAGUE AND COUNCIL, was held at Scarborough during the week-end. There were fifty-five delegates in attendance, and the subject discussed was the capitalistic system. The leaders in the discussion were Mr. Ernest J. P. Benn, C.B.E., on one side, and Mr. Andrew Dalgleish, organiser of the Workers' Union, on the other.

Mr. BENN briefly traced the growth of the present complicated and delicately-balanced machinery of commerce from the earliest and most simple processes of exchange. What was known as the capitalistic system was a normal and inevitable development, and any sudden violation of the deep-seated instincts which had produced it would lead to disaster. The steady improvement in the general standard of living was due almost entirely to the energy, enterprise, and courage of our so-called capitalists, who first saw a new demand and strove to supply it. Much of the objection to our present system, with its great prizes to those who court fortune, arose from the natural human weakness of envy and malice. Success in others was irksome to those not similarly favoured. A man did not like to be passed on the road by a motor-car. The remedy was not to dig up the road and put a barrier across it, but to get into a swifter car. The four essentials to successful industry were high wages, high profits, high production, and low prices.

MR. ANDREW DALGLEISH, an organiser of the Workers' Union, took up the challenge in the succeeding session. The remedy, he submitted, was co-operation. He did not pretend that this was going to happen in a night. As capitalism marked a period in the world's progress, so he believed that co-operation would fill in the next period.

Questions were freely asked after each address, and the third session was given up to open debate.

The final session was devoted to the clearing up of points by Mr. Benn and Mr. Dalgleish. The interchange of views was of the frankest and yet of the friendliest character. It is impossible to over-estimate the usefulness of a conference of this kind, where employers and employed not only confer together, but live together, mixing in the freest social intercourse, and, above all, learning to appreciate the honesty of the other man's point of view.

Employer and Employed.

A manifesto was issued last week by the Council of the INDUSTRIAL WELFARE SOCIETY, which includes among its members Lord Invernarn (Sir W. Beardmore & Company), Sir Robert Hadfield (Hadfields, Ltd.), Mr. Alexander Johnston (North British Rubber Company), Mr. Sam Mavor (Mavor & Coulson, Ltd.), and Mr. Douglas Vickers (Vickers, Ltd.).

They appeal for further co-operation between employer and employed, and state that many of the earnest attempts which have been made to this end have failed, because, instead of acquiring experience and fostering a friendly atmosphere by dealing first with non-controversial, though important, matters, wages, hours, and security of tenure have been discussed. The worries of the ordinary worker, they point out, are connected with a wide range of problems—domestic, social, mental, physical. These should be attended to, and such matters as hours and wages should be left to trade union and federation officials. Finally they state that they feel that the time has come when the burden of maintaining the organisation should be shared by all who have at heart the future well-being of industry. The society propounds no pedantic theory of economic control, but attempts to deal in a practical way with industrial problems as it finds them; bringing to bear upon their solution a new spirit, or rather the resemblance of an old-world spirit of comradeship and humanity, which, in an age of material progress, had almost been forgotten.

The Oppau Explosion.

The recent explosion at the works of the BADISCHE ANNALEN SODA-FABRIK at Oppau, while distinguished by the tremendous loss of life and destruction of property which have accompanied it, are doubly unfortunate in that the cause of the explosion must, we fear, ever remain unknown. Accidents of this character are unfortunately the accompaniment of all scientific progress, and of many industrial operations, but from many of them can be learned useful lessons for future use. In the Oppau case, however, this will be quite impossible. As is well known, the Haber process which was being carried out at Oppau for the manufacture of nitrogen products contains many elements which render the danger of explosions extremely likely. For instance, the explosion may have occurred either in the gas-holders where hydrogen was kept, or in mass of salts stored. For ammonium nitrate, though not explosive in the ordinary sense, would become so under the powerful excitation of an initial explosion, and this might well have added to the disaster, seeing that it is probable that thousands of tons of this material were on the site.

MULLARD RADIO VALVE COMPANY.—Correction.

We regret that in the advertisement of this company published in last week's issue the patent number was given in error as 15 870/21. This should be 158 720/21.

Electricity Supply.

It has been decided to light the streets of **HOLSWORTHY** by electricity.

Application is to be made by **ESTON** Urban Council for sanction to borrow £62 000 for an electric lighting scheme.

Electric driving is to be adopted for the pumps at **WORKSOP** Waterworks, which are at present driven by steam.

STIRLING Town Council have increased the charge for electricity for heating from 2d. to 3d. per unit as from Oct. 1.

GLASGOW Electricity Committee is purchasing 100 electric cookers of the latest design, to be let to consumers on hire or hire-purchase.

REDDITCH Town Council have decided by a large majority not to receive and discuss a proposal for the sale of the electricity undertaking.

EPSOM Urban Council have arranged to supply electricity to the London and South-Western Railway Station for a period of five years at 4d. per unit.

The new electricity station at **WHITEBIRK, BLACKBURN**, is to be formally opened by Lord Derby on Oct. 21. The estimated cost of the erection and equipment is £850,000.

At a meeting of **PHILLACK** Urban Council a letter received from the Cornwall Electric Power Company with reference to the proposed electric lighting at **HAYLE** was referred to the lighting committee.

MELTON MOWBRAY Electric Light Company announce that owing to the recent reduction in the cost of coal a special discount of 10 per cent. will be allowed on all electricity used for power and heating after Sept. 30.

It is stated that **ASHINGTON** Urban Council have entered into an agreement with an electric lighting company for the lighting of the district for a period of ten years at a cost of £7 040. The scheme provides for 705 lamps.

Although it has not yet been found possible to light **BRIGHTON** on the pre-war scale, the Corporation Electricity Undertaking has decided to light all the street lamps from dusk to midnight. This will entail an additional £1 800 a year.

BRADFORD-ON-AVON Urban Council have decided to take steps to have the Provisional Order for electric lighting granted to Mr. Edwards cancelled, owing to the work not yet having been carried out, and **Spencer-Moulton & Company, Ltd.**, have been asked to quote terms for supplying the town with electricity.

At a meeting of **CHEADLE** and **GATLEY** Urban District Council the clerk reported that the Commissioners desired an assurance from the council that if the Electricity Order applied for is granted, the works referred to in the engineer's report will be proceeded with. It was resolved to give the assurance asked for.

An agreement has been reached by **LLANUDNO** Council and the North Wales Power and Traction Company for the supply of electricity in bulk to the town. The council will lend £15 000 to the company for the erection of the overhead transmission line from the main, which will run along the coast from the power station in the Vale of Conway.

Dr. W. I. Purves, of Exeter, the holder of the Provisional Order for the supply of electricity to **TEIGNMOUTH** and **SHALDON**, has been requested by Teignmouth Urban Council to obtain the Amending Order so that he can begin work at Teignmouth at once. It is hoped that within three years **Dr. Purves** will be able to get **SHALDON** also lighted by electricity.

The report of the Electricity Committee as to the amount required for plant and mains during the next two years was adopted by **NORWICH** Town Council last week. It was resolved that application should be made to the Electricity Commissioners for sanction to borrow £50 785, to be distributed as follows:—Excess expenditure on plant under the 1919 sanction, £7 785; new boiler, £10 000; mains and services, £33 000.

Another wages discussion, involving about 2 500 men, has arisen in the **SCOTTISH ELECTRICAL TRADE**. The contracting employers propose a further reduction of 2d. an hour—1d. on October 1, and 1d. on November 1. The members of the Electrical Trades Union are now balloting on the employers' offer, and there are indications that it will be rejected. On May 23 wages were reduced from 2s. 3d. an hour to 2s., after a nine weeks' strike.

At a special meeting of the **NENAGH** Council last week it was decided that unless the Nenagh Gas and Electric Supply Company complied with the reasonable request of the Urban Council to light the streets in accordance with the new scheme, and also keep a certain number of lights switched on during the night, the council would take steps to protect their interests and restrain the company from making current for illuminating purposes within the town.

The advisability of lighting **WORCESTER** streets on the pre-war scale was discussed by the Watch Sub-Committee recently. As far as the electricity department was concerned, it was stated that no increased cost would be incurred. An increase of 50 per cent. on pre-war rates was charged, whether the whole number of lamps was lighted or not. The position with regard to the gas company was uncertain, and it was decided that before doing anything further this should be ascertained.

NAVAN (Meath) Council has decided to light the central parts of that town with electricity, which is to be supplied from Messrs. Spicer's batteries. It has been suggested that Messrs. Spicer's premises be acquired, together with the plant, and that customers

taking current from that firm be taken over by the corporation. The previous plan was that the current should be taken from the Blackwater (Mr. Elliot's) Saw Mills. A special committee is now dealing with the matter.

It has been agreed by **GELLIGAER** Urban Council and the South Wales Electric Power Distribution Company that the council shall not be tied to the company for thirty years on the matter of supply, and that if they wished to generate their own power the company would not object provided they were allowed to act as distributors. The company are prepared to allow the council to derive supply from the **Powell Duffryn** Company for the area above Bargoed, which will involve a saving of £8 000 in mains.

At a public meeting in **GOSPORT** last week a resolution was passed expressing the opinion that the Gosport and Alverstoke Electric Lighting Company was not fulfilling its statutory obligations, in view of the number of consumers still waiting, and that all consumers not connected should be supplied within one calendar month from that date; and that a copy of the resolution be forwarded to the Electricity Commissioners in order that the company might be compelled to carry out its statutory obligations.

TISBURY electric light scheme has come to a successful issue, a limited company formed for the purpose of lighting the town proceeding to allotment on Sept. 19. Mr. E. Doran Webb and Mr. W. W. Kendall were appointed local directors, with Mr. Robert Lust as local secretary, the other directors being Mr. Pippard (of Messrs. Edmundson's) and Mr. A. B. Randall (Salisbury Electric Light Company), the latter also acting as registered secretary. Messrs. Edmundson's tender for the installation was accepted, and it is hoped to complete the work by the end of November.

The proposals for extending the output at **STIRLING** electric station by receiving a bulk supply from Alloa or the Scottish Central Electric Power Company came before **Stirling Town Council** last week. The Alloa Town Council, it was reported, were agreeable to come to an arrangement, and a letter was submitted from the Electric Power Company quoting terms for a bulk supply. It was stated that Mr. Robertson, the Burgh's consulting engineer, had gone into the question, and would report shortly on the proposals. It was decided to await this report before making any recommendation.

KILMALLOCK RURAL DISTRICT COUNCIL received a deputation last week from Messrs. J. J. Power, solicitor; W. H. Madden, D. Cussen, and T. Conna, directors of the local Electric Light and Power Company, with regard to the lighting of the town. Mr. Madden, who acted as spokesman, said they were sent there as a deputation to know if the Council would lend them monetary aid for lighting the lamps of the town. Hitherto the lamps were kept lighted by one or two benefactors. After discussion it was decided to put consideration of the matter on the agenda for the next meeting.

WALSALL Corporation Electric Supply Committee acknowledge that the charges for electricity are too high, especially for the tramways, but have decided that it is impossible to reduce the prices at present. When they have the new generating set running they hope to be able to do something. At a recent meeting **Alderman Cope** (chairman of the Tramways Committee) said the tramways undertaking was paying between £4 000 and £5 000 a year more than they ought to for electric current. Councillor **Talbot** (chairman of the committee) replied that unless the cost was reduced by Christmas he "should resign his job."

Several questions came up for consideration at a recent meeting of **LYNN** Town Council. The Electrical Engineer reported that the makers of the new turbo set were fitting an automatic vacuum breaker to all sets now being turned out, and offered to supply one for £22. The Council instructed him to take up the question with the makers and report to the next meeting. It was also resolved that the main on the Chase Estate be completed as arranged for. The question of the payment of a fee to the Engineer in respect of the recent extensions and additions to the works was considered, and adjourned to the next meeting for a complete statement to be delivered to the committee.

ROCHDALE Electricity Committee propose a reduction in the cost of electricity for lighting purposes from 8d. to 7d. per unit. They also recommend that rents for hired meters to all classes of consumers be reduced by 25 per cent. The proposals follow the reduction in the price of coal and the drop in wages. The Electricity Works Sub-Committee last week paid a visit of inspection to the electricity sub-station at the D. R. Cotton Mills, Sudden, which is said to be the largest sub-station in England. The power for the mills is supplied in bulk from the Lancashire Electric Power Company's station at Radcliffe, and the Rochdale Corporation have expended about £30 000 on transformers and other plant at the sub-station.

SOUTHPORT Electricity Committee has received 150 applications for the position of borough electrical engineer. A sub-committee has reduced the number to eight, and the final selection will shortly be made. At the monthly meeting of the Town Council, to be held this week, the annual report of the Electricity Committee will be presented. It shows a net profit for the year ending March 31 of £1 759. The Works Sub-Committee of the Southport Electricity Committee have recommended a 25 per cent. reduction in the electricity charges, in view of the savings which had been effected by the installation of new plant. The Electricity Committee, however, have deferred consideration of the matter until the new engineer has been appointed.

Municipal Accounts.

YARMOUTH Corporation made a profit of £2 000 on its electricity undertaking last year, but there was a loss of £3 000 on the tramways.

BRISTOL Electricity Department's accounts for the year ended March 31 show a net profit of £6 864. The credit balance brought forward from last year's account was £6 432, which, with adjustment of income tax (1919-1920), £5 405, gives an available surplus of £18 699, which has been appropriated as follows: Expenditure of capital nature, £11 665; new meters for renewals, £3 669; proposed Joint Electricity Authority (on account of share of expenses), £250; depreciation of stores, £1 796, making a total of £17 378, and leaving £1 321 to be carried forward. The amount of loans borrowed is £1 104 778, of which £550 722 has been repaid. The number of consumers increased by 1 657 to 8 923. The total connections to the mains are equivalent to 1 263 485 30 W lamps, as compared with 1 094 560 last year, and the units sold numbered 33 529 417, an increase of £4 489 737.

The annual report of the COVENTRY CORPORATION TRAMWAYS Committee shows a deficit on the past year's working of £13 514, which the committee recommends be provided from the rates. The number of passengers carried continued to decrease. In an endeavour to meet the situation arising from higher costs and decreased revenue the 1d. minimum fare was increased to 1½d. on May 20, and to 2d. on October 4, but the increased revenue derived was not sufficient to meet the additional cost of operations for the year. In connection with the question of increase of fares, the committee emphasise the fact that, while there has been an increase in working costs as compared with the previous period of 211.6 per cent., the fares have increased only by 100 per cent. to passengers travelling one stage, and by 50 per cent. to passengers travelling more than one stage.

For the year ended March 31 the accounts of the ST. ANNES-ON-SEA Electricity Undertaking show total revenue £55 835, total expenditure £27 800, leaving a gross profit of £8 032, which is equal to 11.76 per cent. of the capital outlay at the beginning of the year. Interest and debt redemption charges, however, required £5 506, which, deducted from the gross profit, leaves a net result of £2 526, which has been transferred to reserve fund bringing it up to £2 951. During the year £1 761 was transferred to the credit of the sinking fund from the net revenue account, of which £176 was in respect of interest on monies withdrawn from the fund for redemption of debt. The amount of loan debt outstanding at the close of the year was £37 872. The number of units sold was 1 847 664, against 1 522 985, an increase of 324 679. Consumers numbered 2 513, an increase of 304; maximum demand, traction 446 kW, lighting 807 kW; maximum simultaneous load, 998 kW.

Institution Notes.

The 1921-22 Session of the NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS will open on October 14, when Sir J. Noble, Bart., will give the presidential address.

The annual festival of the ELECTRICAL TRADES BENEVOLENT INSTITUTION will be held on Wednesday, Oct. 26. The festival dinner will take place at the Trocadero Restaurant, and will be presided over by Sir Tom Callender. This year, for the first time, ladies will be present.

After a long period of discussion between the central body and branch committees, the SOCIETY OF TECHNICAL ENGINEERS—a unique body, inasmuch as it represents an interest which is neither of capital nor of labour, but of expert applied scientific knowledge—has decided that its objects fall into two groups—those connected with the interests of individuals and of the profession, and those connected with the advancement of the British engineering industries. The society is attempting to establish communication with employers and with organised employees in pursuit of these objects, and, while not associating itself with the labour movement officially in search of improved conditions of service, it will earnestly seek to find some means of co-operation with the unions of manual workers in its efforts to secure the advancement of the Empire's engineering industries.

Trade Boards Committee.

THE COMMITTEE APPOINTED BY DR. MACNAMARA, Minister of Labour, to inquire into the working and effects of the Trade Boards Acts, and to report what changes, if any, are required," will be:—

Viscount Cave (president), Lord Weir of Eastwood, Dame Adelaide Anderson (late H.M. Chief Woman Inspector of Factories), Dame Edith Lyttelton, Mr. James Bell (secretary of the Oldham Weavers' Association, and M.P. for the Ormskirk Division of Lancashire), Mr. W. T. Layton (director of the National Federation of Iron and Steel Manufacturers), Sir Arthur Pease, Mr. E. L. Poulton (chairman of the Parliamentary Committee of the Trade Unions Congress), Mr. A. Pugh (secretary of the Iron and Steel Trades Confederation), Mr. A. MacCallum Scott, M.P. for the Bridgeton Division of Glasgow, Mr. H. D. Hancock, of the Ministry of Labour, will act as secretary.

Electric Traction.

HALIFAX Tramways Committee have sanctioned, subject to the Town Council's approval, extensions to the tram-shed at an estimated cost of £11 000.

It is stated that NEWCASTLE CORPORATION Tramways Committee have decided to effect a reduction in the men's wages in order to keep the system going.

The removal of the electric standards in Great Western-road, from the centre to the side of the road, was again discussed at a meeting last week of the GLASGOW Tramways, Watching and Lighting Committees. The vote was taken, with the result that thirty-four voted against the removal, and thirty in favour of it.

Mr. Pilcher, manager of EDINBURGH tramways, has prepared a scheme for submission to the Tramways Committee which, if adopted, will give an appreciable extension of most of the present penny and twopenny stages. No actual cash reductions are proposed. The present average length of the penny stage is 941 yards, and it is proposed now that these should be increased to an average of 1 127 yards.

Three electric vehicles competed in the LIVERPOOL COMMERCIAL MOTOR USERS' PARADE, held on Saturday. The first prize was won by a six-ton electromobile lorry, belonging to Messrs. Tate & Lyle, Ltd., of Liverpool and London. This vehicle had I. M. V. 7 Iron-clad Exide batteries, and is employed daily in carrying sugar between the docks and the refineries. The other two vehicles were Ward electrics, owned by Messrs. J. Blake & Company, and used on postal services.

On Monday next extensive improvements on all branches of the UNDERGROUND RAILWAYS are to come into operation. The last train (except on the City and South London) will leave central stations at 12.30 instead of at midnight, longer and more frequent trains will be used during rush hours, and there will be a general speeding-up, with more non-stop trains. Several more through trains are to be put on to Southend from the District Railway, and all stations, except four, are to be open all day on Sundays.

In our issue last week we stated that, after considerable discussion, an amendment was carried by SUNDELAND Town Council to accept, against the recommendation of the Tramways Committee, the English tender for tram rails, fishplates, &c., in spite of the fact that the foreign tenders were much lower, and the rails, &c., had proved to be superior to those of British make. The Tramways Committee have since held a special meeting, and have decided to re-submit the original recommendation that the foreign tender be accepted. Specimen sections of rails were submitted for the inspection of the committee, and the comparison was strongly in favour of the foreign rail. A section of a foreign rail which had been in use since the track was laid twenty-one years ago was found to be only about half worn away, with still a good deal of life left, whereas an English rail put down only about two months ago was seen to be already showing distinct signs of wear.

A new method of making secure joints of tramways rails has recently been introduced in SHEFFIELD, and tested with success on the Abbeydale route. It does its work without the use of bolts or nuts, and is simply a welding process throughout. In the new process, fishplates of 14 in. are used, which fit tight between the web and flange of the rail. The plates (which are of specially selected steel, made by Messrs. Cammell, Laird & Company, Ltd.) are grooved on the top and bevelled at the bottom. One of these is placed on either face of the rail, and forced into close contact with the rail by powerful cramps, which hold it in position until the edges can be welded. The plate is welded to the rail, top and bottom. A sole plate, fixed underneath the rail, supports the joint and gives it a strong foundation. The device is to a large extent due to the ingenuity of Alderman H. Bolton, a member of the Sheffield City Council, who has patented it, but is allowing the Sheffield Corporation the free use of the process, which, it is claimed, makes for the stability, durability, and cheapness of the joints. Sample joints were submitted to severe tests of the "crow" and "up" type, and withstood them very successfully.

THE NORTH-EASTERN RAILWAY COMPANY have received tenders for their new standing sheds for the Tyneside electric cars at Gosforth, and will proceed to let the contracts in the next few days. The total expenditure on the new sheds will amount to between £200 000 and £250 000, exclusive of the site, which was purchased some two years ago. Our readers will remember that the car sheds at Heaton, in which the electric train stock was stored, were burnt down some time ago. They were more or less temporary sheds, and the "Yorkshire Post" states, inadequate to hold all the stock, and there was no room on the site for extension. Plans for the new buildings have been prepared by the company's architect to provide standing for 120 vehicles. The buildings will have steel framework structure, and the panels filled in with brickwork. They are 720 ft. long by 245 ft. wide, all under one roof. The roofs are partly glazed, the remaining portions being of corrugated asbestos sheets. The sheds are divided into four bays carrying ten roads, each road being furnished with an examination pit. Attached to the standing shed is a repair block 28 ft. high, with two roads, and this is fitted with a traverser crane capable of lifting the heaviest vehicle used. The repair block comprises a repair shop, 300 ft. by 60 ft., armature and electric fitter's shop, sub-generating station for working the sheds, and premises, a boiler-house, &c. The travelling service for the Tyneside electric railways is on the third-rail system, but as the cars enter the shed they will have trolleys attached, and all movements will be operated by the overhead system.

Personal and Appointments.

Mr. W. E. ROBSON, who is retiring after thirty-nine years' service from the staff of the Western Union Cable Company, Penzance, has been presented by his colleagues with a silver salver.

Mr. EDGAR NUTTALL has been appointed out of 200 applicants as junior charge hand in the electricity department at Torquay. Mr. Nuttall has filled a similar position at Burnley Electricity Works, where he has been employed for seven years.

Mr. J. B. TYRRELL has recently been elected vice-president and chairman of the Engineering Section of the American Association for the Advancement of Science. The annual meeting of the association will be held in Toronto in December next.

Mr. JOSEPH SAVAGE, power station superintendent in the Paisley electricity department, who is leaving to take up an important position with the St. Helen's Corporation, has been presented with an aneroid barometer by the staff and employees at Paisley.

Mr. FRANK AYTON, who is retiring from the position of electrical engineer and tramways manager to the Ipswich Corporation, and joining the firm of Ransomes, Sims & Jefferies, Ltd., of Ipswich, as joint managing director, has been presented by his old staff with a leather-bound illuminated volume containing the signatures of employees (300 in all) of the various departments.

Although the official announcement of the appointment has not yet been made, it is understood that Mr. CHARLES B. COLLETT, who for the past two years has acted as deputy chief mechanical engineer of the Great Western Railway, will, upon the retirement of Mr. G. J. CHURCHWOOD in December, act as the chief mechanical engineer of the company.

The officials and staff of St. Annes Electric Tramways met last week for the presentation of a gold watch and smoker's outfit to their traffic manager, Mr. G. W. WOOD, in recognition of twenty-three years' service. Mr. H. W. LAING, general manager, presided, and Mr. J. J. WILKINSON made the presentation as the oldest member of the traffic staff, supported by Mr. E. SNOWDEN.

HammerSmith (London) Electricity Committee have appointed Mr. C. H. WESTLEY of Surbiton, as mains engineer, at a salary of £411 12s., in the place of Mr. Jordan, resigned, and have also appointed Mr. A. G. OLDS as clerk of works in connection with plant extensions at the electricity works, at £6 per week. The Committee also recommend that Mr. J. A. WEST, engineer-in-charge, be promoted to boiler-house superintendent at £675 4s. 9d. per annum.

Mr. ALBERT E. WEBB, B.Sc., A.M.Inst.C.E., has been appointed senior assistant in the Department of Civil and Mechanical Engineering at University College, in succession to Mr. H. P. PILLBOLT, who resigned in July on being appointed Professor in the Finsbury Technical College. Mr. Webb has been for eleven years with Messrs. Vickers, Ltd., Barrow-in-Furness, where he became assistant chief designer and chief draughtsman. He will begin his duties in October.

A partnership is announced between Sir Charles Bright, Mr. A. Seabrook, consulting engineer (late chief engineer and general manager to the St. Marylebone (London) and other electric supply undertakings), Mr. A. J. Stubbs (late assistant engineer-in-chief to H.M. Post Office), and Lieut.-Col. H. Woodall (director and consulting engineer of gas and water companies), under the style of **SIR CHARLES BRIGHT AND PARTNERS**, consulting engineers, with offices at 146, Bishopsgate, E.C. 2.

On the occasion of the twentieth anniversary of Rotherham Electricity Works and of Mr. E. Cross's control, the staff presented him with a gold watch, and Mrs. Cross with a gold wristlet watch. Ald. D. L. Winter, the chairman of the Corporation Electricity Committee, who made the presentation, said the undertaking was now one of the largest in the kingdom. In the summer of 1901 they opened a little power-station generating 250 kW. To-day the super-power-station represented 7,500 kW.

Members of the VICTORIA WORKS ATHLETIC CLUB (employees of Johnson & Phillips, Ltd., Charlton) held a fancy dress dance and carnival in the club buildings on Thursday evening, Sept. 22, to celebrate the first anniversary of the opening of the buildings. The president, Mr. H. J. Sheppard, presented the Blundell Maple Shield and Medals to the club football team, as winners of the Eastern Section of the Southern Suburban League, 1920-21. Mr. C. Stewart afterwards presented the senior and junior departmental cricket cups and medals to the winners, the switchgear and telegraph departments respectively. Prizes were awarded during the evening for the best fancy dresses (ladies' and gentlemen's). The music was provided by the club string orchestra.

In our issue of August 26 we announced that Mr. E. BRONTMAN, electrical engineer and contractor, assisted by various well-known manufacturers, would give a lecture and demonstration at St. Peter's Hall, Bournemouth, on October 5. At the request of the firm concerned, it has been decided to hold the exhibition for six days, and the hall has accordingly been engaged for a further five days. Amongst other things, demonstrations will be given of electrical cooking, and as food must be cooked Mr. Brontman has hit on the happy idea of feeding the children of the local unemployed who are most in need, and has secured the co-operation of many of the residents and clergy with regard to the selection of

the children and the collection and distribution of the food. Mr. J. Beckett, the champion boxer, has consented to open the evening proceedings.

Mr. LEONARD ANDREWS, M.Inst.C.E., M.I.E.E., informs us that the work he has been carrying out for Messrs. Johnson, Matthey & Company during the past three years (viz., the equipment of three of their factories with new and modern machinery) is now practically completed, and he has come to an arrangement with them which permits of his undertaking other private work, and provides for his resigning his appointment of borough electrical engineer of Hastings some nineteen years ago. Mr. Andrews has aimed at getting the greatest possible variety of engineering and commercial experience, both in this country and abroad, with the ultimate object of qualifying to practise as a consulting engineer, and he has now started an office for this purpose at 104, Victoria-street, Westminster, S.W. 1 (telephone, Victoria 6100 and Pinner 147).

Wireless Notes.

The seventy-fifth anniversary of the introduction of the telegraph into Belgium was celebrated in BRUSSELS on Sunday.

Regular work at LEAFIELD WIRELESS STATION, the British end of the Imperial Wireless Chain, which was formally opened by the Postmaster-General on Aug. 18, will be started to-morrow (Saturday).

Mr. EVELYN CECIL, M.P., chairman of the Select Committee on the Telephone Service, is making a short stay in Berne in connection with the committee inquiry. Mr. W. W. COOK, the assessor to the committee, has left for Canada and the United States to report on the conditions there.

In a letter to the "Times" Mr. Robert Donald suggests that there could be no better way of finding useful and necessary labour for unemployed men than by the erection of wireless stations, in connection with the IMPERIAL WIRELESS CHAIN, which would employ engineers, brass founders, electricians, and other skilled workers, as well as builders' labourers.

The RESEARCH WORK in connection with the Engineers' Department of the G.P.O. is to be done in future at Dollis Hill. Disused army huts have been put up on a site acquired before the war, and later a permanent building will be erected. The wireless branch of the Department will remain at St. Martin's-le-Grand, but there will be an installation for its experiments at Dollis Hill.

A NEW TELEPHONE EXCHANGE, to be known as MINORIES, was opened on Saturday at 98, Mansell-street, Minories, London, E. It has a capacity of 2,000 lines, and within two or three minutes 800 subscribers on Avenue Exchange and a number from London Wall and Bank exchanges were switched on to Minories, where they were informed of the change and their new number.

At a meeting of the Highlands Reconstruction Association in Inverness on Saturday the question of TELEPHONE FACILITIES in THE HIGHLANDS was discussed, and the Right Hon. Ian Macpherson, M.P., Minister of Pensions, stated that he had seen the Postmaster-General with a view to the post office utilising the existing telephone poles which had been erected by the Admiralty during the war, and he was hopeful that something would be done.

Educational.

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY will receive the sum of \$1,000,000 under the will of the late Frances Appleton Foster, of Weston, Mass.

A SCHOOL OF INSTRUCTION in RADIOGRAPHY, RADIOTHERAPY, AND ELECTROTHERAPY has been opened at King's College Hospital. The classes are under the supervision of Dr. Knox and Dr. Colwell, and the course includes general elementary physics, electricity, anatomy, and photography.

THE CLEVELAND TECHNICAL INSTITUTE was opened at MIDDLESBROUGH last week by Sir Charles Parsons. The institute is not a technical college—though it is hoped that there will be one in Middlesbrough one day—but is a place where all who are interested in local industry may foregather and exchange notes. It is not intended for those who are in the position of pupils, but for those who are engaged in the direction of industry, and who desire to perfect their knowledge of it.

During the coming session RINGSEND Technical School (Co. Dublin) are introducing day courses in mechanical and electrical workshop practice. Instruction will be given in installing electric lighting and power plants suitable for country houses and farms; wiring and installing of engine ignition systems and of motor-car lighting and starting systems; and in dismantling and reassembling magnetos. An important feature in connection with the school is the preparatory day school for boys who wish to take up as a career electrical engineering, telegraphy, or telephony, &c. A course of instruction extending over two years has been arranged. Boys leaving the school after completing this course and entering apprenticeship are expected to continue their studies in the evening classes. A supplementary third year has also been arranged for those who can avail themselves of it.

Business Items, &c.

MESSRS. CUFER, ROBERTS & COMPANY have commenced business as electrical engineers, at 7, New-street, Herne Bay.

FAIRMAN, LTD. announce the opening of a branch factory at 134, West George-lane, Glasgow.

At the request of Capt. Williams, biologist to the SHACKLETON-ROWETT EXPEDITION, a 100 c.p. "Pointolite" outfit has been provided for his use by the Edison Swan Electric Company, Ltd.

BERRY'S ELECTRIC, LTD., installed a "Magical" electric fire (Berry's Patent) in the Ward Room of the "Quest." Masta fuse-switch gear is also installed for controlling the entire electric heating, lighting, power, and wireless equipment of the ship.

MR. ARCHIBALD CAMERON, representative of the Swiss Insulating Works, Ltd., of Bretonbac, is now conducting the agency from 8, Wolsey-road, London, N. 8 (phone Hornsey 2601), instead of 27, Chancery-lane, W.C. 2.

The British Electrical Development Association, 84, Kingsway, W.C. 2, has a large collection of LANTERN SLIDES dealing with the generation, distribution, and use of electricity for industrial, business and home purposes. Mr. J. W. Beauchamp, the director, will be glad to hear from those who wish to obtain the use of slides for lecture purposes during the coming winter.

The development department of that go-ahead city, CARDIFF, loses no chance of keeping the claims of municipality in the foreground. Its latest effort is a booklet, whose object is, by its contents, to induce manufacturers and others to establish their works in the district. One great argument in favour of this course is that electricity for both power and light is cheap, and any quantity can be supplied, while owing to the dock facilities export trade is facilitated and the importer is kept in direct touch with the large consuming population in the immediate vicinity. Those interested in the matter should write to Mr. T. W. D. Smith, the Development Agent, at the City Hall, Cardiff, for a copy of the booklet, in which these arguments are made the most of.

Imperial Notes.

Electric street lighting has been adopted in and between BELGRAVE and UPWEY (Victoria).

THE ELECTROLYTIC ZINC COMPANY OF AUSTRALIA has completed a contract with the Board of Trade by which the company will receive 750,000 tons of concentrates and slimes.

According to the Board of Trade Journal there are 125 heat, light and power establishments in NEW ZEALAND, employing 4,984 people. The Dominion has an area of 104,000 square miles, as compared with the 121,000 square miles of Great Britain and Ireland, and a population in 1916 numbering over 1,099,499, as compared with about 45,000,000.

A LONG-DISTANCE WIRELESS OUTFIT, capable of taking messages at the maximum distance of 12,500 miles, has been manufactured by an Australian firm to the order of PERTH OBSERVATORY. The instrument measures 30 in. by 18 in., and covers all ranges of Hertzian wave lengths from 600 to 25,000 metres. It will be capable of taking messages from the American station at Annapolis without interference from the Applecross installation.

Of the 134,211 people employed in industrial establishments in SOUTH AFRICA, 5,779 are engaged in heat, light and power works. The iron and steel industry has developed considerably during the last few years. Steel rails, reinforcing steel rods and bars, and lighter sections have been rolled in the Transvaal, steel shoes and dies for the gold mines have been cast locally. Up to the present most of this work has been done by working up scrap in electric and other furnaces, but large developments in the production of pig iron and steel on a commercial scale from local ore are, it is reported, pending, three undertakings of this nature being in various stages of preparation.

The "Manchester Guardian Commercial," discussing the formation of a NEW FIRM OF MERCHANT BANKERS under the title of the Trans-European Company, says: From the composition of the board, which includes prominent members of the staff of the Great Eastern and Canadian Pacific Railways, the nature of the business of the new company is not difficult to conjecture. It is, in fact, understood that the company was formed with the object of acquiring a share in German railway interests, and that a participation in the German restaurant and sleeping-car company, "Mitropa," has been acquired. Already considerable friction with the Cie. Internationale des Wagon-Lits, in which French and Belgium interests are important factors, has been experienced by the Mitropa Company, the chairman of which is the president of the Deutsche Bank. To what extent this new move is the first step in the working out, under joint German and British auspices, of the pre-war German conception of the Berlin to Bagdad railway system is yet to be seen. The financial position of the Wagon-Lits Company is understood to be by no means a strong one, and the fight for supremacy, which may now be expected, must provide an interesting sequel. Whatever the result may be, if the new move contributes even in a small degree to a greater unification of transport facilities through Central Europe, good will have been achieved.

Foreign Notes.

An international exhibition for metallurgical manufacturers, organised by the LEAGUE OF METALLURGICAL INDUSTRIES OF FLANDERS, is to be held at Ghent in 1923.

The Netherlands East Indian Trade Fair Association have decided that the THIRD FAIR AT BANDOENG, which will take place in the latter part of September, 1922, shall be international. Plans, application forms, and scales of charges may be obtained on application to the Secretary, Vereeniging Ned. Indische Jaarbeurs, Menadostraat, Bandoeng (Java).

AMERICAN TRADE WITH CHINA is growing by leaps and bounds. The following increases are indicative of the general situation in most manufactures:—Electrical materials exported to China in 1913 were valued at 179,079 Hk. Tls., in 1920 they had risen to 2,012,397 Hk. Tls.; the figures for machinery during the same period were 1,244,044 Hk. Tls., and 10,134,195 respectively, and for motor-cars and motor vehicles 148,038 Hk. Tls. in 1913, against 2,339,259 Hk. Tls. in 1920.

Although the use of ELECTRICAL POWER in the OIL FIELDS is comparatively recent, the "Electrical World" reports that numerous fields are now using this motive power, especially in California, where the San Joaquin Light and Power Corporation, of Fresno, is supplying energy to a number of wells. The flexibility of the electric drive is such that electric power can be employed without changing any of the old rigging, except the size and arrangement of the engine house. Dehydration of oil is also being accomplished electrically.

Good results are said to have been attained at the three principal GERMAN FAIRS—Leipzig, Königsberg, and Breslau. The Association of German Machine Tool Manufacturers were not represented at the Leipzig fair, but it is thought they will not repeat the experiment of keeping out in future. The Krupp concern, on the other hand, put in an appearance for the first time, and good business is said to have resulted in fittings, small electro motors, and equipment for auto-oxygenous welding. Not much business was done at Königsberg with reference to electrical supplies.

Consequent on the suspension of payment of the Banque Industrielle de Chine, which held the French shares, the board of directors of the PEKING Tramway Company has petitioned the Government to cancel the Sino-French agreement in connection with the formation of the organisation, so that it may be converted into a purely Chinese enterprise. The Ministry of Finance has appropriated \$500,000 for Government shares so as to enable the work to continue without interruption. The Ministry of Foreign Affairs is negotiating with the French authorities to secure the cancellation of the agreement.

MR. W. G. WICKHAM, H.M. Senior Trade Commissioner in South Africa, is engaged on an official tour of this country for the purpose of discussing with firms the possibilities and conditions of UNITED KINGDOM TRADE with the UNION OF SOUTH AFRICA. He will be in Leeds from Oct. 3-5, and in Bradford from Oct. 6-11. Firms in these centres desiring to interview Mr. Wickham should communicate immediately with the secretary of their local Chamber of Commerce. Arrangements to visit other industrial centres will be notified in due course.

MR. H. H. FOX, H.M. Commercial Counsellor at SHANGHAI, in a communication to the Department of Overseas Trade, points out the utility of British manufacturers sending catalogues to China in which no prices are given. He gives as an example a case which recently occurred, in which the Chinese owner of extensive offices was greatly interested in illustrations of an appliance for cleaning the interiors of large buildings. Not even an approximate figure could be given, and although the price was telegraphed for, it is more than probable, he points out, that by the time the information is received the owner of the offices will have lost all interest in the appliance, and an order will have been lost to a British firm.

Standard Tramway Axles.

A British Standard Specification for Tramway Axles has been published by the British Engineering Standards Association, and should be of considerable benefit both to Tramway undertakings and manufacturers.

This specification follows very closely the lines of the revised British Standard Specification for Railway Carriage and Wagon Axles (with analysis), which is included in Part 1 of the new edition of Report No. 24. A percentage of 0.05 of phosphorus or sulphur is permitted in the steel as in the case of the railway axle specification, but for the manufacture of tramway axles, no particular process of steel-making is specified. Falling weight, tensile and cold bend tests are required, the latter being for use only where the order is for a number of axles under fifteen, when it is to take the place of the falling weight test. A diagram is included illustrating the method of performing the cold bend test. Normalising (of which a definition is given) or oil-treating is specified, the choice to lie with the purchaser.

The specification may be obtained from the offices of the British Engineering Standards Association, 28, Victoria Street, S.W.1, or Crosby, Lockwood & Son, Stationers' Hall Court, E.C.4., price 1s. 2d. post free.

Tenders Invited and Accepted.

UNITED KINGDOM.

EDINBURGH CORPORATION. OCTOBER 10.—Electric light, wiring, and fitting of the City Collector's offices. Particulars from the City Engineer, Dewar-pavilion, Edinburgh.

LOUGHBOROUGH CORPORATION. (a) OCTOBER 31. (b) OCTOBER 17. —(a) Steam-raising plant; (b) high and low pressure mains networks. Particulars from Mr. C. H. Wordingham, at 7, Victoria-street, Westminster, S.W. 1; or 11, Moseley-street, Manchester.

NOTTINGHAM CORPORATION. OCTOBER 21.—For North Wilford Power Station: (a) Three 10,000 kW turbo-alternators (for 1,500 f.p.m.), with exciters, condensers, auxiliary plant, &c., and one 1,000 kW turbo-generator alternator, with condenser, auxiliary plant, &c.; and (b) six water-tube boilers, with mechanical superheaters, forced-draught fans, &c. Specifications, &c., from Messrs. Preece, Cardew & Rider, 8, Queen Anne's-gate, Westminster, S.W. 1.

EDINBURGH TRAMWAYS COMMITTEE. OCTOBER 10.—Sixteen tram-car bodies. Particulars from the Tramways Manager, 2, St. James's-square, Edinburgh.

MERSEY RAILWAY COMPANY. OCTOBER 7.—Collector shoes and brake blocks, electrical sundries, metallic and carbon filament lamps, signal wire, ironmongery, rubber goods, oils, &c. Particulars from the General Manager and Secretary, Central Station, Birkenhead.

FIFE EDUCATION AUTHORITY. OCTOBER 14.—Electric lighting work in connection with new school at Crossgates. Plans can be seen at the office of Mr. H. H. Maion, Union Bank-chambers, Dunfermline.

PORTRUSS URBAN COUNCIL. OCTOBER 8.—Work connected with the public electric lighting of the district. Particulars from the offices of the Council, 44, Wellington-place, Belfast.

ST. ANNES-ON-THE-SEA URBAN DISTRICT COUNCIL.—For approximately four miles of armoured cable. Particulars from Mr. J. H. Clothier, Electricity Works, St. Annes-on-the-Sea.

AUSTRALIA.

VICTORIAN RAILWAY COMMISSIONERS. OCTOBER 5.—* Double-wheel lathes for Jolimot Workshops (contract No. 33 356).

QUEENSLAND, POSTMASTER-GENERAL'S DEPARTMENT. OCTOBER 5.—† Bronze wire (schedule 536).

ADELAIDE, POSTMASTER-GENERAL'S DEPARTMENT. OCTOBER 12.—* 2,750 yards of telephone cords, 120 handsets, and 160 jacks.

QUEENSLAND, POSTMASTER-GENERAL'S DEPARTMENT. OCTOBER 12.—† Galvanised iron and steel wire (schedule 537).

QUEENSLAND, POSTMASTER-GENERAL'S DEPARTMENT. OCTOBER 19.—† Insulated wire.

VICTORIAN RAILWAY COMMISSIONERS. OCTOBER 19.—* Direct-current arc welding plant for Jolimot Workshops (contract No. 34 377), and armature winding machine, with electric motor and starting gear (contract No. 34 378).

VICTORIAN RAILWAY COMMISSIONERS. OCTOBER 26.—* 1120 cwt. best steel boiler plates (contract No. 34 342).

VICTORIAN RAILWAY COMMISSIONERS. NOVEMBER 2.—* Storage battery, with accessories and spares (contract No. 34 229).

NEW ZEALAND.

WELLINGTON CORPORATION. OCTOBER 13.—Two water-tube boilers, with feed-water heaters, &c., and a 5,000 kW turbo-alternator, with condensing plant. Particulars from Preece, Cardew & Rider, 8, Queen Anne's-gate, Westminster, S.W. 1.

WELLINGTON, PUBLIC WORKS TENDER BOARD. NOVEMBER 1.—* New or secondhand auxiliary plant for the Rotorua electric supply as follows:—One oil engine (200 to 250 h.p.) and one three-phase 50 cycle alternator of 190 kW (power factor of 0.8), with exciter, &c. Also for steel pipe lines and fittings in connection with the Mangahao power plant.

WELLINGTON, CONTROLLER OF STORES, POST AND TELEGRAPH DEPARTMENT. NOVEMBER 21.—* 750 red and 750 white switchboard cords (three conductor, to specification No. 87).

WELLINGTON, PUBLIC WORKS DEPARTMENT. NOVEMBER 29.—In connection with Mangahao electric power scheme. * Section 12: Three water-wheels of 6,450 h.p., and two water-wheels of 3,225 h.p., complete with governors, couplings, and accessories; Section 13: Three 6,000 kVA and two 3,000 kVA alternating-current generators; Section 14: Two three-unit exciter sets, each consisting of one 375 h.p. Pelton wheel, one 250 kW direct-current generator, and one 350 h.p. asynchronous motor; Section 15: seven 4,000 kVA single-phase transformers and accessories; Section 17: insulators for 110,000 V 50 cycle transmission lines; Section 18: lightning arresters for operation on two 110,000 V three-phase transmission lines; Section 19: switchboard, switches, and accessories.

SOUTH AFRICA.

PRETORIA (TRANSVAAL) MUNICIPALITY ELECTRIC LIGHT AND POWER DEPARTMENT. OCTOBER 4.—Coal-handling plant (contract No. 6), 6,600 V cables (contract No. 7), induced draught and ash-handling plant (contract No. 8), and feed pumps, steam, air, and water

* Particulars from the Department of Overseas Trade.

† Particulars from the office of the High Commissioner for Australia.

pipings, &c. (contract No. 9). Particulars from the General Manager, or Mr. G. M. Clark, 40-42, Meische-buildings, Johannesburg.

BULAWAYO (RHODESIA) MUNICIPALITY. OCTOBER 12, NOVEMBER 15.—The date for receiving tenders for the supply of electric light and plant has been extended to October 12, if tenders are delivered to Davis & Soper, 54, St. Mary-axe, London, E.C. 3, and to November 15, if sent to the Town Clerk.

RAND WATER BOARD'S MAIN PUMPING STATION, VEREENIGING. NOVEMBER 7.—Two steam-driven electrical generating sets of 350 kW capacity, each complete with switchboards and all accessories. Tenders to the Secretary of the Board, Central House, P.O. Box 1705, Johannesburg.

ADMINISTRATION OF THE SOUTH AFRICAN RAILWAYS AND HARBOURS. NOVEMBER 7.—* For twelve months, from December 31, of 85,560 incandescent train lighting lamps (tungsten filament) for 24 V, 8 to 10 c.p.; 8,125 engine head lamps, 150 W, 32 V (gasfilled $\frac{1}{2}$ W type, with concentrated filament); 50,472 incandescent lamps (tungsten filament); 5,545 incandescent lamps (carbon filament).

MUNICIPAL CORPORATION OF HUMANSDORP, CAPE PROVINCE. NOVEMBER 30.—Machinery and plant. Section A: one water turbine and dynamo, switchboard with connections, battery of accumulators, and accessories for same; Section B: electricity supply main and public lighting; aerial distributing lines, street lamps, fittings and accessories, section boxes, service cut-outs, meters, &c.; Section C: ferro-concrete pipe line; Section D: reinforced-concrete tank; Section E: buildings and foundations. Further particulars from the Town Clerk, Humansdorp.

SOUTH AMERICA.

BUENOS AIRES STATE RAILWAYS. OCTOBER 21.—* Electrical stores for one year.

ARGENTINE STATE RAILWAYS. NOVEMBER.—* One year's supply of railway signal material, telephone and telegraph materials.

BULGARIA.

MINISTER OF RAILWAYS, TELEGRAPHS AND TELEPHONES. OCTOBER 12.—* Brackets, bolts, and other hardware furniture of telephone and telephone lines.

SOUTHERN-ON-SEA TOWN COUNCIL have accepted the tender of the Newcastle Electric Supply Company, Ltd., for meters at £1 each.

LOWESTOFT CORPORATION are recommended to accept the tender of the Pulsometer Engineering Company for the supply and erection of pumps and motors with electrically-controlled gear for pumping-stations at Oulton Broad, at £2 624.

COLWYN BAY Urban Council have accepted the following tenders.—W. T. Glover and Co., for e.h.t. cables, £7 530 for l.t. cables, distribution pillars, &c.; £2 225; Bertram Thomas, e.h.t. and l.t. switchgear, £5 299; and H. Morris, Ltd., for overhead crane, £445.

Miscellaneous.

The death is announced in Copenhagen, at the age of eighty, of COMMODORE E. SUNDEN, honorary president of the board of the Great Northern Telegraph Company.

During the period August 2-31, 114 companies INCREASED their NOMINAL CAPITAL by £4 966 666 in all. Of this sum electricity companies accounted for £14 000.

A LICENCE OF RIGHT has been granted to J. Y. Johnson (Badische Anilin und Soda Fabrik) in connection with patent No. 16 636/11 "for improvements in the production of long stable electric arcs for the treatment of gases."

The Air Ministry states that, as the distance of audibility of sound is of great scientific importance in questions relating to the structure of the atmosphere, the Director of the Meteorological Office, Air Ministry, W.C. 2, would welcome any information from those who heard the sound of the OPPAV EXPLOSION.

The success attending the series of PUBLIC MEETINGS held at the CAXTON HALL last year under the auspices of the Industrial League and Council proved so great that a further session has been arranged during the coming autumn and winter. The opening meeting will be held at the Caxton Hall on Wednesday, Oct. 5, at 7.30, when Mr. Ernest J. P. Benn will give an address on the Capitalistic System.

An interesting article on "Empire Migration," by Lieut.-Col. H. F. Meurling, D.S.O., M.C., is included in the September number of "The Industrial League and Council Journal." A full account is also given of the recent week-end conference of members of the League at Sir Samuel Waring's home at Foots Cray, when the subject of foreign exchanges and their influence on industry was discussed.

Mr. W. J. Dickinson, electrician, of 25, Barracks-square, Burnley, who recently invented a PATENT for STOPPING RUNAWAY MOTOR WAGGONS, has had an offer of £5 000 for the invention. This he has refused. Last week the patent was given a severe test on a four-ton motor lorry with successful results. Whilst proceeding at a speed of twenty miles an hour the slipper-like patent came into operation, and the motor was brought to a standstill in 13 yards. In a similar test with a speed of thirty miles the lorry was pulled up in 12 yards, and the patent operated equally well with one slipper in use. The manner in which the invention acts is such as to remove violent shocks, a rubber arrangement reducing shock to a minimum. The device has been made for motor waggons, but can be adapted for motor-buses and other vehicles.

Companies' Reports, &c.

SHANGHAI ELECTRIC CONSTRUCTION COMPANY announce a first dividend of 6 per cent. actual (12½ per share), less tax.

The directors of TRACTION AND POWER SECURITIES have declared a dividend of 3s. 6d. per share, tax free, on the ordinary shares for the half year.

BRUCE, PEEBLES & COMPANY announce a dividend at the rate of 7½ per cent. per annum, less tax, on the 7½ per cent. cumulative participating preference shares for the half year ended June 30.

The profit of J. STONE & COMPANY for 1920, after allowing for depreciation, &c., was £101 889, plus £125 774 brought forward, making £227 663, less dividend on preference shares, £15 000. The directors propose to pay a dividend of 7½ per cent. per annum on the ordinary shares, carrying forward £152 633.

NEWCASTLE-UPON-TYNE ELECTRIC SUPPLY COMPANY announce that, as the results of the coal strike, they have decided not to pay an interim dividend on either the non-cumulative 5 per cent. preference shares or the ordinary shares. The interest on the 7 per cent. cumulative preference shares will, however, be paid.

MARCONI'S WIRELESS TELEGRAPH COMPANY have declared the following dividends:—5 per cent., final for the year 1920, less tax, on the 7 per cent. cumulative participating preference shares; 10 per cent., final for the year 1920, less tax, on the 2 616 906 ordinary shares, numbered 1 to 500 000, 750 001 to 1 473 648, and 1 500 001 to 2 893 258 inclusive.

The net profit of the DIRECT WEST INDIA CABLE COMPANY for the year ended June 30 was £14 601, plus £91 437 brought forward, making £106 038, less £5 388 expended on repairs. The directors propose to pay a further dividend of 3 per cent., tax free, making 6 per cent., carrying forward £96 050, subject to excess profits duty and corporation tax.

THE CLYDE VALLEY ELECTRICAL POWER COMPANY is holding separate meetings of the ordinary and preference shareholders to-day (Friday) to consider proposals for creating and authorising the issue of 70 000 8 per cent. cumulative second preference shares of £10, and establishing a special reserve fund for the proposed new issue. The authorised capital is £1 900 000 in £10 shares, of which 60 000 ordinary and 30 000 preference shares have been issued, leaving 100 000 shares unissued.

VICTORIA FALLS AND TRANSVAL POWER COMPANY.—The net profit for 1920, after providing for interest and premium on debentures, £153 892, and for depreciation and income tax, &c., £409 940, was £175 161, plus £94 320 brought forward, making £269 482. A dividend of 5 per cent., less tax, on the ordinary shares for the year was declared, and as the preference shares are entitled to share *pro rata* with the ordinary shares in surplus profits distributed, the directors also declared a further and final dividend of 4 per cent., less tax, on preference shares, carrying forward £92 482.

At the annual meeting of DUNDEE BROUGHTY FERRY, and DISTRICT TRAMWAYS COMPANY, LTD., Mr. George Balfour, M.P., who presided, in moving the adoption of the report, said it was very gratifying to the shareholders that the directors were in a position to pay a dividend of 7 per cent. on the ordinary shares. As a result of the unemployment in Dundee and district receipts from pleasure traffic were not so high as they would have been had trade been brisk. The increased fares charged by the Dundee Corporation, too, had caused an increase in the price of through tickets, which had resulted in a reduction in the number of through passengers carried. Traffic on the tramway system had benefited owing to the reduced railway service during the period of the miners' strike, and that, together with increased fares during the last few months, had compensated for the falling off during the earlier months of the year. Operating expenses again showed a considerable increase, due almost wholly to the high cost of labour and materials and an increase in the cost of power. He thought, however, they might look for a decrease in operating expenditure soon. During the past year the company's cars ran 271 080 miles, compared with 288 720 during the previous year, and carried 2 477 808 passengers, compared with 2 676 012. The gross revenue totalled £24 609, compared with £22 684. Mr. David Hynd and Mr. G. U. Thomson were re-elected directors.

Benn Brothers' Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"The Cabinet Maker": "The History of the Port of London"; "Present Tendencies in Furnishers' Window Displays"; "The Trade Board Question."

"The Chemical Age": "Hydrogenated Phenols and Alcohol Substitutes"; "Catalysis with special reference of Newer Theories to Chemical Actions"; "Special Report of Joint Meetings of the Society of Chemical Industry and the American Chemical Society." "Farm and Home": "Pigs and Forage Crops"; "The Canadian Stores Problem," by James O'Donovan; "International Tractor Trials at Shrawardine."

"The Fruit Grower": "Box Packing of Apples"; "De-Control and Conciliation"; "National Rose Society Show Awards." "Gardening Illustrated": "New Roses at Autumn Rose Show"; "Some Autumn Flowers"; "Plums." "The Hardware Trade Journal" (Autumn Issue): "Preparing for the New Season's Trade"; "Birmingham Meeting of the Institute of Metals"; "Drill Chucks"; "Pottery Trade Developments."

Catalogues, Price Lists, &c.

A circular recently issued by the METROPOLITAN-VICKERS ELECTRICAL COMPANY deals with the interesting subject of water-wheel alternators. A full specification of these machines as made by the firm is given, and the pamphlet is profusely illustrated with views of installations already at work.

A six-page folding leaflet has been issued by G. MEIDINGER & COMPANY, of Basle (London office, 17, Whitefriars-street, E.C. 4.), illustrating their electro-motors, alternating current generators, direct current generators, converter sets, transformers, electrical starters and regulators, centrifugal blowers, air turbines and air filters, &c.

Among the advertising literature recently issued by Messrs L. G. HAWKINS & COMPANY are leaflets relating to the Miller electric fixtures, pendants, brackets, &c. As usual, the production is tasteful, and the advantages of the apparatus—which, besides being artistically designed and finished, are very reasonable in the matter of price—are set out in an attractive form.

An illustrated six-leaf pamphlet on "Exide" accumulators for the control and operation of oil switches and high-tension switch-gear, has been issued by THE CHLORIDE ELECTRICAL STORAGE COMPANY, the sole manufacturers of the "Chloride" accumulator, the "Exide" accumulator, and the "Plantide" accumulator. Throughout the war, and for many years before, the "Exide" was the standard battery plate in use in the British submarine service.

The folder issued by the BASTIAN ELECTRIC COMPANY gives details of the various types of fires and heaters produced by the firm. These range from 2 kW Adam and similar style fires suitable for the living-room through a compact pattern for use on board ship, and a storage geyser for the bathroom and kitchen to crucible and muffled furnaces for industrial work. Ovens and accessories for up-to-date domestic electric light are not forgotten.

THE ELECTRICAL APPARATUS COMPANY will be glad to forward on application copies of their new leaflets, H. 27, H. 44/5, H. 43/5, H. 51/2, B. 220/1, and B. 222, dealing respectively with d.c. automatic motor starters for motors up to 250 H.P.; air immersed, drum type, slow motion rotor starters; drum-type starters squirrel cage motors; ironed air break, switch and fuse units for alternating current up to 50 A, 650 V, and 30 H.P.; mercantile d.c. panels for 100-250 V motors up to 5 H.P. and machine tool controllers, "Navy" type, mica steel, up to 20 H.P., 500 V d.c.

DICTOGRAPH TELEPHONES, LTD., are circulating a descriptive pamphlet of their new calling system, which does away with the enormous waste of time entailed by chasing after the managing director or departmental chiefs to tell them they are "wanted on the phone." The "Dicto-Call" system consists of an operating instrument and a line of bells, horns, buzzers, and other signals. These signals are distributed in such a manner that every foot of floor space is within the sound radius of at least one signal. The operating instrument is placed near the telephone switchboard, if one exists, within easy reach of the operator's hand. It is quite simple to work. All that has to be done is to press down the selector keys and give a turn to the starting key. The instrument does the rest. The starting key can be set to give a call from one to seven times, and if the person is not found before the calls are finished, it is only necessary to give the starting key another turn to carry on for another seven, and so on. The loud staccato calls are repeated at well-timed intervals. The use of the "Dicto-Call" is not confined to the locating of individuals. It can be adapted for notifying the starting and stopping hours, as a warning for moving cranes, at street crossings, as a fire alarm, for mine signals, &c. The maintenance of the system is practically nil, current being derived from the electric light supply.

Arrangements for the Week.

FRIDAY, Sept. 30th (to-day).

EDINBURGH ELECTRICAL SOCIETY.

8 p.m. At the Philosophical Institute, 4, Queen-street, Edinburgh. Lecture on "Magnetic Clutches," by Mr. W. E. Townsend.

MONDAY, Oct. 3.

SOCIETY OF ENGINEERS.

5.30 p.m. At the Geological Society, Burlington House, London. W. Paper on "The Winning of Tidal Lands in British Guiana," by Mr. Gerald O. Case, A.M.E.I.C.

WEDNESDAY, Oct. 5th.

INSTITUTION OF RAILWAY SIGNAL ENGINEERS.

6 p.m. At the Midland Grand Hotel, St. Pancras, London, N. Resumed discussion on Paper, "Problems of Automatic Train Control," by Mr. W. J. Thorowgood.

FRIDAY, Oct. 7.

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, London, S.W. Paper on "Colour Vision and Colour Blindness," by Dr. E. Green, C.B.E.

SATURDAY, Oct. 8th.

ASSOCIATION OF ENGINEERS-IN-CHARGE.

6 p.m. At the Holborn Restaurant, London, W.C. Annual Dinner.

BIRMINGHAM AND DISTRICT ELECTRIC CLUB.

7 p.m. At the Grand Hotel, Colmore-row, Birmingham. Paper on "Commercial Efficiency of the Telephone," by Mr. C. G. Findlay.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Partnership Dissolved.

BARNETT, William, of Burnt Tree, Dudley; SAUNDERS, Frank, of Dudley-road, Tividale; and THOMPSON, Peter James, of Whitehouse-street, Burnt Tree, carrying on business as engineers, at Dixon's Green, Dudley, under the style or firm of The B.S.T. Electric Fittings Company, by mutual consent as from September 20, 1921. Debts received and paid by Frank Saunders.

Bankruptcy Information.

MATHERS, Ernest Edward, 10c, High-street, Doncaster, electrical engineer. Date of receiving order, Sept. 21, debtor's petition.

TAYLOR, John Henry, 99, Blackhorse-street, Bolton, Lancashire, electrical engineer and contractor. At the public examination of this debtor, held last week at Bolton, the statement of affairs showed liabilities £539, and deficiency of £569. Debtor stated that he was brought up in the electrical business, and commenced business on his own account in 1919, after being demobilised from the Army. He was fairly successful until about July, 1920. At that time he developed a severe illness, and was ill for six months. During that period he put a manager in charge of the business, but it suffered through contracts being delayed. He attributed his position to illness, personal and family. The examination was closed.

Notice of Dividends.

WAMPACH, Alphonse Christian Adolphe, Formby Lodge, Seabrook-road, Hythe, electrical engineer. Amount per £, 6½d., supplemental, payable September 25, Official Receiver's Office, 68A, Castle-street, Canterbury.

WARD, William Henry Stannard, 56, High-street, Acton, Middlesex, electrical engineer. Amount per £, 7½d., first and final, payable September 26, Official Receiver's Office, 29, Russell-square, London, W.C. 1.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors, we do not report subsequent county court judgments against him.]

BODEN, Dennis, 149, Brighton-street, Seacombe, master electrical engineer. £30 2s. August 6.

BROWNE BROTHERS, 129, St. Albans-road, Seven Kings, electricians. £14 5s. August 5.

BURGESS, A., & COMPANY, 300, Garratt-lane, Earlsfield, electrical engineers. £43 5s. 9d., August 8; £20 9s. 5d., August 10.

HORPHAM, —, 5 Court, 11 Thomas-street, Sheffield. £12 15s. 4d. August 9.

MATHERS, E. E., 10A, High-street, Doncaster, electrical engineer. £118 5s. 6d. August 4.

OLDAM & COMPANY, 162, Whetstone-lane, Birkenhead, electrical engineers. £10 5s. 10d. July 18.

PUGH, H. J., & COMPANY, 37, Broadway-parade, Crouch End, electrical engineers. £44 11s. 10d. July 20.

RAWSTHORNE, Thomas, 67B, Paradise-street, West Bromwich, electrician. £6 5s. 11d. July 26.

SCOTT, James, 48, St. Mark's-road, Sunderland, electrical engineer (and others). £28 1s. August 10.

WALES BROTHERS, 27, Combe-lane, Norbiton, Kingston, electrical engineers. £20 10s. 5d. August 4.

Books Received.

"The Physical Properties of Colloidal Solutions." By E. F. Burton, B.A. (London: Longmans, Green and Co.) Second Edition. Pp. viii.+221. 12s. 6d. net.

"Tables of Complex Hyperbolic and Circular Functions." By A. E. Kennelly, Sc.D., A.M. (Cambridge, Mass.: Harvard University Press.) Second edition. Pp. 240.

"Chart Atlas of Complex Hyperbolic and Circular Functions." by A. E. Kennelly, Sc.D., A.M. (Cambridge, Mass.: Harvard University Press.) 14 plates.

"Practical Electricity." By W. E. Ayrton, F.R.S., and T. Mather, F.R.S. (London: Cassell & Co.) Fourth edition. Pp. xxiii.+547. 15s. net.

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Forty Years Ago.

(THE ELECTRICIAN, OCTOBER 1, 1881.)

THE EDISON DYNAMO-MACHINE.—The great dynamo-machine has at length arrived in Paris. It will, however, be several weeks before it is finally in place.

EFFECT OF HEAT ON THE COMPASS.—It is stated that during the intense heat which has recently been experienced in America the compass was found to stay in any position in which it might be placed without reverting to the north.

ELECTRIC LIGHT AT MIDDLESBROUGH.—This town, which fifty odd years ago was not in existence, is celebrating its jubilee. The streets, or some of them, are to be lit by sixty-four Brush lights, supplied and erected by Messrs. Hammond & Company, in honour of the event.

PRICES.—The prices as quoted for this week are: For gutta-percha, per lb.: Genuine, 4d. to 3s. 3d.; reboiled, 3d. to 1s. 3d. India rubber, fine Para, 3s. 3½d. to 3s. 4d.; negro-head, 2s.; Central American, 1s. 5d. to 2s. 2½d.; Assam and Pegu, 8d. to 1s. 10d.; other East Indian, 1s. to 1s. 10d.; Madagascar and Mozambique, 1s. 5d. to 2s. 2d.

INTERNATIONAL ELECTRICAL EXHIBITION.—THE JULY.—In our issue of the September 17 we gave the number of the jurymen appointed to represent each country. We now give the names of the English members, viz.: Mr. Warren Delarue, Major Armstrong, R.E., Mr. Shelford Bidwell, Mr. Crampton, M.S.T.E., Mr. Crookes, F.R.S., Professor Everitt, F.R.S., Professor Forbes, Mr. J. F. Moulton, F.R.S., Mr. W. H. Preece, F.R.S., and Mr. A. Stroh.

New Companies.

The following list is compiled from information supplied by Messrs. Jordan and Sons, Ltd., company registration agents, 116 and 117, Chancery Lane, London, W.C. 2.

WIMLETON ELECTRICAL COMPANY, LTD. (176 905), 15, Kingeton-road, Wimbeldon, S.W. Registered Sept. 21. Makers and vendors of electrical apparatus. Nominal capital, £1 000 in 1 000 ordinary shares of £1 each. Directors: J. B. Bower (managing director) and E. Smith. Private company.

BROOKMILL MOTOR & ENGINEERING COMPANY, LTD. (176 885), 25, Brookmill-road, Deptford, S.E. Registered Sept. 21. Motor and electrical engineers. Nominal capital, £12 000 in 12 000 ordinary shares of £1 each. Directors: L. Amato and J. Solva. Qualification of directors, 1 share. Private company.

BAYNES ELECTRICAL COMPANY, LTD. (176 835), 29, York-street, Manchester. Registered Sept. 17. Electrical engineers, &c. Nominal capital, £2 000 in 2 000 shares of £1 each. Directors: J. Kearton, E. A. Thurley, and R. Moore. Qualification of directors, £1. Private company.

ARTIC FUSE AND ELECTRICAL MANUFACTURING COMPANY, LTD. (176 834). Registered Sept. 17. To acquire patents Nos. 123 807 and 154 390, relating to pressure contact, self-aligning fuse carriers and link switches, and to develop, manufacture, and grant licences in respect of such patents. Nominal capital, £5 000 in 4 700 ordinary shares of £1 each, 4 000 founders' shares of 1s. each, and 100 deferred ordinary shares of £1 each. Directors: F. A. Ross, A.M.I.E.E., 6, Queen's-drive, Whiteley Bay (chairman and technical adviser), G. P. Dennis, M.I.E.E., 6, Normanston-road, Birkenhead (managing director and sales manager). Qualification of directors, 250 shares.

Prices of Metals, Chemicals, &c.

		TUESDAY, SEPT. 27.		
		Price.	Inc.	Dec.
Copper—	Best selected per ton	£69 5 0	—	5s. 0d.
	Electro Wirebars ..	£74 10 0	—	—
	H.C. wire, basis	0s. 11½d.	—	½d.
	Sheet	0s. 11½d.	½d.	—
	Phosphor Bronze Wire (Tub. phom)—			
	Phosphor-bronze wire, basis	1s. 3½d.	—	½d.
Brass 60/40—	Rod, basis	0s. 8d.	—	—
	Sheet, basis	0s. 10½d.	—	—
	Wire, basis	0s. 11½d.	—	—
	Pig Iron—			
	(Cleveland Warrants) per ton	£6 10 0	—	5s. 0d.
	Galvanised steel wire, basis 8 SWG ..	£23 0 0	—	—
Lead Pig—	English	£24 5 0	5s. 0d.	—
	Foreign or Colonial ..	£23 5 0	7s. 6d.	—
	Tin—			
	Ingot	£157 15 0	£3 2 6	—
	Wire, basis	2s. 1½d.	½d.	—
	Sal ammoniac.—Per cwt. 65s.-60s.	—	—	—
	Sulphur (Flowers).—Ton £13.	—	—	—
	(Roll-Brimstone).—Per ton	£65.	—	—
	£13.	—	—	—
	Sulphuric Acid (Pyrites, 168°).—			
	Per ton, £9 17s. 6d.	—	—	—
	Rubber.—Para fine, 1s. 1d.; plantation 1st latex, 9½d. lb.	—	—	—

The metal prices are supplied by British Insulated & Helsby Cables, Ltd.

THE ELECTRICIAN

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[No. 15, 1921, 10s. 6d.]

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Notes of the Week.

Tramway Undertakings and Motor Traffic.

THE necessity of dealing with more mundane matters than the history and difficulties of tramway development prevents us commenting more than cursorily on the proceedings at the recent annual meeting of the Municipal Tramways Association. That will be remedied next week. In the meantime we may remark that the presidential address of Mr. G. HOLFORD, and the various Papers that followed it, bear mainly on two problems—the competition now liable to be caused by mechanically driven vehicles, and the vexed question of contributions for the maintenance of roadways. While everyone is aware of the salutary influence of healthy competition, that need not prevent us from appreciating the position assumed by tramway undertakings. Indeed we do appreciate it, for they have statutory duties and obligations and have expended considerable sums in developing their respective areas. If competition by the "care-free" motor-bus is unrestricted and indiscriminate, there will undoubtedly be heavy losses incurred on many routes—possibly both by the tramway undertaking and by the injudicious competitor.

The Real Problem.

For the problem is not a matter of "tramcar versus motor-bus." Many tramway experts would admit, for instance, that in view of the exceeding costliness of extending tramcar routes at the present time, in many cases traffic needs might be better met by a supplementary motor-bus or trolley-bus service. They would also admit that in some congested areas the tramway authority cannot adequately meet the enormously increased traffic demand,

and that motor-buses might well be diverted to these crowded routes to carry the excess of traffic during peak-hours. But they urge that true economy in such cases is only possible with a monopoly similar to that enjoyed by electricity and gas supply undertakings in their areas, and that the use of supplementary aids to traffic must be co-ordinated. Their grievance is accentuated by the conviction that, under the conditions prescribed by the Act of 1920, they become the major contributors to the upkeep of the roads, although, in the wear and tear sense, the minor users—that, in short, they are called upon not only to make good their own disturbance of road-surface, but to pay for that due to their competitors. Mr. CHAMBERLAIN quotes figures to show that permanent way costs absorb as much as 24 per cent. of the tramway revenue, so that even a small alleviation of this factor might have a substantial influence on results. Tramway authorities have certainly a right to a very careful hearing on these points, and the immediate future has various critical aspects that deserve study.

Unprofessional Conduct.

THOSE members of the Institution of Electrical Engineers, or chartered electrical engineers, as they may now be called, who read "The Times," must have been startled to see in a recent issue an advertisement from one of their number soliciting work as a consulting engineer. Had the offender been a member of the medical or legal professions a display such as this would have been followed by a condign penalty, probably taking the form of expulsion and subsequent eclipse. Now, though we have recently argued that any sanctions which can be applied to the professional conduct of electrical engineers must ultimately rely on the attitude of the public towards them, we still consider it

say that at this juncture there is no means of dealing with this matter, which can be considered a punishment. For expulsion from the Institution cannot, unfortunately, be included in this category, conditions being such that the public are equally willing to employ anyone who calls himself an electrical engineer, whether in a consulting capacity or otherwise, without troubling to enquire into his qualifications or capability. This is bad for the profession generally, for the engineers themselves, and last, but not least, bad for the public. For that reason we consider it would be generally to the advantage of the electrical industry if those among its ranks who wished to practise as consulting engineers became members of the Association of Consulting Engineers, and so placed themselves under a code. This would allow anyone employing them to be certain of the regulations under which they worked. We hope, in addition, it will soon be possible to take steps to differentiate clearly between the chartered and unchartered electrical engineer, and strictly to enforce rules of professional conduct against the former.

Simpler Tenders.

A LITTLE while ago we listened to Dr. ROSENBERG on the shortcomings of the consulting engineer. This week Mr. DYKES favours us with some views on the delinquencies of the manufacturer. Curiously enough, both critics take the specification as their text, and to the onlooker the result is not unlike that of the famous battle of words between the pot and the kettle. Dr. ROSENBERG's plaint was that the consulting engineer was too individualistic. Mr. DYKES thinks the supervision of contracts might be conducted in a more economical way and that tenders might be simplified, with a saving of time to the manufacturer and a resulting increase in sympathy on the part of the consultant. The accusation is one which manufacturers might well take to heart, for it is axiomatic that the fewer of their employees there are engaged on unproductive work the better will be the result of the year's trading. Longwinded specifications and equally diffuse tenders are an outcrop of the legal mind with which as engineers we should have as little to do as possible.

The Need for Financial Assistance.

It may truly be said that the leading theme of the articles which we publish in this week's issue of THE ELECTRICIAN is the need for co-operation between all branches of the electrical industry in order that our future development may be at a satisfactory rate. This co-operation must not only take the form of removing the obstacles and smoothing away the difficulties that sometimes exist, but when it is required of something much more active as well. For instance, Mr. DYKES makes the interesting suggestion that manufacturing firms should do something to assist the small electricity supply companies in their present plight. These firms, or a combination of them, can raise capital more easily than can the small electricity supply companies, and since, if, for instance, the cable makers did this, they would be indirectly increasing their own business, the scheme has much to recommend it. If, however, money was raised on these terms some share in both policy and management would have to be conceded, and this might not be agreed to without difficulty. But any scheme which makes for the development of electrical business should not be left unexplored, and we therefore hope that this matter will before long be taken up.

Electricity in Mining.

FROM the presidential address of Mr. A. B. MUIRHEAD to the members of the Association of Mining Electrical Engineers we learn that there are two causes which are checking progress in the use of electrical plant in collieries: the attitude of the Home Office inspectors, who do not appear to be very friendly to the use of electrical machinery underground, and the nationalisation campaign of the Labour leaders. While we deplore the folly of the latter, we cannot help feeling surprised at the charge brought against the inspectors of mines. At all events, we feel sure that the Electrical Inspector of Mines is not opposed to the extended use of electricity, though it is possible some of the district inspectors are easily impressed by occasional accidents, due mainly to the carelessness of operators, and make unreasonable demands upon the mine-owners and managers. It is only by the extended use of machinery and of electrical plant that efficiency can be secured; in the present condition of trade there is nothing so urgently wanted as increased output and a reduction in the price. As Mr. MUIRHEAD pointed out, the colliery owners are willing to carry out any reasonable regulations, but it is quite easy to carry safeguards to such an extent as to render production altogether too costly, with the result that industry is checked. Everywhere some risk has to be taken, but safe working conditions are reached sooner by friendly co-operation than by carping criticism and officious interference.

Postal Telegraph and Telephone Service.

THE Treasury Returns for the half-year support the views of those of us who criticised the revised charges for the postal, telegraph and telephone services. It is only a Government department that could anticipate increased revenue from an increase in the cost of services which are much less efficient than formerly. No doubt the truth will be perceived even by the Post Office authorities in due course, but, unfortunately, whatever its results, their experiment will have been a very costly one for the trade and industry of the country. Notwithstanding the greatly increased postal charges, only £1 650 000 more was received than in the corresponding period of last year, although an increase of £3 450 000 was anticipated; but instead of an increase of £1 900 000 from the telephone service the revenue is £1 200 000 less! It is clear that the charges have been fixed above the economic limit, and we hope that the authorities will take into consideration at the earliest possible moment the question of a reduction. The income from the telegraphs for the six months shows a decrease of £200 000, which is the exact decline predicted for the year. Altogether we want a reduction not only for the sake of the Post Office finances, but to remove a drag on our industrial development.

Surface Wiring Systems.

ON another page of this issue we give a description that may almost be called impressive of the various surface wiring systems whose aim and object is to cheapen and improve electrical installation work. These systems range from the ancient "Stannos" of SIEMENS BROTHERS & Co., to that lusty bantling, the "Kingsway," recently placed on the market by the GENERAL ELECTRIC Co. While they differ in detail, they all have the idea of attempting to do something better than it has ever been done before. We do not propose to detail the advantages of the various

systems: that is best done by their makers. Nor do we propose to deal with their disadvantages (if they have any); that will be cheerfully done by their competitors. Our object here is merely to record an interesting phase which may well have a profound effect on electrical progress.

Mainly Economic.

At the present time the question which is the best wiring system to use is mainly economic. That is, such a system has to be chosen that, while giving a reasonably long life unspotted by regrettable incidents, is low in first cost and easy to erect. We are not sure that of these three desiderata the last is not the most important. For the best of systems may be spoilt by bad erection. Moreover, at a time when labour is costly and not over-skilled, any system which can resist the attentions of the amateur "wirebuster" has much to recommend it. While then for high-class work in public buildings, hotels and large country houses the screwed conduit will hold first place, where money is an important object the surface wiring idea should have an ever-increasing application. It can certainly be said in its favour that it cuts down initial costs, and given reasonably careful installation it possesses an uneventful life. That attention which is being given to the matter by electrical manufacturers is sufficient indication that this is the case, and should lead at no distant date to that reduction in cost of installation work which is so eminently necessary.

Technical Books Advisory Service.

We receive so many requests from our readers for advice in the choice of technical books, that we have decided to extend our service in this direction. We have accordingly added to our staff an expert who has made an intimate study, during a long period of years, of the technical literature of the electrical industry, and whose experience and knowledge of the subject is unrivalled. This arrangement will enable us, with the minimum of delay, to assist those of our readers who may find a difficulty in tracing just the right book for their purpose, and will obviate the necessity of a lengthy search through catalogues and works of reference. It often happens that a particular piece of information of the greatest value is to be found concealed in a simple chapter of a work which might not be supposed, from its title, to cover the subject in question. We need hardly add that it will be our pleasure to bring such information to our readers' attention, as well as to answer enquiries of a more general character.

Mr. Dunlop and the B.E.A.M.A.

RUMOUR, mildly speaking, has a way of exaggerating and of ascribing quite erroneous consequences to simple actions or combinations of actions. When, then, that little bird which is never far away from editorial offices told us that Mr. D. N. DUNLOP was about to resign his position as director and secretary of the B.E.A.M.A., we were at first surprised and then wary. We are now officially informed that there is nothing in it, and are authorised to deny that there is. Mr. DUNLOP is not resigning from the B.E.A.M.A., and the alarms and excursions which always result from the vacation of so important a position, and are almost as disturbing as a general election, will not, therefore, be necessary. There is matter for congratulation in this, not the least because of the proverb about changing pilots during a storm.

How to Promote Trade.

In days gone by, according to the poet, springtime came bringing new desires. In the present days of grace springtime is associated with east winds, snowstorms and football matches, and the autumn is the period when industry shakes off the enervating influence of Deauville, North Berwick or Margate, and once more begins to strain at the collar for its own and other people's advantage. This year is no exception. For those connected with the electrical industry have within the past few weeks been returning from their holidays willing and anxious to develop their businesses and to do their part in placing British trade once again in a stable position. But they have returned to find how difficult that task is, and, in fact, to discover almost insuperable difficulties to its realisation. The order book is empty. Enquiries are made and answered, but the rest is silence. The price of raw material remains in the mountainous regions. Taxation is still oppressive. Overhead charges show no signs of coming down. Wages placed in juxtaposition to consumption are too high. The selling price cannot be made to suit consumers' pockets. How is this disastrous state of affairs to be remedied? Develop your sales is the facile reply. The question is, how can sales be developed and how can trade be promoted? It is a question to which many would like to find the answer.

The Lessons of This Issue.

We lay no claim to omniscience in this matter. But if on the occasion of the publication of our Autumn Trade Promotion Number we summarise some of the lessons, explicit and implicit, which the articles that appear on other pages of this issue contain, we hope to clear the ground and make the path to a brighter future a little easier. This is no time for false starts. We want to go ahead directly towards the goal.

Now, in a consideration of this problem one fact emerges, threadbare and weather-beaten, it is true, but none the less a fact. That is that for real development the whole industry must work to one end—the education of the inhabitants of the country generally, and (for the necessity of building up our export trade must not be forgotten) of the inhabitants of other countries, too, to show them the ways in which electricity can help their industrial and domestic existence.

Is the Contractor the Weak Link?

It has often been argued with some force that the weak link in the chain of co-operation in the electrical industry—which includes the manufacturer, the supply engineer and the contractor—is the last named. There is undoubtedly some force in this, but it is the result of natural causes. The contractor is usually a man in a small way of business. His financial resources are meagre, and even did he wish to develop his trade to its fullest extent (which is by no means always the case) he could not do so without assistance.

The Contractor's Position.

Now the co-operation which we have suggested is all the more necessary, as there are indications that all is not well with the contracting branch of the electrical industry. The reasons for this are interesting and valuable to examine. They seem to include the following: During the war and for some time after the demand for power and lighting supplies continued to be very brisk, and consequently there were plenty of orders at remunerative prices. In many districts there were long lists of consumers waiting for connection, and contractors secured work practically on their own terms.

But this happy state of things was not to last. Soon complaints began to be made by customers of high costs, and a prejudice arose against the contractor, which, unfortunately for him, still persists.

Municipal Wiring no Remedy.

To counteract this a few local authorities have, in fact, gone so far as to put into force their powers of undertaking installation work, and municipal wiring departments have been organised in the hope of bringing down prices.

But while we sympathise with any movement which will cheapen installation work, we do not believe that municipal wiring will bring about the desired result. At any rate, it is not co-operation. Moreover, it is not equitable for a local authority to enter into direct competition with its own ratepayers. Fortunately, there are not many municipal supply authorities who undertake this class of work, and where they do it is certainly partly due to the apathy and lack of organisation among the local wiring contractors. But even then it is unwise, and the desired result should be brought about in some other way.

Organisation a Necessity.

If contractors were properly organised and sufficiently alive to their own interests they need have no fear of municipal wiring competition, for, generally speaking, the officials of local authorities realise the arguments against municipal wiring that we have put forward above and only do this work to avoid absolute stagnation. It is, in fact, to the credit of the great majority of borough electrical engineers that they are not in favour of engaging in this kind of business, not the less because it interferes with their ordinary and more important duties and involves the organisation of a separate department for the preparation and submission of estimates, the supervision of work in progress, and the separation of accounts.

And this is where co-operation comes in. For assistance might well be provided both by the manufacturer and the supply engineer in their respective ways, so that through the contractor as many points of contact as possible may be established with the consuming public.

The Uses of Advertisement.

We are glad to think that this is beginning to be done. By means of advertising campaigns, easy terms of purchase, leaflets, advice on showroom displays, and not the least by the inculcation of enthusiasm, the contractor is at last beginning to see that he must reform, work and employ modern methods not only to help himself, but to help the industry. Surely such a policy cannot fail of success, and it is certainly better than the old-time method of kicking him downstairs on each and every opportunity.

Electricity Now a Serious Matter.

The state has now been reached in the development of civilisation when the public regards electrical apparatus less as a means of providing fun at tea-parties by giving shocks than as a real help in their domestic economy. So much have the public been educated in the domestic electric idea that the daily Press are beginning to talk about its advantages. But those engaged in the electrical industry must not conceal from themselves the fact that the price of the apparatus is a great drawback to its extended use and an equally grave obstacle to sales promotion.

Help From Hiring.

This difficulty can to a large extent be circumvented by a wide adoption by electricity supply authorities of hiring arrangements, and by manufacturers and contractors of hire-purchase methods. Most of the business of the gas com-

panies has been built up in this way, and it is interesting to note that after temporarily discarding this method of development the Gas Light and Coke Company is once again advertising the hire of all sorts of apparatus. And we have no doubt that other suppliers of gas will follow suit.

We admit that hiring has been done in a small way by some undertakings, and we are glad to see that development on these lines is to be a feature of the Glasgow Corporation Electricity Department's sales development. But hiring must become more general. As has recently been pointed out by the British Electrical Development Association, satisfactory cooking-ranges, vacuum-cleaners and washing-machines are now on the market, and hiring departments can be set up at no great cost and no great strain on the network. And they will be a very great help in bringing the electric idea before the public.

A Lead from Aberdeen.

If this be doubted we may mention that there are not wanting local authorities who have found hiring schemes of the greatest advantage, especially in developing the demand for power and domestic purposes. To show how popular these hiring schemes are we might mention that at Aberdeen the electricity departments, whose annual accounts have just been issued, has now on hire 2 652 heating and cooking utensils, an increase of 478 during the past year. Of course, no contractor or group of contractors can undertake this class of work so well as the supply authority. It is therefore to be hoped that this example will be more widely adopted.

Why Hiring is an Advantage.

It may be argued that hiring is not a great step towards increased sales. We do not agree. At worst the wide employment of hiring would be a beginning. But we feel sure it would be much more than that. It would stimulate interest in the use and capabilities of electrical apparatus, and, as the desire of possession is in each one of us, it would eventually—indeed, before very long—increase sales. This increase would receive no little assistance from the use of hire-purchase agreements by both manufacturers and contractors. As Mr. MORTON shows, this is a matter in which the manufacturer and the contractor might well go hand in hand to the advantage of both.

Co-operation of Contractors.

Again, a number of local electrical contractors might well establish a showroom on a co-operative basis, or form a separate company for the purpose. Unfortunately, their sense of organisation and co-operation does not seem to be sufficiently developed to enable them to undertake such a useful and remunerative work, though we are glad to see that Mr. ORRIDGE recognises it is along these lines that progress can best be made.

The Place of the Small Apparatus.

It is to a certain extent fortuitous, but none the less significant, that the new apparatus which we describe on other pages of this issue is mainly small. It implies, we think, a recognition of the fact that in the domestic field lies the great chance for future electrical development, not the less because it is a field which has been practically untouched. It is upon relatively small apparatus that the electrical industry must more and more depend. There cannot in the nature of things be a market for more than a few 15 000 kW turbo-alternators, but there must for a very long time be an almost unlimited demand for such

appliances as cookers, irons, small motors, heaters, toasters, fans, vacuum-cleaners and washing-machines, and the wide range of accessories which are a necessary accompaniment of their use.

We have indicated, somewhat allusively, perhaps, the ways in which the electrical industry can be expanded and electrical trade developed. By co-operation, by advertisement, by hiring and by an increasing determination to reduce the cost and improve the quality of the product. These are, in fact, outstanding necessities. In the past few years we have greatly improved our methods. But we feel that improvement is still necessary—a remark that is not made in any spirit of carping criticism, but because to improve is to live and to stand still is to die.

Some Effects of the Strike.

It has often been said that there is no sentiment in business, that the man does best who goes ahead regardless of the sore heads and corns of his competitors, and keeps his end, which is generally his own advantage, in view irrespective of the obstacles which he may meet on the way. Without subscribing entirely to this policy, there is no doubt that in the electrical industry, at any rate on the domestic side, development will be achieved by the displacement of existing methods of heating and cooking, and to that extent, therefore, our gain will be other people's misfortune. The war, as has often been pointed out, brought before the general public in a most striking way the advantages that can be obtained by using electricity for domestic purposes and for such applications as the heating of offices. The development which resulted was not entirely on the score that electricity was more convenient, important as that is, but because to a large extent the reliability of the supply and the quality of the product made it stand out above its competitors. So that throughout the inconveniences of the later war period electricity to a larger extent than any of the other heating commodities could be depended on to come up to specification.

An Unconscious Advertisement.

From communications we have received from electricity supply engineers all over the country it is evident that the coal strike simply added to the good work which had thus been begun by emphasising in a somewhat circuitous way the advantages that electricity could confer on the general public. There is no doubt that this illustration would have been more pronounced had not the summer weather, which continued practically throughout the whole course of the cessation of work, made artificial heating of houses and offices almost unnecessary. Moreover, in certain districts, generally those remote from industrial areas, the stocks of coal in hand, both in the domestic cellars and in the gas works, allowed almost a normal supply of heat to be obtained. Those who suffered most, as is always the case in an industrial dispute, were the poorer classes, who were for financial reasons unable to take advantage of the alternative methods offered.

Restrictions and New Business.

On the other hand, in certain districts the restrictions placed on the output from the stations prevented any campaign being instituted in favour of the further use of electrical apparatus. Nevertheless, even in these places a satisfactory increase in the consumption was noticeable in the case of those consumers who already possessed electrical equip-

ment, and the envy excited among their neighbours by the better conditions under which these fortunate people were able to live has led to a large number of additional enquiries which the coming of the autumn season will no doubt still further increase. This is a psychological result with a vengeance.

Some Examples of a Benefit.

We may illustrate our argument with a few examples. In Birmingham, for instance, Mr. CHATROCK tells us that during the period of the coal stoppage nearly 300 kW of additional heating and cooking connections were made to the mains, and although it is difficult to say to what extent the coal stoppage was actually responsible for this satisfactory state of affairs, there is no doubt that it accounted for a considerable proportion of it, and that, moreover, it has turned the attention of the public effectively to a consideration of the advantages of installing electrical apparatus. The same point is made in a different way by Mr. C. G. MORLEY NEW, of Cardiff, where, owing to the special relation of the city to the coal trade, the connections added during the strike were naturally small. Nevertheless, it seems quite possible that the lessons enforced by the strike as to the value of being independent of coal as a heating agent will bear fruit during the coming months, and this opinion is backed up by the large number of applications which are now being made for new connections and extensions to existing installations.

Contractors Reap a Harvest.

At the other end of the country a somewhat similar condition of things is evident. For Major RICHARDSON tells us that in Dundee the coal strike certainly caused many consumers to use electricity for culinary purposes, and that the contractors reaped a good harvest by the sale of electrical utensils. As a result the consumption of units for domestic purposes increased to a large extent, and applications for special heating circuits are still on the increase. This condition of things was generally assisted by the electricity department being able to give a continuous supply, while the gas was cut off altogether during certain periods of the day, and when available was only of poor quality.

Gas Rationing a Help.

The effect of gas rationing was also an advantage to the electricity supply department of the Glasgow Corporation. Here a noticeable increase in sales in the departmental showroom was found, and there was a constant demand for domestic and industrial irons, boiling-rings, kettles, table-cookers and grills and small electric fires. In one week alone over 300 electric irons were sold, and altogether appliances to the extent of from 500 to 600 kW capacity were sent out from the showroom. In addition, many electric cooking emergency outfits were installed in restaurants, in national kitchens, and in the canteens of the municipal buildings.

The Moral of It.

Similar information has been received from Manchester, Newcastle, Salford, and Sunderland, and though in a few cases we have been told that the strike had a more harmful than a beneficial effect, we think that the voting indicates that electricity has rather gained than lost prestige and worldly wealth by this occurrence. We hope, therefore, that steps will be taken to keep the momentum up, and that by the lessons that have been learned no chance will be lost of bringing before consumers all over the country the advantages which can be obtained by the employment of domestic electric apparatus.

Some Steps to a Reconstructed Industry.

By A. H. DYKES.

During the Middle Ages, despite the operation of the natural law whereby, save for external checks and causes, the population tends to double itself in twenty-five years, the inhabitants of this country increased in number very slowly. Even as late as 1801, when the first census was taken, the total population of England, Scotland and Wales was only 10 million.

The census recently taken shows that this figure has now increased to nearly 43 millions. This enormous increase in the last 120 years is almost entirely due to the fact that during this period England has changed from a largely agricultural into a manufacturing and trading country. The population, which in the Middle Ages was regulated by the capacity of the agricultural industry to supply the needs of the people—a year of drought causing famine and death—has since 1800 been largely supported by the profits from our manufactures and exports to foreign countries, paid to a great extent in the form of food.

Produce and Sell, or Fail.

Unless, therefore, the prosperity of the country is to decline and its population to dwindle to something like the numbers at the end of the eighteenth century, it is evident that the nation as a whole, employers and workmen, financiers and managers, must pull together and produce and sell goods at such a price as will retain our vital foreign trade. For if an article can be produced more cheaply in a foreign country than here, then the world will buy in that country, and nothing we can say or do will prevent it.

We have to face the fact that the capital on which in the past we have largely relied for the initiation of new enterprises and for the financing of other countries, which in turn would become consumers of our own products, has been drained in the great fight. The dividends from foreign investments, which helped to provide wages for large numbers of our people, have disappeared. The chief cause, however, of the present depression and unemployment is due to the fall in the rate of exchange, many of our best customers abroad having been so impoverished that they can no longer afford to buy our goods. French money has lost half its purchasing power; Italian money more than two-thirds; the Indian rupee, which last year bought 2s. 10d. worth of our goods, will now buy only 1s. 3d. worth; and the German, who formerly paid his 20 marks for a sovereign's worth of our goods, would now have to pay 300.

Even were the price of our goods no higher than before, the fact that all these people—our former customers—have, through the fall in the exchange, to pay many times as much money for our goods would make it difficult for us to obtain their orders. Much more difficult is it, then, when our cost of production has been so much increased.

How to Win the Peace.

The question of the equalisation of the rate of exchange is one for Governments and financial experts to deal with, and in any case will only gradually be solved. The capital of these countries has been dissipated, and their wealth will have gradually to be built up again, principally through agriculture and by thrift. Good harvests for the next year or two would help greatly, as would also stern economy and self-denial. Pending such improvement in the rate of exchange, the supreme effort of the electrical, as of all other, industries in this country should be directed to reducing the cost of its products.

We won the late war by mobilising the whole resources of our Empire, by putting into the fight the best brains, the best organisation and the best labour of which Great Britain was capable, and by "scrapping" all customs and methods which stood in the way of success. And now we

can only win back the prosperity of the country by adopting similar methods, with the addition of thrift and economy, which were not conspicuous during the war.

Let no one think, because the particular product with which he is concerned is largely used for home consumption, that he is not interested in foreign orders. The lower the price at which electrical energy can be supplied the less will be the cost of production for the manufacturer who requires current for lighting or running his works, and the greater the chance of his obtaining foreign orders.

Increased Production—Not Low Wages.

Low cost of production does not necessarily mean low rates of wages for those engaged in the industry; it means *maximum output per man employed*, and to obtain this is needed the co-operation of each one in the industry, from the managing director to the youngest workman.

There never was a time in the history of our country when our works were better equipped and organised than at present; never before was so much done for the social welfare of employees. Canteens, clubs and sports grounds are to be found in connection with most of our largest works. All that is wanted is a spirit of co-operation between the employers and the workmen—the employers to see that the organisation and equipment is kept up to the highest level, the staff and workmen to see that in exchange for good wages a good day's work is given and no opportunity lost of increasing the output of the works.

The Place of the Works Committee.

In many works much good has already been done by works committees, but much still remains to be done. It is only by bringing the workman into closer contact with the management and by educating him in elementary economic principles that any real improvement can be made. "Ca'-canny" and the various rules connected with "Demarcation," which prevent a man from doing the smallest job beyond what strictly belongs to his own trade, must go if we are to regain our former prosperity.

The more far-sighted among the Trade Unionists realise this, but, apart from the appeal which both these practices make to the lazy, selfish workman, many of the more conscientious men are still influenced by them, because they think (wrongly, but none the less strongly) that by working in this way they help to give employment to more men.

The Employers' First Duty.

It seems to me, therefore, that the most important duty of the employers at the present time is to mix more with their men, obtain their confidence, explain to them the underlying economic principles, and show them that by increasing production for a given wage more payment (principally in the shape of food) can be obtained from abroad, and thus more people supported in this country.

The lessons of the war have undoubtedly led to a much greater interchange of ideas, and more co-operation amongst employers and combinations have been effected which will admit of our English electrical firms undertaking complete contracts of the largest size. It is, however, essential in many cases that the manufacturers should be prepared not merely to sell plant for delivery f.o.b., but to quote for the complete erection. An established electrical company may be quite capable of taking delivery f.o.b. and erecting and starting, but in the case of, say, an Indian municipality, with an electrical staff still to be formed, the firm (whether English or foreign) which is prepared to quote the lowest price for the plant as specified, delivered *and erected*, will in all probability get the job. It is in the erection that the greatest waste generally occurs.

Better Supervision of Contracts.

There is still room in many of our largest works for better organisation of the supervision of contracts, and I am often struck by the way in which firms differ in this respect. In some, one man represents the firm, carries out all the negotiations and settles all details with the purchaser or the consulting engineer. In others one may have to deal with six or eight different people representing different departments, each of whom confines his interest strictly to his own department and is supremely indifferent to any mistake or difficulty affecting the firm as a whole as long as his department is cleared.

A minor point is the unnecessary waste of time and energy in connection with tenders. When an engineer has drawn up a detailed specification and form of tender, why will some firms say: "Our tender comprises . . ." and proceed to quote page after page from the specification, every word of which must be read through to see if haply any item is omitted or differs from that specified? The tender which says: "Everything as specified, with (when necessary) the exception of the following items . . ." saves paper, saves clerks' time, and by saving the engineer's time is likely to secure sympathetic consideration.

How Financiers Might Help.

I cannot help feeling, too, that more might be done by the large manufacturing firms and their financial friends to assist their customers in the present crisis. The cable-making industry is one of the soundest in this country, and collectively could raise money much more cheaply than the majority of the smaller electricity supply companies. The latter were not allowed to raise their prices sufficiently during the war—or since—and in consequence are utterly unable to raise money for necessary extensions of mains. If the cable companies and the financiers who are interested in them could devise a scheme by which such supply companies could obtain needed additional mains on easy terms, not only would employment be found for a large number of men directly, but indirectly the addition of new electricity consumers would react in the increased sales of wiring materials, increased work for wiring contractors, and increased demand for meters and all kinds of electrical accessories.

The public has at last been educated up to the advantages of electricity supply, but all over the country at the present time are to be found "would-be" consumers unable to obtain current because the supply authority cannot provide the necessary mains. With the increased business resulting from such mains extensions there would inevitably result increased orders for generating plant.

More Enterprise by the Wiring Contractor.

The introduction some years back of the metal-cased surface system of wiring, which has now been copied by most of the cable-makers, has greatly simplified the wiring problem, but it has still unfortunately to be said that in many cases the wiremen have not allowed full advantage to be gained from the facilities offered, the number of points wired per day being in no way commensurate with the reduction in the labour involved.

There is an immense field for the wiring contractor in the thousands of small houses still without electric light. That these smaller houses can be profitably supplied by a combination of manufacturers and supply authorities has been already demonstrated, and it is a matter of surprise that this large source of revenue has been so neglected. If both are prepared seriously to go into the business together, not only will they find an outlet for their products, electrical energy and wires and lamps, but if proper tried methods are adopted each will receive a satisfactory dividend on the capital put into the scheme.

Hopes for the Future.

Surveying the electrical industry as a whole, there are good grounds for concluding that, serious as is the present

position, the crisis has been passed, and that slowly, but none the less surely, prospects are improving. The importance of the industry has been recognised by the grant to the Institution of a Royal Charter, and the honour paid to it by the King in consenting to become the first Patron is one to encourage all electrical people.

The general body of employees are becoming increasingly distrustful of the noisy extremists, who have misled them in the past, and are beginning to realise that their interests are bound up with the prosperity of the industry. The futility of incessant strikes has been borne in upon the consciousness of some of the labour leaders, and if only all concerned, whatever their position, will give of their best, if we can sweep away senseless restrictions on output and each give a fair day's work for a fair day's wage, the industry as a whole will be able to bring down the price of its products more nearly to pre-war prices, when the gradual improvement in the rate of foreign exchange should bring a prosperity such as our electrical industry has never so far experienced.

How the Contractor Can Help the Industry.

By JOSEPH ORRIDGE, President, Electrical Contractors' Association.

A large majority of electrical contractors of repute in the United Kingdom are members of the Electrical Contractors' Association and other kindred associations, and as such are fully alive to the important part electrical contractors can, and will, take in the development of the electrical industry. Electrical contractors come into daily contact with users, or would-be users, of electricity. They are in constant touch with the requirements of the consumer, and, in the opinion of the writer, are best able to create an increased demand for electrical energy (desired by most supply authorities) which will necessitate an increased distribution of the electrical manufacturers' products.

Up to a few years ago electrical contractors appeared to concentrate more on the practical or technical side of their business; in consequence, sufficient attention was not bestowed on the sales or commercial side. During the last few years electrical contractors (like many other business men) have reorganised the staffs and are better able to successfully cope with a big volume of trade, of which we are all so much in need at the present time.

The Showroom an Assistance.

Electrical contractors must, and will, materially help in the development of the electrical industry by providing, individually or collectively, well-equipped electrical showrooms, with fully-qualified technical assistants in charge, well able to advise consumers or prospective users. In isolated or rural districts, if there should be any difficulty in this matter of showrooms, co-operation with the authority should be sought.

Municipal engineers and supply authorities recognise the impetus the electrical industry has gathered for some years past. They also know that every electrical contractor of repute is an energetic canvasser, and can be relied upon to bring forward increased demands for current. Has it ever occurred to readers of *THE ELECTRICIAN* that most of the electrical contractors who have the development of the electrical industry at heart, by soliciting an order for a new installation and obtaining one, often introduce to the supply authority a new customer from whom they are likely to derive some profit for, it may be, a long period of years, whereas the only remuneration received by the electrical contractor concerned is the small amount of profit derived from putting down the first installation?

The Need for Closer Co-operation.

It will, therefore, be seen that the time has arrived when municipal engineers and supply authorities must work in

co-operation with *bona fide* electrical contractors as one object in view, namely, the development of the electrical industry.

Electrical contractors, like manufacturers in all trades, are fully alive to the necessity of keeping their costs for installation work down to the lowest possible figure, otherwise the progress of the electrical industry will be impeded. The provision of well-equipped showrooms, qualified technical assistants and properly trained canvassers may mean increased overhead charges (often overlooked by certain manufacturers in the electrical industry); but the time has now arrived when it ought to be possible for the electrical manufacturers and the electrical contractors, through their various organisations, to get together to formulate fair trading conditions as between all parties interested. If

only fair-minded representatives (who, I am convinced, are in a majority on the various bodies) from the electrical manufacturers, electrical wholesalers and electrical contractors will meet in joint conference with a view of clearing up any misunderstandings that do undoubtedly exist, then the development of every section of the electrical industry will surpass the most sanguine expectations existing to-day, and the future will be worth looking forward to.

During my year of office as President of the Electrical Contractors' Association I sincerely hope that it may be possible for somebody, say, the Electrical Development Association, to seize an opportunity for convening a meeting at which representatives of every section of the electrical industry will be present to air their views on these points. Nothing but good can result.

The Tendencies of Electric Lighting.

By HAYDN T. HARRISON.

Artificial lighting, like clothing and other modern luxuries, passes through phases or fashions, which change as new means are devised for improving the result. Unfortunately, in artificial lighting there is often a tendency in this country to mix the periods; for example, it is not an uncommon sight to see the tungsten lamp of to-day projecting far below the shades designed for the carbon lamp of the last decade, or the gasfilled lamp in the opalescent globe which was used to diffuse the lower hemispherical rays of the carbon arc.

Such inconsistencies are allowed to continue, due to a lack of cohesion between lamp makers and fittings makers in this country. In America these two industries work together, with the result that the great advances which have been made in the efficiency of electric lamps have benefited both the pockets and the eyesight of the public, whereas in this country, the improved efficiency of the lamps is very often the cause of much discomfort, or is rendered abortive by unsuitable shades and reflectors.

Illuminating engineering, as a profession, has now been in existence for some time, but its influence is rarely noticeable in the domestic life of the country. And even in the case of public buildings, such as churches, etc., many examples still exist of the way in which artificial lighting should not be carried out.

Progress Means More Screening.

The tendency to increase the efficiency of electric lamps by shortening the wave length produced, demands that the actual filament should be screened from the eye, otherwise, its high brilliancy will cause the iris to contract, with the result that the improved illumination is no longer a benefit, and eyestrain results.

If the shades or globes used for this purpose absorb or waste more light than has been gained by improving the efficiency of the lamp, the lamp of lower efficiency and brilliancy would still prove the more economical, but as the public often has a tendency to favour the more brilliant and whiter light source, it is essential that the devices for protecting the eye against injury should be of such a nature that they perform this object without wasting all that has been gained.

Since the days of carbon incandescent lamps the efficiency has been increased ten times. The brilliancy of a carbon lamp was about 300 c.p. per sq. in., that of the gasfilled lamp of to-day is 3 400 c.p. per sq. in.; thus the brilliancy has increased in very much the same proportion as the efficiency.

When it is remembered that the brilliancy of the ordinary candle flame is 3 to 4 c.p. per sq. in., and that many authorities consider this the maximum brilliancy which should be allowed, the importance of shades and reflectors cannot be over-estimated.

Wasted Energy.

Much time and energy have been spent in developing means for overcoming this difficulty, and all sorts of fittings have been devised which, if used, would result in the improvement in lamp efficiency being for the public good; but unfortunately the tendency of those who supply and erect electric light fittings still seems to be to allow their customers to select unsuitable apparatus often on account of the low price, without bringing to their notice the importance of considering the unpleasant and sometimes dangerous result of using such fittings.

Precautions Against Eyestrain.

In the case of factories, workshops, schools, etc., which come under the Home Office inspectors, whose duty it is to look after the health of the workers, precautions are insisted upon to prevent eyestrain which would eventually result in ophthalmic troubles. Unfortunately, private individuals do not appear to have realised that the gradual increase in the power of light sources has led to a stage when such precautions should be taken, but it is to be hoped that those who install electric light will, by constantly reminding their clients of the danger of overlooking these points, eventually educate the public to the importance of care in this direction.

The Conflict of Æstheticism and Illumination.

The chief difficulty appears to be in satisfying the æsthetic sense and, at the same time, to provide sufficient illumination. In cases where appearance is of minor importance, as in workshops, etc., opaque shades which completely screen the light source from the eye are now generally used with most satisfactory results.

In high buildings or rooms where the lamps can be erected well above the line of sight, efficient results are obtained by reflectors which collect the luminous energy and direct it downwards, but in low rooms where the light source is often well within the line of vision, it is becoming a common practice to use bowl fittings which do not allow much of the light energy to pass, but are supposed to reflect a considerable percentage of the ceiling above, which if kept white diffuses it over the room. Such bowls, if made of the right material and kept clean, do give excellent results, but as these conditions are rarely complied with it is not unusual to find that despite the fact that the luminous energy provided by the lamp is more than sufficient, the resulting illumination is so low as to cause complaints which are often justified.

No Need for Inadequate Illumination.

Inadequate illumination, considering the efficiency of the present electric lamps, should be a thing of the past;

numerous tables are published which give the degree of illumination required for various purposes. Fittings makers and the better class of contractors, by careful design and proper lay-out of installations, obtain these degrees of illumination, and are able to prove they do so by the use of portable photometers, the final result being satisfactory.

This satisfaction is not always permanent, as many of the fittings supplied depend for their efficiency on constant cleaning, and on their surroundings reflecting much of the light. It is, therefore, to be hoped that the more modern type of fittings, which are designed to exclude dirt and have self-contained reflectors, will be generally adopted, as these, being easily cleaned, receive that small amount of attention necessary to maintain a degree of efficiency which does not result in the illumination falling below the prescribed limit.

The Importance of Suitable Glassware.

The quality and type of glass used for illuminating ware require careful thought. The supply was much reduced during the war, and the result has been that unsuitable material has been put on the market, but there are indications that more care is now being given in this direction.

In America, where propaganda work relating to illumination is more thoroughly carried out, the diversity of these types of shades is noticeably less, due probably to the fact that there are very few suitable designs and qualities of glass, whereas in this country all sizes, shapes and qualities are used regardless of their suitability or efficiency. This tendency is to be deplored, and it is to be hoped that more consistent propaganda work and careful buying will be the keynote of the future. Shopwindow and other lighting designed to attract the eye of the public has received considerable attention. In this direction the work of the illuminating engineer is often very noticeable, but it is regrettable that the special directive reflectors and other accessories for this purpose are to a large extent imported from abroad.

Public Buildings.

The illumination of public buildings still leaves much to be desired. In the case of new buildings, such as modern picture theatres, the architect sometimes shows a tendency to take advantage of the scientific developments made in illuminating devices; on the other hand, many still appear to think that their work ceases when they have provided a ceiling rose or fitting which will support a lamp of any description with or without a suitable shade.

Streets and Roads.

The lighting of streets and roads has received little attention since the war. New fittings have been devised by which a higher degree of illumination than was ever thought of in 1914 can now be obtained. These consume the same electrical energy as would have been used in the back streets, but apparently municipal authorities have not yet found time to turn their attention to this branch of their duties, and in many cases are still content to allow the streets to remain in the gloomy condition to which the war accustomed the public.

This condition of affairs is the more surprising considering the attention which has been paid by Government and other committees to motor-car head-lights in this country. These committees have failed to formulate any definite regulations, which is not surprising, as the weight of evidence tends to show that the greater safety lies in the driver of a car being able to observe people and obstructions in the road at a considerable distance, thus allowing time to stop or avoid them. If the power and brilliancy of the head-lights are reduced in order to avoid glare, this factor of safety disappears and more accidents are likely to occur. Attempts to keep the level of the beam below the eyes of advancing pedestrians or drivers have not been successful, owing to the irregularity of the road's surface causing

variations in the angle of the beam; the only condition under which powerful head-lights may be safely turned out is when the streets and roads are sufficiently illuminated by other means. This should lead to the municipal authorities improving the public lighting to the extent necessary to be able to enact that powerful head-lights are not used when passing through populated districts; which act would be much appreciated by the public themselves.

The Disappearing Arc Lamp.

The great advance in the efficiency of incandescent electric lamps is tending considerably to reduce the use of arc lamps, high-pressure gas lamps, etc.; in fact, arc lamps are very rarely used for public lighting, except in important streets where the cost of lighting permissible is sufficient to allow of flame-arc lamps being used at short intervals, and erected at a considerable height, as their particular distribution of light demands.

Modern Conditions in Picture Theatres.

Perhaps the most noticeable tendency at the present time is that of the picture theatres to improve both the lighting conditions in the auditorium and the illumination of the screen. It is only lately that these results have been obtained by the application of more scientific means, which result in much higher efficiencies being obtained, and it is probable that moving pictures will shortly be shown even in the large theatres with a pleasant degree of illumination in the auditorium, instead of under the darkened conditions now generally existing. This will reduce the eyestrain, and tend to more hygienic conditions generally.

Improvement in Apparatus.

Continual improvements are being developed in the construction of incandescent electric gas-filled lamps, chiefly with the object of producing small candle-power units, to replace those of the vacuum type. The fact that the larger units are more efficient and the first cost is lower, due to the smaller number of points required, should tend to increase the average candle power of the lamps used, thus rendering the production of these small candle-power units of less importance.

The Neon-filled Lamp.

The latest lamp to be put upon the market, namely, the neon-filled bulb, giving light by gaseous conduction between the electrodes, indicates a tendency which may lead to important developments in future. The scarcity of neon, with its exceptional luminous efficiency, has hitherto restricted developments in this direction, but as it can now be obtained in quantity it is probable that such lamps will become an important factor in the future. Up to the present the only lamp of this type on the market is of very small candle power and low efficiency, but the glowing appearance of the light-giving electrode has led to its adoption for signs and indicators, as the electrode may be formed in any desired shape. The more direct the conversion of electrical to light energy which occurs in this type of lamp would indicate that greater efficiency may be obtained than by transforming the electrical energy into heat, as is done at present in the majority of electric lamps.

It is reported that lamps of this nature have been already produced in laboratories which give considerable light at a high efficiency. Should these be perfected to a commercial stage, they will probably have a low intrinsic brilliancy, thus again modifying the present tendencies of electric lighting by allowing the adoption of unshaded light sources.

The economy of electric lighting compared with other artificial illuminants no longer being a matter of dispute, it only remains to reduce the cost of installation to cause it to be universally adopted. All devices to reduce the cost of installations should receive encouragement from the supply undertakings and the manufacturers of the various accessories and fittings necessary for this purpose. It is in these directions that research must be carried out.

Light as a Selling Agent.

By J. S. DOW.

It is commonly said that "trade follows the flag." It might, with equal truth, be said that trade follows the *light*. Proficiency in the art of using artificial light has been suggested as a very fair criterion of the degree of civilisation attained by a nation.

that the illumination should be shed on the goods by concealed lights, in the same manner as operates on the stage. Fig. 1, which is a view of a well-lighted shop-window shown by Mr. L. M. Tye in the discussion referred to is a good example of such methods.

In this case the effect is enhanced by the contents of the window consisting mainly of light goods. Fig. 2 shows an example that should not be followed. The exposure of powerful arc lamps at a low level, or of naked filaments distributed amongst the contents of the window should be avoided. The glare that arises dazzles the eyes of approaching customers and repels closer inspection, and in these days the mere multiplication of bright lights scarcely forms an attraction. It is much better to rely on a charming display in the window, effectively illuminated by concealed lights, or, if external bright lamps are installed, to soften the glare of these behind some shielding luminous device.

Some Criteria of Illumination.

It is not proposed to enter deeply into the technical problems involved in the arrangement of lights in show-windows. Much depends on the size and shape of the window and the nature of the goods. Windows that are closely packed with small articles arranged quite close to the glass are notoriously difficult to light. A window should contain a few choice articles artistically arranged; it should not attempt to be a catalogue of the contents of the shop. The degrees of brightness naturally depend much on the nature of the surroundings. An illumination of 10 to 30 foot-candles and a consumption of 0.5 to 1.25 W per cubic-ft. of space illuminated are usual.

There are now available many special forms of reflectors designed especially for show-window lighting.

These are familiar in the large stores in London. But it has been remarked that in provincial cities, and in the Colonies the same standard of lighting is not always attained. Properly designed reflectors, as well as modern efficient lamps, constitute "selling agents," and should have a wide scope in many such cases.

Interior Lighting.

While the lighted show-window is primarily a means of attracting customers, the illumination of the interior of the shop is a valuable aid in promoting a purchase when the customer has entered.

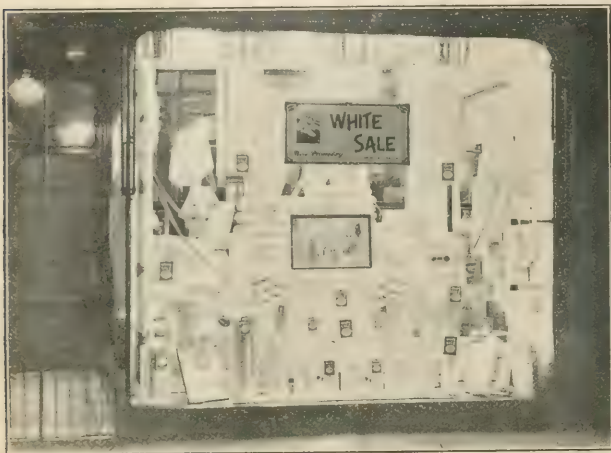


FIG. 1. A GOOD EXAMPLE OF CONCEALED WINDOW-LIGHTING, THE EFFECT BEING ENHANCED BY THE LIGHT-COLOURED GOODS EXHIBITED.

and it is common knowledge that, so far as business carried on after dark is concerned, artificial illumination plays a most important part in attracting custom.

Effective Street Lighting.

One of the most potent aids in this direction is effective street-lighting. Tests conducted in the United States show that the number of persons passing along a well-lighted street is, in general, much greater than along one that is insufficiently lighted. Doubtless a person proposing to purchase at a particular shop would make for it in any case; but the roving crowd of casual purchasers is attracted into the brilliantly-lighted street. The same, of course, applies to shop-window lighting. In one sense the lighting even takes precedence of the contents of the window as an attractive force. For the object of the window may often be only clearly distinguishable at close range, whereas the brightly-lighted window will bring people right across the street. One of the most telling and, in view of the results, the cheapest forms of advertisement is the maintenance of effectively lighted and decorated windows after shopping hours. In recent years abnormal restrictions in the interests of economy naturally hindered such displays; but before the war Harrods and other large stores made a regular practice of leaving a long line of windows so lighted, and this practice is now being resumed. It may be noted that it is not absolutely essential to retain someone on the premises to turn off the lights at a certain time. In America the method of controlling the lighting of the windows by an automatic clock-switch is used.

The effectiveness of show-window displays was illustrated by a legal point that arose in 1910, when certain shopkeepers in London were summoned on account of the crowds that assembled round their windows. These crowds were held to constitute an interference with traffic. It is a debatable point whether the mere exhibition of some curious effect that draws a crowd of casual sightseers is beneficial to trade. The merchant does not want a waiting crowd, but one that is continually moving and, during business hours, furnishing a fair proportion of customers. In the case of a series of attractively lighted shop-windows the effect is usually to divert the attention of the stream of people passing by without causing them to congregate in a dense mass. This is probably what is desired after business hours with a view to paving the way for prospective custom.

The Technical Aspects of Shop-window Lighting.

The technical aspects of shop-window lighting have been much discussed in recent years, notably at a meeting of the Illuminating Engineering Society, held in February of this year. It is now accepted as a fundamental principle of the best window-lighting



FIG. 2. AN EXAMPLE OF INCORRECT METHODS OF WINDOW LIGHTING. THE NAKED FILAMENT LAMPS DISTRIBUTED AMONG CONTENTS OF WINDOW, AND THE ARC LAMPS HUNG AT AN UNDESIRABLY LOW LEVEL CAUSE INCONVENIENT GLARE.

It is common knowledge that a badly-lighted and sombre interior is bad for trade. Inadequate lighting leads to mistakes and inattention, and to spoiled material, besides leaving a depressing effect on the mind of the customer. The aim in a modern store is naturally to make the interior as bright and cheerful as possible, so that potential customers regard a visit as a pleasure, and are

reluctant to cut it short. So far as the technicalities of interior shop-lighting are concerned there are now many forms of ornamental fittings which are eminently suited for this work. The most popular are probably those which employ semi-indirect lighting, and various pleasing types of moulded bowls have been designed. Opportunities also occur for the concealed lighting of cabinets,

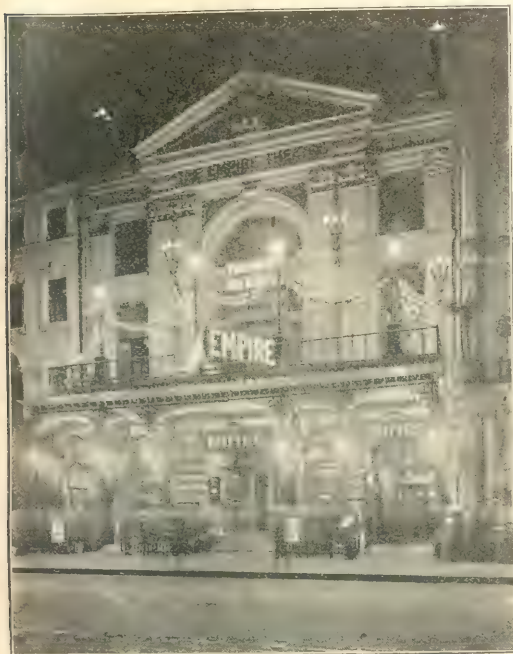


FIG. 3.—SPECTACULAR LIGHTING IN LEICESTER SQUARE, ILLUSTRATING THE USE OF LIGHT IN ATTRACTING ATTENTION TO ENTERTAINMENTS.

containing costly and pleasing objects. Another special opportunity for the using of light as a selling agent occurs in the illumination of coloured objects by means of the new "artificial daylight" units, which are designed to give correct rendering of colours. Most of these utilise a special tinted glass screens in conjunction with a gasfilled lamp; the Sheringham daylight unit, however, achieves the imitation of daylight by reflection of light from a specially coloured reflector.

Advertising Places of Entertainment.

The primary object of show-window lighting, that of attracting custom, also applies to the spectacular lighting of the outsides of places of entertainment. In Fig. 3 is shown a typical view in Leicester Square illustrating the use of light in this way. Here, again, the tendency in many instances has been towards the indiscriminate use of powerful lamps, making a blaze of light. Such methods are so common, however, that in the theatre districts a mere display of light does not have the attractive effect that it formerly had. There is, therefore, room for originality of effort either by the bold use of special colour-harmonies or novel lighting effects, or by the choice of illuminated signs and transparencies which compel attention for their subject-matter as well as their luminous appearance. Fig. 4 shows a novel effort in this direction formerly used outside a cinema theatre. The arch was outlined with a Moore tube and the name of the theatre "written" by means of a luminous Neon tube, the vivid orange hue of which naturally attracted attention. The Moore tube has made little headway in this country, but the simpler Neon tube is likely to be more seen in the near future, and forms an effective contrast with the green light of mercury vapour lamps. The full use of such methods demands very careful design of the architectural features of the building. The idea of combining a special design of the frontage with the judicious use of concealed lights of various colours has been little explored as yet. A pleasing instance of this was formerly to be seen at the Gaiety Theatre in London, where mercury vapour lamps were concealed behind pillars in the upper corridor illuminating their surroundings, but themselves invisible.

Exhibition Lighting.

The old idea of outlining buildings in small incandescent lamps, so familiar at exhibitions and in special lighting at times of festivity, still persists, but is now regarded as a crude device. Exhibition-lighting, in particular, offers a great field for originality in lighting, and is perhaps as good an instance as any of the use of light as a selling agent. The most remarkable effort in this field in recent times was doubtless the Panama-Pacific Exhibition at San Francisco in 1915. Remarkable colour-combinations, chiefly involving the use of concealed lighting to illuminate the exteriors of the exhibition buildings, were produced. In the United States the use of flood-lighting, *i.e.*, the lighting of large surfaces from a distance by means of searchlight beams, has made great strides, and will doubtless be more heard of in this country. One of the first familiar examples was the illumination in this way of the Singer tower in New York. The sky-scrapers familiar in American cities doubtless are particularly amenable to such treatment, but flood-lighting might often be used with advantage in this country. The idea is to utilise the light to make a particular building or name familiar, and is similar in principle to the illuminated sign.

The Field of the Illuminated Sign.

The illuminated sign now assumes many varied forms, some of which were illustrated and described at the meeting of the Illuminating Engineering Society mentioned previously. The variety first developed, which has found use on a very large scale in the United States, is the ordinary sign with letters or devices outlined in incandescent lamps, commonly extinguished at regular intervals by some automatic flashing device. Such signs have an undeniable advertising value, but, if injudiciously used, may prove a disfigurement. In some cases they have been designed to startle rather than to attract. An unpleasant after-impression should be carefully guarded against. The design of letter-signs requires more care than is generally assumed. The consumption involved in a large sign may be considerable, and on grounds of economy



FIG. 4.—ANOTHER MODE OF SPECTACULAR LIGHTING BY LUMINOUS TUBES, OUTLINING THE ARCH AND INDICATING THE NAME OF THE CINEMA IN RUNNING LETTERS. THE UNUSUAL COLOUR OF THE LIGHT IS AN AID IN ATTRACTING ATTENTION.

one naturally prefers to choose lamps of relatively low candlepower. Spacing of lamps needs care to prevent confusion at a distance. Trough letters have been used to prevent reading of the sign from an oblique angle becoming difficult. The modern tendency is towards the use of lamps of somewhat higher candlepower, 20 to 25 W in place of 10 W lamps. Frosting the lamps is sometimes

are provided with a view to softening the light, but such lamps are apt to become somewhat rapidly coated with grime. A white background to the lamps has also a diffusing effect. Maintenance is a particularly important factor; blank spaces owing to failure of lamps or uneven spelling out of a word create a disagreeable impression. Many highly ingenious moving signs, *e.g.*, those in which a figure goes through a prescribed cycle of operations, owing to the appropriate lighting up and extinction of certain lamps, have been devised. It is clear, however, that in the course of time even this type of sign becomes familiar and its advertising value diminishes.

Modern Picture Signs.

An alternative to flood lighting signs is to illuminate a translucent pictorial sign from behind. Some striking



FIG. 5.—A GOOD IDEA OF THE SPECTACULAR EFFECT OF ILLUMINATED PICTORIAL SIGNS. MUCH MORE EFFECTIVE CONTRAST IS OBTAINED BY LIGHTING FROM BEHIND THAN BY ORDINARY FRONT LIGHTING.

examples of this form of sign have been exhibited by Mr. Leachman before the Illuminating Engineering Society, of which Fig. 5 is an example. As the illustration suggests, one can get more effective contrasts by this means (just as a lantern slide is, in general, more effective than a photographic print). The choice of pigments is an important factor, but it is stated that colouring materials



FIG. 6.—THE "INTERNAITE SIGN," IN WHICH LIGHT FROM CONCEALED TUBULAR LAMPS ILLUMINATES THE INTERIOR OF A PLATE OF GLASS, ON THE BACK OF WHICH LETTERING IS ENGRAVED.

which show the necessary richness and translucency, and yet are also effective when seen by daylight, are now available. This type of sign naturally lends itself well to artistic treatment. The

first cost of preparing a special picture is naturally somewhat high, but in many cases, *e.g.*, in advertising cinema artists and films outside theatres, suitable pictures can be rented. A feature of the sign is the readiness with which any picture can be changed and the interchangeability of all the parts.

Smaller Signs for Advertising.

The signs referred to above are of a type suitable for giving information to a large and distant audience. But the number of smaller signs for advertising purposes or conveying information is legion. The ordinary box-sign is familiar and has been widely used on the underground railways, but a form of sign recently described by Mr. E. T. Ruthven Murray has novel features. This sign, which is illustrated in Fig. 6, uses a concealed tubular lamp placed at the upper edge of a glass plate, on which any appropriate lettering can be stencilled at the back. The light passes into the interior of the glass plate, where it undergoes total internal reflection, with the result that the stencilled lettering appears brilliantly illuminated, but floating on a transparent background.

The writer has recently had an opportunity of witnessing several new developments in this sign that deserve mention. By leaving a space open along the length of the tubular lamps at the back, surplus light can be used to illuminate the contents of a shop window, the area illuminated being controlled by a folding shutter. Letters can be executed in colour or gold, or white letters may be given a distinctive tint or a combination of colours by means of appropriately tinted strips of glass inserted below the lamps. In the latest models, operated by flashers, a series of successive colour effects in great variety can be produced, thus calling attention to the lettering without any unduly abrupt or startling impression. Although hitherto used mainly to illuminate script it is understood that the basic principle of the sign can be applied to coloured pictures stencilled on the back of the glass, very vivid and brilliant colouring being thus secured.

Technical Interest Must not be Stressed.

The problems met with in this class of sign illustrate one danger that needs to be guarded against—*i.e.*, that the public may be so impressed by the technical interest or peculiar working of a sign as to overlook the actual object advertised! This is probably best avoided by arranging that any changing device is closely associated with the lettering or picture so that the eye cannot fail to read the message which it is sought to convey.

Such a sign can be used either for advertising purposes or as a means of affording information. The latter function of a sign, as illustrated by the familiar Underground Railway map in Fig. 7, perhaps hardly falls within the scope of the use of light as a selling agent. The fundamental idea is to afford information. Yet the notice that it attracts indirectly acts as an advertisement, and the frequent use of such signs outside Underground stations has perhaps done as much to draw attention to the travelling facilities on the tubes as any other form of publicity.

The Need of Common Understanding.

Finally, attention may be drawn to one important aspect of the use of light as an aid to publicity, *i.e.*, the need for some common understanding between those who wish to advertise their goods. It has often been remarked that one great difficulty in inducing shopkeepers to discard the use of masses of bare lamps is the fear that if they do so, their display may be "killed" by the excessive brilliancy adopted by a neighbour. Much the same applies to illuminated signs. A really effective and tasteful device may be rendered inconspicuous by the presence of a much larger and more brilliant device next door. There is also a distinction between a shop-window and a place of entertainment. The merchant necessarily uses his window to show what he actually has for sale, whereas an entertainer may adopt some form of device to attract attention, which is more or less independent of the nature of his show. It has been suggested that advisory committees consisting of prominent tradesmen working in co-operation with the local authority should be formed to regularise display-lighting. In the case of an exhibition the opportunity for this form of co-operation is evident, and some simple general regulations which would be equally to the benefit of exhibitors and the public could easily be framed. Light wisely used can act as a very effective salesman; unfortunately if used indiscriminately and without guidance it may actually have a deterrent effect on trade. Hence the need for restraint in arranging lighting displays, and for care in the selection of lighting fittings properly adapted to the end in view.

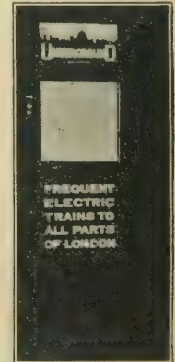


FIG. 7.—TYPICAL MAP SIGN EXHIBITED OUTSIDE UNDERGROUND STATIONS IN LONDON.

A DELICATE CONTRAST.

A Comparison of British and American Business Methods.

By ALAN SULLIVAN.

The characteristics of a city, of clothes, manners or any other method of self-expression, are a matter of national temperament, plus certain factors of time, location, climate, and physical surroundings. This applies directly to any comparison between affairs electrical in England and America.

The popular British idea of the industry in the United States might be pictured in the person of a tall, lean, lantern-jawed individual who has a cigar in one corner of his mouth and talks with the other, while in his right hand is balanced a million dollars, and in the left a hundred million kilowatts. Looking this way across the pond, the American is apt to perceive an elderly gentleman in a frock coat of the vintage of '98, who is ready to devote a week to selling an electric iron (which he does not use in his own house), and conducts all negotiations in the measured accents of an undertaker. And this is what a lot of people think.

To arrive immediately at the main differences, it is necessary to jump. Therefore, let us jump; and, as a matter of courtesy, put the American first.

A Vast Mechanical Appetite.

Perhaps the most vital point of difference is the Westerner's vast mechanical appetite. He is a good deal of a mechanic himself, but—as a general thing—he doesn't like work, and invents countless automatic machines to do it for him. He has a great respect for the inventor. He absorbs new appliances and applications of energy as rapidly as they are turned out. He is not prone to ask how strongly they are built or how long they will last, but, rather, will they satisfy the mechanical need of the moment. And he likes repairing them himself.

He is, as well, mechanically impatient. He wants the last thing out, and is ready to discard his present possession for that which is more up to date. He demands that it be attractive and decorative, and he has a fairly large private scrap-heap.

The 10-Ton Toaster!

In Britain the path is more difficult. There are traditions to overcome. There is no particular mechanical appetite. The idea of investment is more prominent. And—my blood be on my own head—the product is not always so attractive. It is made to last; and, God knows, the stuff is there; but is it necessary to design a toaster like a ten ton crane? Would not the lighter touch and the decorative idea help a little? Would they not stimulate in the potential customer the desire to possess, not only for utilitarian reasons, but also because the thing itself was of suggestive and tempting design.

The Obstacle of Tradition.

Mention is made of tradition. The Westerner hasn't any. It's more than possible that he came west to get rid of it. An American woman wrote the other day that Oxford just quivers with culture. If Britain did any quivering at all—which she doesn't—it would be with tradition. It is difficult for the masses to think of doing the same old thing in any but the same old way. Even the electrical salesman must, first of all, divest himself of tradition, which is the price and, to a certain degree, the penalty of living on an island where there is no racial intermingling. Consequently, it seems that a good method of approaching the people one wishes to influence would be the obverse to that successfully used overseas. By this I mean the cultivation of a human dissatisfaction with time-honoured customs and habits.

No Feminine Resignation in America.

Another point. In America there is nothing to parallel that feminine resignation with regard to work, which—amongst the masses—is so characteristic of Britain. Millions

of women in this country accept drudgery in so unquestioning a spirit as to make one think they would consider the lack of it something immoral. It is this ceaseless pouring out of life and health and strength, which might be nationally so much better employed, that gives the electrical industry in Britain such a notable opportunity or service. The American woman would not have it, even if the man of the house allowed it—which he wouldn't. I don't know what proportion of the family budget is spent in Britain by the woman; but across the pond it's about ninety per cent., and probably more since prohibition. Here the percentage is, no doubt, lower. But whatever it may be, general observation confirms the belief that when a woman wants a thing—obviously, firmly and continuously—she generally gets it. Does this suggest where the seed of rational dissatisfaction may most wisely be sown?

Quivering with Enthusiasm.

If Oxford quivers with culture, the American electrical representative quivers with enthusiasm. This is partly racial, partly climatic, and due in part to a very real belief in his job. It is also infectious. The country is young and responsive. So is he. And yet it would not be possible for him to apply American methods in Britain with any success. He has not the experience gained by jolting against an immobile human wall. He has not—because he doesn't need it—that peculiar kind of conservatism which finally overcomes conservatism. He does not study the business ground, the method of approach, and other relative factors in the British way; because, owing to the complexion of the public, that isn't necessary either.

Enthusiasm, however, takes varied forms. It is difficult of cultivation in the mind of a man who is secretly disillusioned of his one-time dreams and disappointed in the attitude of the public toward the modern miracle in which he himself firmly and justly believes. And should this article meet the eye of some fellow-believer in the most valuable method of the application of energy, who is down in the mouth because he thinks—only thinks—this country is behind America in electrical progress, I would like to assure him that, considering the clientele to be dealt with, Britain has more than held her own, and that whereas in London there are central stations, a third of whose output is used for cooking, I do not know of a single case in America where this claim can be made. Broadly speaking in Britain it is necessary to batter down before one builds up, while in America the ground is clear and ready.

Power houses of vast size and capacity are magnificent creations, but they may not be as profitable, in proportion, as those of a tenth their magnitude. Furthermore, the risk of interruption to service is a matter of indirect ratio to the number of stations supplying it. Imagine what would have happened in New York had a Zeppelin bomb dropped on the Edison power house!

Municipal Trading Extraordinary.

Municipal ownership has done better in Britain than it has overseas. By "better," I mean it has been a cleaner game than, say, in Canada, where publicly-owned organisations—which were liable, of course, for neither rates, taxes, nor dividends—went into open competition with privately chartered operating companies, the latter being taxed to find funds for their rivals. It was—and is—a curious case of the body politic taking a course of action that would not have been countenanced in the individual.

How the American Advertises.

Electrical advertising in America is, it will be admitted, extremely good. It is also lavish. It is saturated with a spirit that expresses the advertiser's confidence in his product. It gets home—at any rate to the American. It is followed up by innumerable aids to business; such as striking

showcards, readable folders and booklets, monthly bulletins and house organs, *i.e.*, magazines—well got up and illustrated, which interest the reader without betraying the too obvious desire to convert him into a customer. The printed page is a power, and the favourable opinion of the man in the street is earnestly sought, whether he develop into a customer or not.

This is a point which, it seems, the electrical Britisher may reasonably consider. The best American undertakings want to be fairly and interestingly interpreted to the public. They want the public to know what is involved in giving them service. They believe in the drama of business, and that that drama has definitely communicable value.

An Oblique Fractional Method.

Sharpen the argument with a parallel. The first-class illustrator of to-day is master of what is called the oblique method of work. If, for instance, he is depicting Brown's murder of Smith, the drawing will probably show a door open a few inches, a section of Brown's agitated face, a wreath of smoke curling from a fractionally visible revolver and one of the feet of the prostrate Smith. But there will not be any lurid picture of Brown standing over his victim's body. The story will have been told without that; completely, and what is far better—suggestively.

The oblique method of advertising should, if carefully and consistently followed, be of great benefit to the electrical industry in Britain. It is a purely psychological process, by means of which there is built up in the mind of the reader a subconscious opinion favourable to yourself and your undertaking.

The Need of Lower Costs.

Another point which invites comparison is that of cost. It would be outside the purpose of this article to dig into the factors that make up cost, but it does appear that until present costs—whether for wiring, utensils, or general equipment—are considerably reduced, the road of electrical progress will continue to be somewhat arduous. One is aware that journalists rush in where angels fear to tread, but it seems to me that until the industry puts more into the day, it won't take any more out. Taking the bit a little more firmly between my teeth—the industry, at large, strikes one as lacking something that is—well—electrical. There is very little in the daily press about it. The reason possibly is, that the press is waiting for the industry to talk first.

It is written that "the meek shall inherit the earth." But not this earth.

The Burglar-Proof Electric Range.

Why not reduce cost? Why should a toaster made near Chicago sell for less than one made in London? Why design an electric range on the lines of a burglar-proof safety deposit vault? Why not use a little less stuff, and spend the saving in telling the public that one has made the thing for their particular use? God forbid that honest workmanship and the proper usage of material be slighted; but, both went into the Pyramids—and Pyramids have been out of date for some time.

Any man who is, technically speaking, fairly well informed can prophesy with reasonable accuracy the degree to which the public will be electrically saturated in, say, twenty years. He will also admit—if he is rational—that this degree will be measured by the activity of the industry itself. Across the pond they have determined that this saturation shall be the human limit. They are working, planning, building and dreaming for it. And with a total lack of modesty they are going more than half way to meet it. The thing may be overdone here and there, but, if it is, a sublime confidence in the ultimate goal will surmount the difficulty.

A Life Drama in Business.

The Britisher, on the other hand, though he has as much inherent confidence, is apt to self-contain it, and that which is self-contained will never energeise others. The man who cozes business at every conversational pore is sometimes an

infernal nuisance, even though he impresses you—at the cost of your regard—with the fact that he is keen on his job. But the job may, on the other hand, animate one's conscious existence without making one an infernal nuisance. The American finds his life drama in his business, especially the electrical American, and plays it up to the last curtain. It may be that he plays it too long; but he is very much in earnest. I wonder if as many slices of British bread would find their way to American toasters if the Britisher found more drama in his job.

Electrical Peaceful Penetration.

By H. T. YOUNG.

Far more can be done to bring about a greater demand for electricity by indirect advertising than might be imagined. Editors of periodicals and newspapers are continuously on the look-out for articles on matters of interest to their readers. Most people use electricity to-day, therefore it is not difficult to interest them on electrical subjects connected with their homes, business or profession as long as the matter bears no appearance of advertisement. In consequence, editors welcome articles from the pens of people of experience. Photographs also are necessary, and they add to the interest and value by at least 50 per cent. if they bear no trade name.

A great deal can be done to assist this form of advertising by everyone connected with the electrical industry. The ordinary commercial and professional man has very little time himself to devote to writing for papers, but he can do a lot of good by introducing his friends who are interested in periodicals and daily papers and journalistic work to the Electrical Development Association. They can then be furnished with useful matter on electricity as applied to the requirements of the particular class of people to whom their paper appeals. For this both the editor of the paper and the reader will be grateful, and the electrical industry will derive great benefit.

The Psychology of Editors.

It may be argued by some that all the papers should be approached by the Electrical Development Association, but those who know a little about the psychology of editors will realise this method would be less effective than the other. As a matter of fact, I have been approached by editors on electrical matters, and have made a useful advertisement out of it for electricity in general and have occasionally received useful and unexpected cheques for my trouble. Periodicals connected with architecture, general engineering, hotels, furnishing, cold storage, brewing, farming, etc., are all useful; in fact, there is something electrical to interest every editor and every reader, and there are hundreds of papers and millions of readers.

There are, of course, other methods of advertising indirectly to which supply authorities should give their careful attention. They should make friends with medical men and architects. This could be done by supplying these people with very cheap current for lighting, heating and general domestic purposes. Encourage, for instance, the doctor to use an electric fire in his waiting and consulting rooms. I would say make him do this by suitable propaganda work and by heating his room electrically at half the cost of gas or coal. It is a fact that nearly every doctor uses gas heating to-day. Why is it? Solely because the gas company is using him as an advertisement.

The same applies to architects, for people generally take considerable notice of the way in which these professional men light, heat, cook and carry out the domestic arrangements of their houses.

The retailer of electrical goods should also be allowed to use current for lighting and heating at specially low rates, and encouraged to consume more and more for the purpose of advertising.

By the use of all these and other indirect methods, combined with discreet direct advertising, every branch of our industry would derive enormous benefits.

ELECTRICAL ADVERTISING.

Signs of Improvement.

By S. M. HILLS.

There are evident signs that the opinions of the manufacturer of engineering appliances on publicity are undergoing a change. The time is not far back when advertising in trade and technical journals was looked upon as a means of subsidising the paper, an expense that had to be borne for the privilege of having a trade organ. It was not surprising, therefore, that but little trouble was bestowed upon the preparation of the matter that was to form the



FIG. 1.—THE TRADE CARD TYPE OF ANNOUNCEMENT THAT MERELY SERVES AS A REMINDER.

advertisement, and the expenditure of an annual sum on advertising was entrusted to a bookkeeper. Gradually a better sense of judgment prevailed, a higher standard was set by one or two firms, until now a number of companies really devote to the matter the serious attention that is required if an advertising campaign is to be of value. A comparison between a copy of *THE ELECTRICIAN* for, say, 1907 and the present issue will readily reveal the improvement that has taken place in the advertisers' announcements. There is, however, room for further improvement. There still exist old-time specimens of advertising which indicate a waste of expenditure on good white space, a waste of time in setting up and a waste of ink in printing. These announcements do not arouse interest, neither do they create any desire to purchase; they virtually amount to a poorly designed trade card—"Smith and Sons, makers and suppliers of motors, lamps, fittings, &c. Write for prices." All that such advertisements do is to impress a certain number of people with the fact that there is such a firm as Smith and Sons. Such an achievement, of course, has a certain value, but greater value could be obtained by devoting the requisite thought and attention to writing interesting copy and making an attractive lay-out.

Preliminary Considerations.

Before any advertisement is written the goods and the market should be carefully surveyed. The points in favour of the product should be noted down and compared with the advantages of competitive goods. The difference between the goods and competitive lines gives an indication of the lines on which the copy of the advertisement can be based. It may be price, quality, design, durability, delivery, standard parts, or some special patented feature, or all of these. Generally speaking, it is either a very ordinary or very poor product which possesses no features peculiar to itself. Having compared the article with competitive articles, the next step is to consider the field of sale. Where could the goods be sold? Are there any fields where it is considered sales could be developed to better advantage than at present? If so, what reasons have prevented such development up to now? Why should the goods sell in these fields? This form of analysis helps in the selection of advertising media, and forms another guide to the type of appeal that should be made.

The Necessity for Forethought.

This form of forethought before preparing an advertisement is just as necessary as the work that is done by a lawyer before going into court to defend or prosecute on behalf of a client. It is these considerations that are tanta-

mount to the careful plans that are made by a commander before going into battle. An advertisement is the first line of attack; it has to open up a way for the sales force to get through and penetrate the defences of the buyer. To do this the whole announcement must first be attractive. A mass of heavy black type is not likely to attract. It is ugly in appearance, and it is against the laws of nature for that which is ugly to attract. The use of a number of heavy lines of type merely results in each line being in competition with the next. No particular line stands out to attract attention. It may be likened to a choir singing together—no particular voice is dominant. Take one line, however, as a headline, put that in heavier type than the rest, you have the effect of a tenor solo. Your analysis of the product and its market should provide a key to what will constitute a headline. It should provide some dominant points that can be dwelt upon, and which themselves attract interest.

The Importance of Good Copy.

Illustrations will perhaps make these points more clear. The advertisement of Clay Cross Company, Ltd. (Fig. 1), does nothing beyond informing readers that this company make fuel economisers. Have they nothing to say in favour of these products? Are there no advantages in their designs?

Jonas and Colver, Ltd., open their advertisement (Fig. 2) with a headline that has news value. "Tufcor"—a



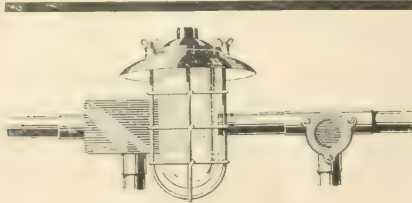
FIG. 2.—A WELL LAID OUT ADVERTISEMENT THAT HAS A HEADLINE POSSESSING NEWS VALUE AND COPY THAT IS INFORMATIVE AND CONVINCING. THE SPECIALLY DRAWN NAMEPLATE GIVES DISTINCTION TO THE ANNOUNCEMENT.

special non-alloy case-hardening steel." Novelty always attracts, and the reader interested in steel of this character will naturally go further and read the copy. Here we find copy of a restrained character that is not wildly assertive. In plain, simple words we are told what the new steel is

what purpose it has been produced. Advertising space being limited, an offer is made to send further particulars on request. As the reproduction of the advertisement will probably be small, the copy is printed here:

It is our object, specially, and as the outcome of much work, to ask in our advertisements. It gives us the benefit of good impact tests, and is unrivalled for parts which call for hard surfaces and shock-resisting qualities. Results of tests and data on treatment on request. As specialists we shall be pleased to advise you on any steel problem.

They could have boldly said: "Tufcor" steel is unrivalled," or have gone a little further and said: "Tufcor" steel is unrivalled for parts which call for hard surfaces and shock-resisting properties," but the effect



SIMPLEX CONDUITS

For a complete list of the various Simplex Conduits, L.T. Standard, and other types, see the Simplex Conduit Catalogue, which is sent on request. It gives full details of the various types of conduits, and the conditions under which they are used. It also gives full details of the various types of fittings, and the conditions under which they are used. It is a most valuable reference work for all those concerned with the use of Simplex Conduits.

Install Simplex throughout, always & everywhere

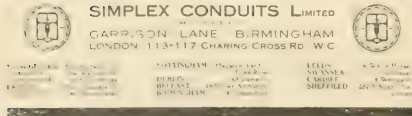


FIG. 1. For objects such as this, a line drawing provides a very effective means of advertisement. Clean, bold, and attractive, it permits more originality of treatment than can be obtained by means of a photograph.

would not have been nearly so good. In sixty-eight words they have clearly and precisely stated the main properties of the product, implied the care and thought that has been bestowed on its production and created a desire for further information. That is the essence of good advertising—attract attention, secure interest, create desire.

Writing Copy.

The skill required in writing advertisement copy is the skill required in all good writing—that is, the skill to make clear, direct, simple statements which can be understood by the humblest reader and which ring true. The highly embellished, over-assertive type of copy rarely appeals to the educated person, because it does not ring true in the way that a plain, straightforward statement of facts does. Had Messrs. Jonas and Colver said:

"Tufcor" steel is the most epoch-making discovery since the days of Bessemer. Years of study and research, costing hundreds of thousands of pounds, have been devoted to the invention of this product. "Tufcor" steel outclasses all other steels for use in the production of parts which have to withstand huge shocks"—the average trade reader would have smiled and left the matter there. He would not have been induced to send for a booklet or further information, because the claims made were over-assertive and did not ring true. In attracting custom to a circus

such assertive claims often prove successful, but where a public has to be appealed to that is in the habit of thinking for themselves such methods spell failure. The copy-writer must always consider the type of buyer that is to be appealed to, and base the appeal accordingly. Having determined the line of appeal and written the copy, the next stage is the preparation of the lay-out or the design for the advertisement.

Making the Lay-out.

Here comes the second chance of attracting attention. The first chance occurred in the selection of the headline. The lay-out, according to how it is prepared, can help or prevent that headline gaining attention. A crowded lay-out will subdue the effect of the headline. White space is what you buy from the paper; in a sense it represents a piece of land on which you can build a house. If the house covers the whole of the land you have no garden. What is the value of a house without a garden? The garden sets off the house, and white space sets off the advertiser's announcement. A well-known advertiser of paper says in a slogan: "White space is part of the picture." By the judicious use of white space and attractive illustration a quarter-page announcement can often be made to dominate the whole page on which it appears. Emphasis in the form of black letters or caps should be used sparingly, otherwise competition results and no part stands out for attention. Insetting the paragraphs of the copy will often add attraction to the lay-out and help the headline to be effective. Borders should be considered with great care. A heavy black border may be suitable for a memorial announcement, but it kills an advertisement. The border must not compete for attention. It is an aid to the whole, not a base for the whole. Think of your announcement as a picture. Would you select a heavy Victorian gold frame for a delicate etching, or would you employ a neat, small frame and a good wide, white mount? Of course you would choose the latter, therefore apply the same principle to an advertisement. Study the advertising pages of a journal yourself, and you will notice that those advertisements which prove most attractive to the eye, which look most readable, are the ones in which adequate white space has been left, in which the types chosen are dignified and not too heavy, and in which the border is quietly effective but unobtrusive.

Alteration and Revision.

By altering and revising lay-outs an atmosphere of freshness can be given to advertisements similar to repapering a room. To be successful advertising must be studied continuously. It is not sufficient to obtain or prepare, say, six good advertisements and then use them for ever and ever. Advertisements must be changed to remain interesting. You have to attract readers. No one continuously reads one book, unless it be the Bible. New headlines, new lay-outs, new copy, new illustrations are continually required if full value is to be obtained for the money expended on advertising space.

Advertising Must be Continuous.

Continuity is also necessary. It is no good having one splash. To be successful advertising must be continuous. The man who has one advertisement and does not go on is like the man who takes out a life insurance policy and allows the policy to lapse after paying one premium. He wastes his money. In addition to continuity of the appearance of advertisements, continuity of style can be obtained by employing a standard design of name-plate, or by always using a standard trade mark or house mark somewhere in the lay-out. A well-designed name-plate will form a miniature advertisement in itself. It will stand out and attract the attention of the casual reader, and, therefore, serve the purpose of a trade card advertisement within the larger advertisement by impressing the name of the firm on the reader's mind. An effect is then made upon the mind of the casual glancer as well as upon the person who studies the announcement.

In many advertisements it is advisable to go beyond the employment of printers' type and a border, and to employ a suitable illustration. An illustration often proves as great an attraction as a clever headline.

Selecting the Illustration.

The selection of a suitable illustration varies greatly with the type of subject to be dealt with. In the early days it was almost general to employ half-tone blocks made from photographs of the article itself. At the first sight this seems to be the cheapest and most straightforward method, but quite often the conditions for photographing the object were far from ideal and, consequently, expensive retouching had to be resorted to. As an alternative there is the method of employing a line drawing or black and white illustration—a method which gives a wide scope to a competent designer to produce effective and original designs. Emphasis can with this method be readily placed where desired. Too few trade advertisers realise the scope that exists for the use of black and white illustrations and designs for advertisements. Many electrical articles, such as lamps, irons, kettles, toasters, lamp-shades (both silk and glass), can with advantage be illustrated by means of this process. What the artist terms "atmosphere" can often be introduced and the drawing made to suggest quality, finish, style, tone, &c., far more readily than can be done by photographic means. The arguments in favour of the half-tone or photographic process are that the camera faithfully reproduces all details and places before the reader an exact reproduction of the article as it appeared. It is remarkable, however, how a retoucher can often largely change the appearance of the photograph, and thereby the faithfulness of the photographic reproduction is reduced.

The Quality of Paper Important.

Another consideration to be taken into account is the type or kind of paper on which the journal is printed in which the advertisement is to appear. Line work should preferably be employed where rough or coarse paper is used. Half-tone blocks require a smooth surface, art or imitation art paper. In many cases it is of value to introduce action into the illustration to suggest an atmosphere of the article in question being in use. This atmosphere of action always arouses interest, and thereby gains a certain amount of added attention. Also the "action" type of illustration tends to be unusual and different from its neighbours, and an effective illustration provides a means of getting out of the rut of conventionality. The attention of a reader who is not looking for anything particular has got to be aroused, and good designs and illustrations strikingly produced will provide that attraction of the unusual which arrests the glance of the casual reader.

Co-operation with the Sales Department.

Sufficient has been said to indicate that there is more in the production of a good advertisement than meets the eye, and that it is not a task which should be attached as an extra duty to a draughtsman or book-keeper. Small firms, and for that matter large firms, can obtain expert assistance in the production of the advertising, and, generally speaking, would be well advised to do so. The large firm often employs an advertising manager as a permanent member of their staff, and then, strange to say, limit him to the production of advertisements, catalogues, leaflets, &c., not realising that advertising is a form of selling. He is left unsupported and in glorious isolation to go ahead as best he can. Co-operation of a most intimate kind should always exist between those responsible for the advertising and those responsible for sales. The publicity man should be informed where sales are poor and where they are good, what lines are overstocked and which lines are unprofitable to push. It is only by working together that the best value can be obtained out of the expenditure made on publicity. Advertising is really selling by means of the

printed word, and it is therefore essential that cordial co-operation takes place between the verbal and the literary selling staff. Travellers and branch managers' conferences will often provide the means of giving the advertising manager new points of view and an indication of the type of appeal most likely to attract the attention of buyers.

The Creation of Goodwill.

In addition to the actual sale of specific goods, publicity can be employed to create goodwill, to define a policy of a firm, to create an atmosphere of service. During the war publicity helped to create an army, to raise loans, to obtain munition workers, &c. The larger a firm becomes the more difficult it is found to keep all customers satisfied; yet, generally speaking, customers are reasonable people. Publicity can often be employed to cement the goodwill of customers, to explain the difficulties experienced in trying to serve all well. Had the Post Office employed publicity on similar lines to the American telephone companies the probability is that there would be much less grumbling than exists to-day.

An Appeal for a Wider View-point.

The trade advertiser would often be well advised to remember that he has not only to sell his goods to the retailer or the factor, but also to the ultimate buyer. It is to the producer's advantage to create a demand which

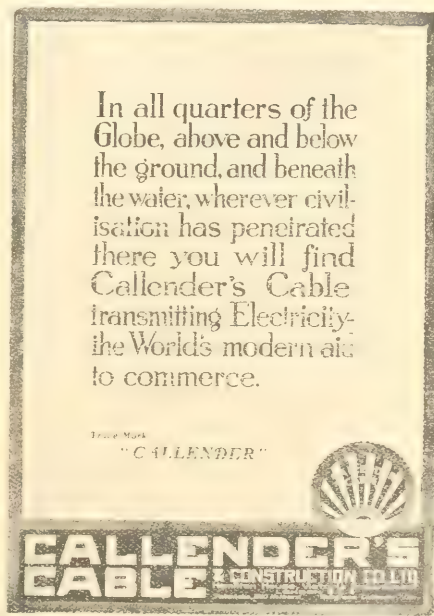


FIG. 4.—A PURELY ATMOSPHERIC TYPE OF ADVERTISEMENT MENTIONING NO PARTICULAR TYPE OF CABLE, BUT INDICATING THE LARGE SCOPE OF THE ADVERTISER'S BUSINESS. THE CLEAN LAYOUT, DISTINCTIVE AND EFFICIENT HAND-LETTERED COPY MATTER, GIVE TONE AND STYLE TO THIS ANNOUNCEMENT.

the retailer will meet by the sale of the producer's goods. Publicity should, therefore, go beyond appealing to the retailer or factor only. Electricity and electrical goods are ultimately used by the public, and if the industry is to progress as the merits of the product warrants, then the public must be told about the merits of electric light and power, as well as about the merits of a particular lamp, cable, or motor. A longer and broader view is required in the industry to-day. All have got to contribute toward the cost of selling to the public that in the end all in the

Electrical industry may benefit. To wait for all to start contributing is to wait for the millennium and to allow competitive industries, such as oil and gas, to gain a stronger foothold. To refuse to subscribe to a general campaign because some do not is a short-sighted policy unworthy of a great industry. It must begin by a few co-operating together and setting the example, then others follow as a matter of course. Independent general publicity on behalf of sections such as lamp-makers, motor-makers, &c., can in the end only result in duplicated and specialised appeals. To stimulate progress for the industry it is necessary that the industry as a whole should

co-operate together to subscribe the cost of a large advertising campaign to educate the public to the advantages of electricity. The medium for the production of such a co-ordinated campaign exists in the form of the Electrical Development Association; but the work of that Association can only be in direct proportion to the funds provided, and at present the publicity so provided is sadly disproportionate to the value and the wealth of the electrical industry. So long as the industry is content to let other interests spend in proportion of ten pounds to one pound on propaganda, so long must our industry be content to remain retarded in development.

A Word to the Contractor.

By L. G. HAWKINS.

Co-operation! This wonderful word sums up sales development in a nutshell.

A contractor's sales will satisfactorily develop if he realises at not too distant a date the exact relationship between all parties in the electrical industry. The central station, the contractor, the manufacturer and the buying public are all necessary links in the chain of electrical commerce.

Whether the central station has trading powers or not, its main function is to generate and supply electricity, and

men; in some instances speciality salesmen or engineers are sent hundreds of miles to keep the contractor up-to-date and to introduce to him the latest developments of the electrical industry. Yet still there are—in spite of what days of war taught them—buyers or contractors who are "too busy," or "out," or "wanting nothing to-day." In many cases they have not the slightest notion about what the representative desires to see them. "Co-operation" of this description has driven many makers of electric vacuum-cleaners and other goods to distribute their products through furnishing houses, ironmongers and others who realise that the manufacturers' existence depends upon the satisfactory and efficient sale of their products. Profitable results are impossible if they have no opportunity to discuss their proposals with the contractor, who is the recognised medium through which they sell.

The Importance of the Sales Department.

In the past the contractor's main business has been on the engineering side. Now the successful contractor must have a sales department. This department must be conducted quite separately from the contracting department, mainly for the reason that the two "won't mix." Take a glance to-day at the old-fashioned contractor's window, and you will find an assortment of dirty switches, ceiling roses, wires, cables, fuse wire and dilapidated kettles and irons. Womenfolk are not attracted in the slightest degree by such a display; in fact, the dowdy, dingy appearance prevents the possibility of any interest being created. The trade generally realise that electrical goods, especially domestic appliances, are of direct interest to the housewife. Is it not the duty of us all to present our products in such a way that they appeal to her? We can with advantage learn much from the blouse or hat shop, or those trades which have built up progressive and profitable businesses by studying the psychology of woman. The easiest and most effective method yet found by these successful businesses is to use the shop windows to the best possible advantage.

The Shop Window as a Sales Factor.

His window is one of the main assets of the contractor. To develop he must capitalise this important asset. If he has no shop window he must get one, preferably in a main thoroughfare. The future possibilities of the electric-appliance business are of such vital importance that it not only warrants main thoroughfare premises, but they are essential. Manufacturers have invested large sums of money to provide the goods. The illustrations (Fig. 1) reproduced in this article are of some of the show-cards, "cut-outs" and other sales helps which are supplied by the manufacturer to the contractor to help sell their products. The manufacturer also invariably includes circulars and folders in bulk for the contractor to distribute with his accounts and correspondence. At least one appliance maker has gone further—by supplying great quantities of advertisement electros, which they loan to their dealers for insertion in local papers to push "Universal" products. Some examples of these are also



FIG. 1. A BUSINESS GETTING "UNIVERSAL" SHOW CARD.

its existence depends upon the sale of electricity. In many cases the contractors have failed to co-operate with central stations in the past, and for this reason municipal trading powers were sought to enable them to demonstrate, display and distribute current-consuming apparatus. Now, of course, the contractors are more alive to these opportunities and many make displays (good, bad and indifferent), while in time to come the contractors will, or should, so efficiently cover the ground that the necessity for municipal trading will not exist.

A Vital Link.

The manufacturer is vital to the successful contractor. Usually he is represented by highly-paid outside

given (Fig. 2). Some progressive dealers use these electros on the back of their letter-paper, which means that every letter sent out is a strong advertisement for the goods in question. It certainly helps the contractor's sales without extra cost. There are innumerable inexpensive forms of advertising: each envelope used should have an illustration of something electrical. The local cinema will gladly show a "Universal" lantern slide on the screen. Every wireman will become an enthusiastic salesman if allowed to carry a sample appliance and if a commission is arranged on every appliance sold by him. Every butcher is a possible buyer of electric meat-choppers and sausage-makers; every grocer is interested in electric coffee-grinders; every shop, business house and home is interested in electric vacuum-cleaners. The electric washing-machine is a ready seller, because it is an investment and not an expense. It pays its own way from the day it is installed, and in twelve months the initial cost is saved.

Prevalent Pessimism.

These are actual facts, but how few electrical men who read this will believe them? How can they believe them when they tell the manufacturer that "they don't sell," although they have never shown or used one? A few days ago it was said by a central station engineer in front of a consumer who contemplated buying a machine that "there is nothing in it and it is not worth the money." The man afterwards admitted that he had never tried one or had one in his own town. How can an industry thrive under these conditions? Do the men who are responsible for sales take enough trouble to study the electric appliances marketed? They should realise the importance of progress made, otherwise they cannot do justice to the manufacturer's products. Is it generally known that the best liquid-heating appliances made to-day are equipped with fusible plugs, thus eliminating the possibility of element burn-outs, although the apparatus may be left on circuit

Use of the Automatic Time Switches.

A feature that has made the American electrical shops such a brilliant success is the use of the automatic time-switch, which cuts out the window lights after business hours. This not only gives an opportunity of displaying effectively at night lighting fixtures and attractive scenic table lamps, but also the washing-machine can remain in operation and other devices can be effectively displayed.



FIG. 3. "UNIVERSAL" APPARATUS FITTED WITH SAFETY FUSIBLE PLUG.

To sum up, it is necessary for the contractor: (1) To be an enthusiast for everything electrical, and to know by *actual experience* the good electrical goods. (2) To have a clean, attractive shop with good display windows. (3) To have live sales assistants, if possible paid partly on a commission basis. (4) To encourage and co-operate with manufacturers of good quality electrical goods. (5) To



FIG. 4. "UNIVERSAL" SWITCH PLUG.

avoid waste of costly printed matter supplied free by manufacturers. (6) To be able to prove that electric cooking is cheaper and better than other methods. (And it is a fact!) (7) To press home the merits of electric domestic labour-savers. (8) To co-operate with the central station, the manufacturer, and give proper service to the general public.

Selling Ediswan Lamps.

Advertising is the life blood of sales, and, as the æmænic gain improved health by the absorption of blood-increasing substances, so sales are increased by more and more advertising of the proper sort. Now the great fault of much electrical advertising is that it is too concentrated. It appeals to relatively few because relatively few see it. And relatively few see it because it issues from too few places at once. It is the great aim of strategy to throw heavy forces with the greatest speed against the weakest point in the enemy's line. The same is equally true of advertising. An advertising campaign must consist of a shout delivered loud and often and simultaneously from as many places as possible. To do this requires careful organisation and thought and especially the establishment of as many points of contact between the producer and the consumer as possible.

To descend from generalities to particulars, the EDISON SWAN ELECTRIC COMPANY are about to launch a Lamp Advertising Campaign, in which they will enlist the help of newspaper advertising and obtain further publicity by the use of well-placed artistic posters. They will go further. They will see that the contractor keeps adequate stocks of Ediswan lamps, for demand without supply is the blackest anathema, an alkali going far to neutralise the acid effect of good advertising. But the contractor is not only expected to sell lamps, he is expected to advertise them, and he will do this by using the folders, billheads, postcards, showcards, illuminated signs and enamelled plates blazoning forth the fact that the Ediswan lamp is available. And all these ends to business will be supplied by the Ediswan Company, the literature being overprinted with the contractor's name. Electros and suggested layouts for contractor's own advertisements in the local papers are also available. Indeed nothing has been left undone that should be done to make the "brilliance, durability, efficiency, and economy of the Ediswan lamp in home, office, shop, and factory and on motor car and motor cycle known to all and sundry."

FIG. 2. EXAMPLE OF AN ADVERTISEMENT ELECTRO LOANED BY THE MAKERS OF "UNIVERSAL" PRODUCTS TO CONTRACTORS.

dry. An illustration of such apparatus is given in Fig. 3. Are the advantages of the "Universal" switch plug (see Fig. 4) fully explained to the buying public? It not only enables perfect heat control of the electric iron, but also is ideal for use at the table on the toaster, coffee or teapot, kettle, &c.

Developing Sales by the Use of Hire-Purchase Agreements.

By E. R. MORTON.

Experience has shown that in many industries comparatively high-priced articles necessarily have a restricted sale where they are offered for cash only. In the industries referred to a system of divided payments has therefore been instituted, resulting in largely increased sales not only to their own customers, but to those of the public generally who would not have been in a position to acquire necessities for their home in any other way. The success of several important industries in this country has undoubtedly been almost entirely due to the possibilities of acquiring the products of these industries by easy payments.

Objections to the Principle.

In some quarters objections have been raised to the principle of easy payments, and this is probably justified in many cases where the individuals wish to purchase, say, a complete house of furniture; but the purchase of one or two articles by a household which is already established is quite a different matter. Even in the event of misfortune preventing the completion of the payments the purchaser only loses an accessory, as, for instance, he would do if he undertook the purchase of a piano by easy payment.

Hire-Purchase Widespread.

The various branches of the electrical industry engaged in merchandising—that is, the manufacturer, the factor and the retailer—have very little experience in this line, and so a great majority are unable to visualise at the present time just what it means in all its aspects. But investigation shows that other industries which have adopted the principle are carrying out a great portion of their transactions on this system. In this connection it is interesting to note that some piano traders do approximately 90 per cent. of their sales on these lines. This is an important point for the electrical industry to remember, because it means that a greater portion of their potential customers have actually had experience of easy-payment purchases in some shape or form. The average user of electrical appliances would not be interested in easy terms for the smaller articles, such as electric irons and kettles. We, therefore, have to consider the attitude of the general public who is in a position to complete payments for more expensive articles.

The writer has seen hire-purchase agreements in various trades made between the users and the general public involving amounts of £5 000 and over. The growth of easy-payment business in this country has recently extended to the motor trade. Here, again, it is a fresh proof that it is a reasonable assumption that potential purchasers of electrical goods on easy-payment terms are likely to be available in very large numbers.

In the present article it is not proposed to deal with anything of a non-removable nature, such as house-wiring systems; these must be treated on quite different lines from those ruling for appliances, for obvious reasons.

The Finance of Hire-Purchase.

In approaching a prospective customer one always finds a natural reluctance to discuss the fact that he is unable to pay cash down for anything he is interested in. This attitude of mind requires careful and tactful handling and a certain knowledge of human nature, but it is one which can easily be acquired by experience and careful consideration of the problems that arise from day to day. It is an established fact that the risk of loss in the divided payment business is almost negligible; even when cheaper goods are considered it has been found to be less than 5 per cent. The risk is, of course, much less on the higher priced articles, which are naturally only sold to well-established households.

The undertaking of business involving easy payment, of course, requires additional capital. It is therefore necessary to consider who should be responsible for the

extra capital required. The present state of the electrical industry requires it to be stated definitely that this must be in the hands of the manufacturer or distributor, the average retailer not being able to afford the necessary capital outlay. The question of finance, however, is easily overcome by the manufacturer or distributor who finds that the business is growing beyond his own capital by obtaining advances from his bank on his agreements or contracts.

In America, where the easy-payment business is on a very much larger scale than is the case in this country, manufacturers frequently form separate finance corporations to handle the easy-payment business on behalf of their dealers and retailers. In most cases, of course, retailers are more in touch with the general public, and are the best medium between the manufacturer, or distributor, and the purchaser. The best system is to allow the retailer to negotiate the business on the distributor's behalf, and to award him the trade discount agreed on after a certain definite number of payments have been completed by his customer; a certain reservation could, of course, be made respecting repayment of the discount awarded should payments not be completed.

Systems of Easy Payment.

There are two broad systems of easy payment. The best and most satisfactory from all points of view is that which is usually termed "hire-purchase." As a matter of fact, in British law there is no such thing as "hire-purchase." This is a convenient term applied to a system of hiring out an appliance, or goods, to an individual who pays an agreed amount at certain stated intervals, on the completion of which the hirer is given the appliance in question without further charge. A standard form of agreement on these lines, which, while it may appear at first sight to be cumbersome, contains nothing that is not absolutely essential, nor anything that can be reasonably objected to by any individual hirer. Similar agreements are in force in industries where individual articles run into figures ranging from £30 to £1 500. On completion such agreements should be stamped by the dealer or distributor.

The other method of divided payments can be embodied in a simple form, but is not so satisfactory from either the purchaser's or the seller's point of view, because, being so simple in form, its conditions may be interpreted in many different ways—i.e., the purchaser signs an agreement on these lines: "Please supply me with one electric cleaner at £20, for which I enclose as first payment £5, and agree to remit you the sum of £1 on the same date in each month for fifteen months." In this case the appliance immediately becomes the property of the purchaser, and failure to complete payments results in considerable difficulties being experienced by the seller. In fixing the price to be charged for business upon the hire-purchase system one has to consider the matter carefully. It is obviously necessary to increase the total price, as if this is not done, or too little is added, it would tend to discourage cash purchases. Too much increase is likewise a bad principle, as it would naturally tend to hamper the hire-purchase business. At the present time the additional amount charged should preferably be between 5 per cent. and 7½ per cent. not on the total value of the article, but on the *balance* left after the initial cash payment has been made. In the event of a hirer desiring to complete his payments before they are due, a reasonable figure to allow as discount is half the increased amount allowed for. In every case percentages are per annum.

A Little Advice.

To any retailer or distributor who launches out into the hire-purchase business we would give this advice: Be diplomatic; do not believe half what your potential buyers

tell you with regard to their feelings respecting easy payments. Retailers particularly should endeavour to obtain experience from traders who already have a knowledge of this sort of transaction. Bear in mind, too, when considering the question of taking up easy payments as a part of your selling, that a good proportion of the business you will ultimately get could not be obtained on a cash basis. Hire-purchase systems therefore offer the electrical industry the prospects of an increased turnover otherwise unprocureable.

Specialised Selling.

Manufacturer, Wholesaler, Retailer and Sales.

By W. F. HARKNESS.

The interests of manufacturer, wholesaler, and retailer are inseparably entwined. Each of them is in business primarily to serve the public. As they perform this function well or ill, so does the public reward them; and no one of them can serve efficiently without the close co-operation of the other two.

How many retailers realise this? How many appreciate that the manufacturer and wholesaler are partners in the retailer's endeavour to render better service to the public, and thereby help him to reap a greater reward? And how many take full advantage of the possibilities of this partnership?

The retailer is often inclined to look upon the manufacturer or wholesaler as a species of enemy who sends out a horde of bandits to levy tribute from him; the bandits being travellers and the tribute—orders. This attitude on the part of the retailer may at one time have had a limited justification, for we can all remember the old-fashioned traveller, whose greatest ambition was to load up the unsuspecting with vast quantities of goods, and then sail gaily away and leave "Friend Retailer" to dispose of them as best he might.

What Suspicion Does.

But *nous avons changé tout cela*, and to-day an attitude of suspicion by the retailer towards the manufacturer harms not only the manufacturer, but also the traveller, the labourer in the workshops and, most of all, the retailer himself.

The modern manufacturer trademarks his goods, advertises them, backs them with carefully designed sales and distribution schemes, and works on the motto: "Goods on the retailer's shelves are only half sold." This type of manufacturer is the retailer's best friend. His traveller's primary purpose is not to levy tribute from the retailer, but to bring wine to his feast, to lay rich meats before him, and to assist him on his journey to the land flowing with milk and honey, towards which all enterprising retailers are travelling. Do these manufacturers exist? They do—plenty of them.

Advertising and Sales Service.

Let the retailer adopt this attitude towards the next traveller who calls upon him, and from the traveller's reply judge whether the manufacturer or wholesaler is his partner or merely a survival from the brigand days of commerce. Let him say to the traveller: "Admitted, this line of yours is good, but what do you propose to do to help me sell it, because I have no intention of buying your goods to ornament my shelves." If the traveller's reply be "Advertising, and Sales Service," let the retailer listen with all his ears, for he has met his real partner face to face.

Details of a Sales Campaign.

A good example of how the modern manufacturer does co-operate with the retailer for their common good is furnished by a recent sales campaign carried out by the makers of the "Whirlwind" suction sweeper. The "Whirlwind" is more or less a new-comer in the vacuum cleaner field. But it has been extensively

advertised in the daily, weekly, and monthly Press. "Whirlwind" advertising centres round the "Whirlwind Girl," an advertising figure which has become to the "Whirlwind" what Johnny Walker is to whisky, or the Kodak Girl to the kodak. This girl, dressed in a costume of quaint whirling lines (in keeping with the name "Whirlwind"), has been featured in all the advertising as "The Whirlwind Girl who solved the housewife's cleaning problem." Here, then, we have the first requisite to success in manufacturer and retailer co-operation—a trademarked article, well advertised, and identified with an attractive advertising figure, and a striking "slogan."

The Objects of a Sales Campaign.

The second requisite, "Sales Service," is illustrated by an intensive sales campaign carried out in co-operation with the retailers in a well-known seaside town. The object of this campaign was twofold. (1) The immediate sale by the retailers of a large number of "Whirlwind" sweepers; (2) the creation, through publicity, of a large and steady future demand. Four of the best-known traders embraced the opportunity offered them, and jointly with the manufacturers undertook an intensive sales fortnight. Their windows were attractively dressed with sweepers and explanatory showcards. The well-known "Whirlwind Girl," dressed in her quaint costume with its curious whirling lines, was engaged to promenade daily the principal streets of the town, carrying over her head a silk parasol bearing the words: "The Whirlwind Girl." Her appearance created an enormous amount of interest, and the question was asked on all sides: "Who is the Whirlwind Girl?" The answer to this question was found in the shop windows, where large placards were displayed announcing the presence, in the town, of the "Whirlwind Girl," and the "Whirlwind" Suction Sweeper.

Simultaneously a circularising campaign and shop demonstrations were carried on. The services of a number of "Whirlwind" re-sale men were placed at the disposal of the retailers for giving demonstrations at the houses of interested persons, and in every way keen co-operation was exercised between the retailers and the manufacturer's representatives to make the scheme successful and profitable to all concerned.

The Results of the Campaign.

Now what were the results of this campaign from the points of view of (1) the retailers immediately concerned; (2) other retailers throughout the country?

In the case of the local retailers, the results were not only fruitful, but diverse. A large number of machines was sold, each of which showed the retailers an immediate profit. The retailers' shops received a great deal of valuable publicity. Customers who called to see the "Whirlwind" frequently purchased other goods. And the "Whirlwind" re-sale men were often able to recommend to the public, on whom they called, the purchase from the retailer of other labour-saving appliances, such as irons, toasters, etc., etc., and so brought further grist to the mill of the retailer. So here were four local traders, more or less direct competitors, who sunk all feelings of competitive jealousy, and joined whole-heartedly in co-operation for their mutual good, with splendid and far-reaching results.

Other retailers throughout the country have felt almost immediate benefit from this campaign. The seaside town chosen for the campaign was full of visitors from all parts. Many of them who saw the "Whirlwind Girl" and the window displays, upon returning to their own homes, called on their local traders for "Whirlwind" Sweepers. Of that the manufacturers have substantial evidence.

Thus is exemplified the close partnership existing between manufacturer and distributor. Let the retailer take every possible advantage of this type of partnership. Let the manufacturer make of it a real partnership, bearing in mind that the sale to the retailer is only the beginning of a sale, and both parties to the partnership will derive from their association incredible benefit.

WHAT OUR MANUFACTURERS ARE DOING.

High Voltage Switchgear for Outdoor Work.

We are interested to learn that the METROPOLITAN-VICKERS ELECTRICAL COMPANY, LTD., are manufacturing a complete line of high voltage switchgear, which they are prepared to build for all voltages now in commercial use. As is well-known, the majority of really high voltage equipments installed to-day are of the outdoor type. Even on the Continent outdoor switching stations have been installed despite the official veto of the V.D.E., which does not recommend outdoor apparatus for pressures exceeding 30 000 V. Stations in France, Italy and Spain are all operating with outdoor equipment on systems over 100 000 V, and in Norway similar equipment is in use on 50 000 V systems, this being the highest pressure on which extensions have been made in Norway during the last few years. The majority of these European equipments employ the same type of apparatus as that now described.

Details of the Oil Switch.

The principal feature of an outdoor switching installation is, of course, the oil switch, and here the Metropolitan-Vickers Company have adopted a design which is in successful operation in all parts of the world. The essential feature in such switches is to house the equipment in such a way that it is at once adequately protected from the weather, and at the same time readily accessible for maintenance purposes. The switch mechanism is assembled on a removable bracket, which can be lifted *en bloc* from the switch frame. All link-work and operating rods are carried through heavy steel piping, and the operating solenoid is within a cast-iron case. In the illustration (Fig. 1) is shown a completely assembled 73 000 V oil switch of this type. The terminals are of the well-known condenser type, which are both mechanically strong and are

it preferable to stand it on the floor. In this case it is customary to arrange an oil piping system serving all switch tanks from a central storage tank and filter equipment, so as to minimise the amount of handling in the course of maintenance. Manholes are provided to permit of ready access to the contacts in position.

In conjunction with the oil switches, complete series of accessory apparatus such as isolating switches, choke coils, busbar supports, &c., have been developed, thus giving the possibility for the first time of securing an all-British extra high voltage installation.

A Modern Switching Installation.

An illustration (Fig. 2) is given of a recent installation in America—the 132 000 V switching equipment at the Colfax Station of the Duquesne Power Company, Pittsburg. This gives a very good idea of the construction which is adopted in outdoor switching stations. As will be seen, the whole of the apparatus is carried on a light steel framework, which seldom costs more than would the steel-work for a building of sufficient size to enclose the switchgear in accordance with the older practice. The Colfax Station is perhaps of particular interest as indicating the entire reliability of service with outdoor switches. The climatic conditions in Pittsburg are probably unequalled in any city in Great Britain, except perhaps in Sheffield or Manchester.

The ground space occupied by outdoor switching equipments can often be kept down to the same area as would be required for a building to house corresponding indoor equipment. In some power stations it has even been found possible to reduce the area by locating the high voltage apparatus on the flat roof.

The Agricultural Load.

American Power Companies have discovered that a very valuable source of revenue lies in the numerous farms over which their transmission lines pass. To serve such isolated consumers they have developed transformer stations having extremely simple and efficient control gear. For this purpose, and indeed for the control of power circuits up to 2 000 kVA normal capacity, it is now common practice to employ horn break switches and fuses to control the high tension circuits. Such apparatus is commonly mounted either on the top of a special tower inserted in the run of the transmission line or on a light steelwork structure placed to one side of the line on to which tap connections are taken.

The Burke Horn Switch.

The Metropolitan-Vickers Company are prepared to build the well-known Burke type of horn switch with its accessory apparatus in the form of fuses, lightning arresters, &c. These devices are commercially and widely used on systems up to 66 000 V, and for special conditions have been applied on circuits up to 110 000 V. It is probably safe to say that the Burke type equipment is more widely used than any other of the numerous competitive types now on the market. In the Colonies there is already a considerable demand for equipment of this type, and with our own rapidly developing high voltage transmission systems there is little doubt that the day of the outdoor sub-station in Great Britain has arrived.

There is a popular but entirely inaccurate impression that the operation of horn switches sets up violent surges on the line. If anything, an oil switch is more likely to do this, since the arcing time is so much less. In a horn switch the break is gradually lengthened, inserting more and more resistance, until finally rupture occurs.

The Burke switch embodies a novel principle in that the main contact arm is jointed so as to obtain a toggle action, pressing home the main contact brush. When opening, this toggle exerts a wrenching movement on the contact, breaking any ice which may have formed thereon. The horns, which have a fixed angular relation to each other at all times, lead the main contact when closing and thus take all arcing.

Railway Automatic Sub-stations.

An illustration (Fig. 3) is given of a railway automatic sub-station, in which it will be noticed that the transformers controlled by Burke type switches and protected by lightning arresters with the typical triangular choke coils, are all placed on a very simple structure out of doors, the small building being used to house only the rotary converter and its switchboard. Equipments such as these can often be employed in positions where more expensive equipment would not be commercially justified.

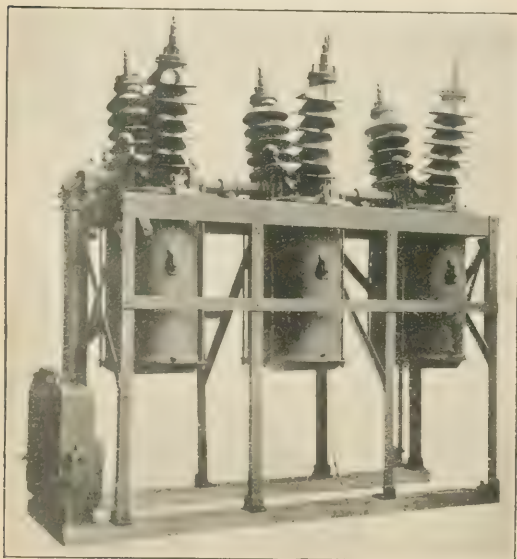


FIG. 1. 73 000 V METROPOLITAN-VICKERS OIL SWITCH COMPLETELY ASSEMBLED.

easily protected from the weather. Owing to the introduction of the condenser principle the dielectric in these terminals is worked at maximum efficiency throughout its depth, and the terminals are consequently of unusually small diameter. This being so, ring type transformers mounted over these terminals will give a very much better ratio curve than those used with the more usual oil-filled or bitumen-filled porcelain insulators. A further point of great value with the condenser type terminal is that with this design the voltage distribution is definitely controlled over the whole length of the terminal, thus giving an exceptionally high flash-over value as compared with terminals of the filled porcelain type. For pressures over 73 000 V the switch tank is of such size as to make

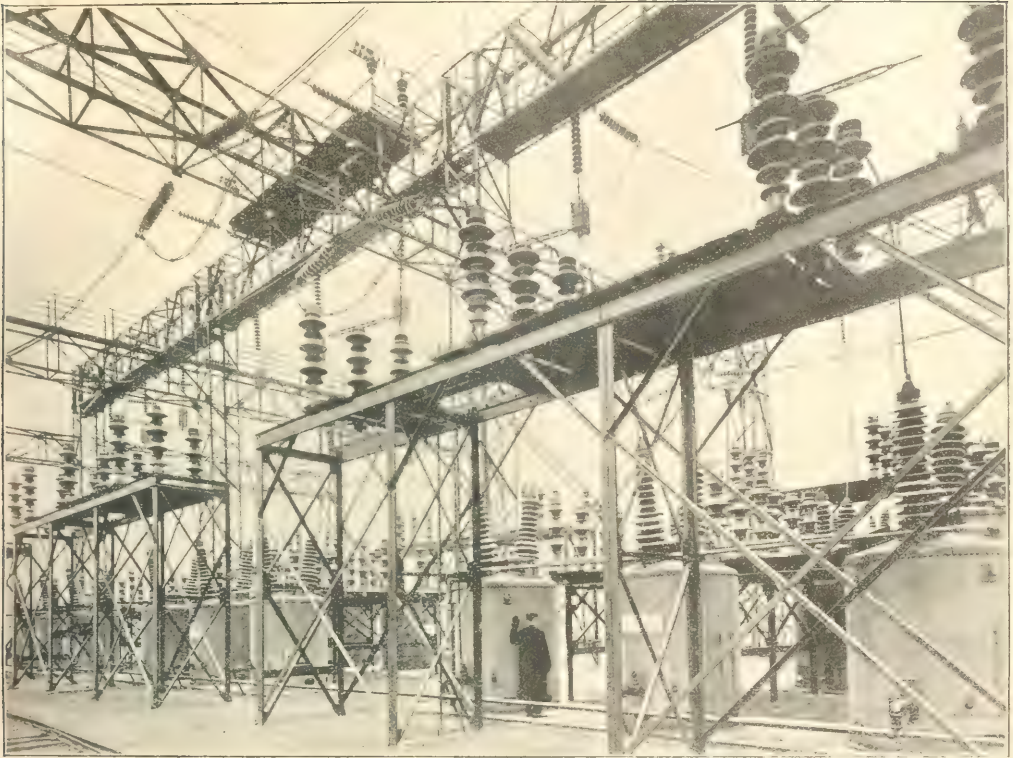


FIG. 2. GENERAL VIEW, COHAN STATION, DEQUESNE POWER CO., PITTSBURG.

The Metropolitan-Vickers Company are to be congratulated on the courage with which they are approaching the task of developing to meet the high voltage switchgear market in the British Empire. They are peculiarly well situated in having access to the working experience of associated companies abroad, so that the purchaser

is relieved of the fear that he is being used as a "laboratory" for the development of an experimental apparatus. The engineering staff in charge of this development includes several men who have been concerned for many years in the design and application of very high voltage apparatus in America and on the Continent.

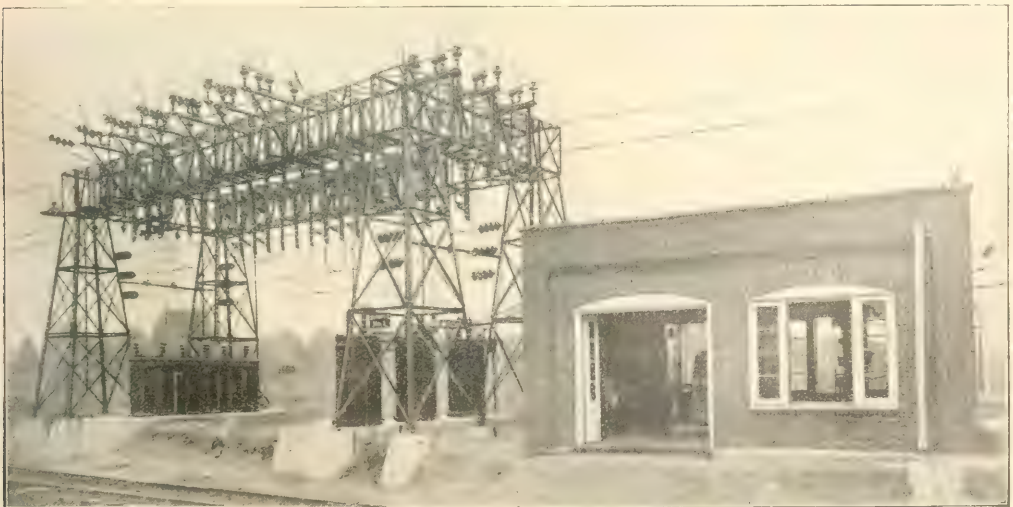


FIG. 3. RAILWAY SUBSTATION, WITH OUTDOOR HIGH-TENSION H.T. SWITCHGEAR.

Modern Tendencies in Low Tension Non-Automatic Ironclad Switch and Fuse Gear.

By W. L. BARBER.

It is perhaps trite to say that in recent years a marked improvement has taken place in the design and manufacture of low tension ironclad switches, fuses, and distribution boards. It seems only a short time ago, and well within the memory of all, when an iron-

electrical industry. Many concerns were making these goods as sidelines more or less uneconomically: accurate costs seldom existed, and consequently the variation in prices between manufacturers of similar goods, was in some cases extraordinary. Since the war,

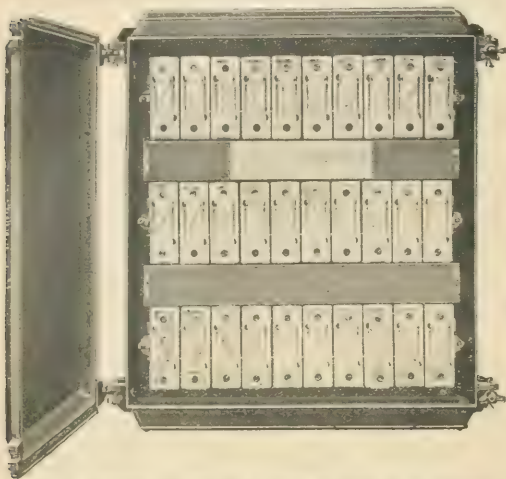


FIG. 1.—MODERN 15 A AND 20 A IRONCLAD FUSE BOARD, SHOWING WIRE INDICATOR AND FUSE WIRE TABLE (MIDLAND ELECTRIC MANUFACTURING CO.).

clad switch was something of a phenomenon, and all sorts of fittings were put forward to meet the ever-increasing demands for protected apparatus of this class. At first wood cases were largely used, but were soon replaced by sheet or cast-iron covers, with handle slots for external operation. Then the composite slotted ironclad switch and fuse appeared and acquired considerable

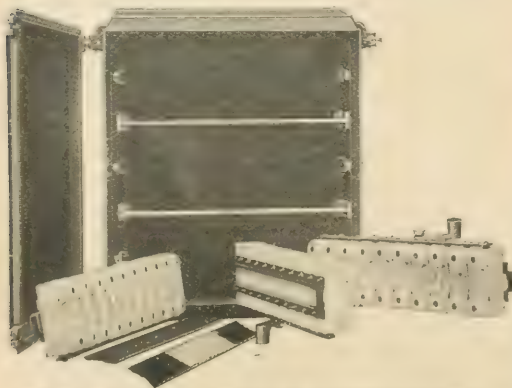


FIG. 2.—THE SAME BOARD DISASSEMBLED FOR ERECTION AND WIRING. DISSEMBLING CAN BE DONE INSTANTLY.

popularity, especially in the smaller sizes. By the generality of manufacturers most of these patterns, however, were considered distinctly as sidelines, and relegated to a corner of the shop as if the firm were ashamed of its products.

Design and Safety of the Operator.

During this transition period, when the safety of the operator had begun to be more carefully considered, the call for a better class of totally enclosed switch became more and more insistent, and the modern side handle lever pattern switch, with its lid interlocked so as to prevent access to the interior when the switch was in the "on" position, was developed in a variety of patterns. It was not, however, until very recent years that the manufacture of this type of switch attained the importance it deserved in the

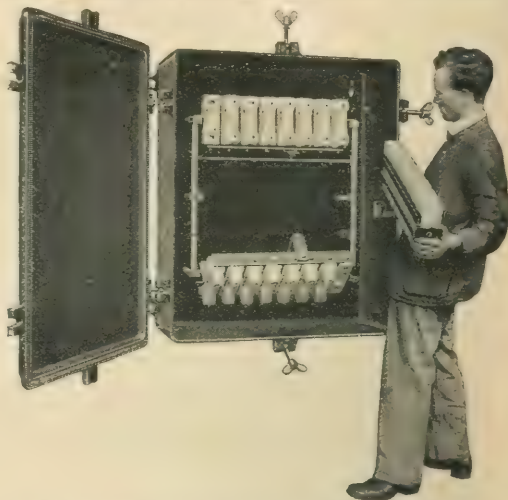


FIG. 3.—MODERN IRONCLAD TRIPLE POLE FUSEBOARD MADE BY THE MIDLAND ELECTRIC MANUFACTURING CO. WITH 100 A WAYS. SHOWING SIMPLICITY OF ENTIRE REMOVAL OF FUSE BANKS FOR ERECTION OR TO SIMPLIFY THE LAYING IN OF MAINS AND THE WIRING OF ONE BANK AT A TIME.

however, one or two manufacturing concerns have definitely laid themselves out for this class of apparatus, making nothing else: the whole lay-out of factory, plant, and equipment being designed for the mass production of this type of gear. Accurate costing

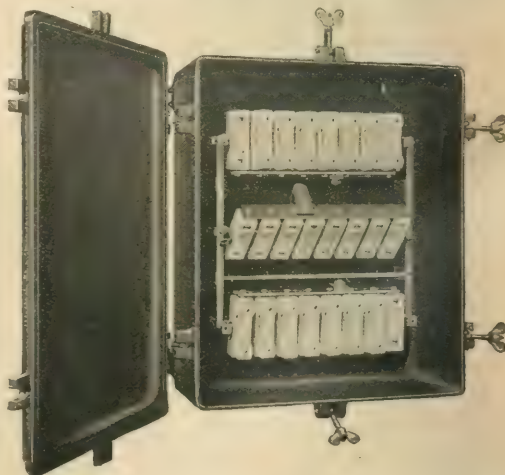


FIG. 4.—THE SAME BOARD SHOWING CENTRE BANK OF FUSES PULLED OUT ON THE TELESCOPIC CARRIER AND SWUNG OVER FOR ACCESS AND WIRING. THE WEIGHT OF THE BANK IS CARRIED BY THE PROJECTING ARMS, THUS ENABLING THE WIREMAN TO USE BOTH HANDS.

departments have been installed, and to-day this industry is giving to the buyer the utmost value.

As showing the development and growth of the business, it is interesting to note that one Midland firm in 1920 manufactured

and sold over 1 000 tons of this class of gear. The development and improvement in design has compelled manufacturers to realise that to manufacture cheaply, design must be carefully studied, castings must be replaced by press work or extruded sections, and all parts must be jig drilled and made interchangeable for easy assembly.

Criticism and Progress.

All this time engineers were becoming more critical, and a design which would pass muster a few years ago would to-day be condemned. It may be stated that some of the leading points required in modern ironclad gear are:—(1) Simple, clean, and robust design; (2) simple wiring and low installation costs; (3) high insulation; (4) quick and efficient break; (5) good contact area, and ample carrying capacity; (6) interchangeable parts for easy renewal; and (7) moderate cost.

Few Possess all the Virtues.

Although many switches on the market at the present time have a number of these virtues, few possess them all. There is at present a distinct tendency towards the use of quickmake switches. Undoubtedly a quickmake switch is a great advantage in industrial installations where unskilled operators are liable to inch on a slow-make switch, with the consequent burning of the contacts, and eventual destruction of the switch. There will probably be considerable developments along these lines in the near future.

Some Recent Developments in Control Devices.

The control of lighting for theatres and kinemas has received a great deal of attention of late years, and the old liquid type dimmer, with its tracker wires and other complications, has been superseded by metallic dimmers, usually located at the stage

switchboard. A modern form of this apparatus is the "Igranic" simplicity theatre dimmer, which is fitted with a large number of contacts, so that the current increments between steps are small, giving a gradual dimming effect without any perceptible jumps. These dimmers are banked together so that while each can be operated by its own handle, combinations can be made up readily by locking them to a shaft and operating by a master lever. Usually the dimmers for the different colours are in separate rows and cross interlocking is provided, so that any combination, say, of one colour can be dimmed while another colour is being brightened. Fig. 1 illustrates a four-tier "Igranic" dimmer for controlling white, red, amber, and blue lights, master levers being provided for each row, and the grand master being handwheel operated through a worm and quadrant.

It is possible with such an equipment to reproduce on the stage colour effects as from daylight to twilight, then to moonlight, and

again through to dawn, &c., in the most natural way and with little exertion on the part of the operator. Such colour schemes are invaluable in the kinema theatre where the effects are part of the programme and are heartily applauded.

Storage Battery Charging.

In another sphere we may mention that the charging of storage batteries has of late years come prominently to the front with the adoption of electric vehicles, industrial trucks, &c. For achieving this end the principal methods in use are the constant current, the constant potential, and the modified constant potential. With the constant current method the current rate is kept as nearly as possible at normal charging rate of the battery until the battery

The modern tendency in ironclad fuse gear and fuse boards is towards making the gear entirely fireproof, eliminating wood in construction, and, in these days of high labour costs, to consider the cost of installation, at least as seriously as the prime cost of the apparatus. At the same time the importance of accessibility is being more seriously considered: thus in modern distribution boards the "Home Office" type of fuses are mounted on pressed steel battens, and the banks of fuses are readily detachable for wiring. In the heavier types, where the banks of fuses are too heavy to handle readily, the banks can be pulled out and swung freely for wiring, whilst they are supported by the retaining arms which are telescopic.

Some manufacturers are making distribution fuse boards in which the fuses are assembled on hinged gates, so that the whole interior of the board can be swung outwards for wiring. Our illustrations sufficiently show the advantages of this arrangement. This is a considerable improvement on older methods, but it has been pointed out by some users that the amount of slack cable required on this form of board militates against safety and against the neatness of installation, especially in boards of high capacity requiring heavy cables.

These few notes are sufficient to show the great advances that have been made from the early days, and, at the same time, to indicate the lines along which progress should take place in the future.

voltage reaches a definite value. For Edison cells this is the point at which the charge is terminated, while for lead cells it is the point at which the current is reduced to one-third or one-quarter of normal and then continued until the battery voltage reaches full charge value. This charge is accomplished in both cases by a variable resistance in series with the battery, portions being cut out as the battery voltage increases.

The constant potential method requires a line voltage of a definite value, depending on the type of battery to be charged. For lead batteries 2.3 V per cell, while for the Edison type 1.7 V are required. While with this method no resistance is required and therefore no losses take place, it can seldom be employed owing to the difficulty of obtaining the correct line voltage due to the serious fluctuations in current resulting from small fluctua-

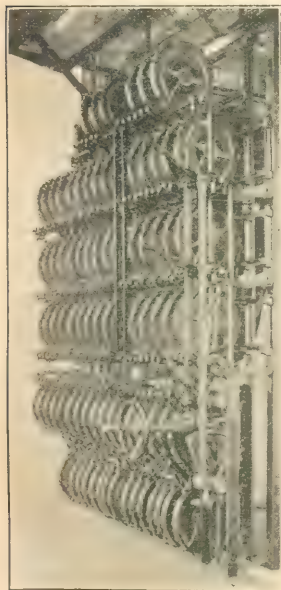


FIG. 1.—FOUR-TIER, "IGRANIC" DIMMER.

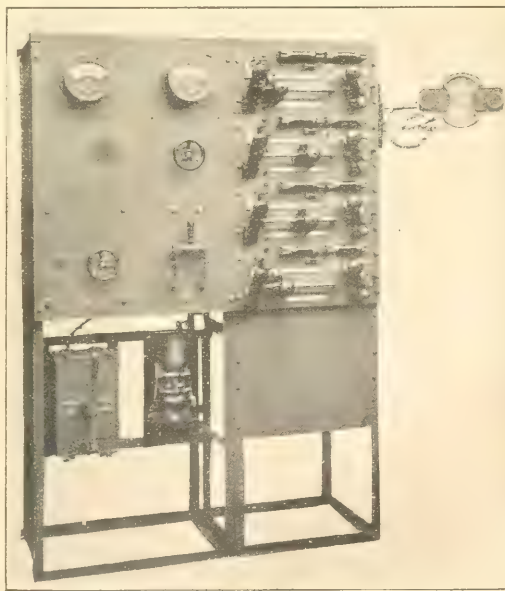


FIG. 2 "IGRANIC" BATTERY CHARGING EQUIPMENT.

tions in voltage, and also owing to the abnormally large capacity required in charging apparatus and conductors. The modified constant potential method has no advantages as regards losses in the resistance, over the constant current method and owing

to the large current taper during charging necessitates heavier conductors and apparatus generally.

The constant current method is that usually adopted, and a number of standardised forms of apparatus have, therefore, been especially designed by the IGRANIC ELECTRIC COMPANY for charging vehicles on this method. One Igranic equipment contains the necessary switchgear for a battery, and being self-contained in unit form (as shown in Fig. 2), allows additional sections to be readily added at any time. By means of the instrument switch at the right-hand side of each panel, current and voltage readings of any battery on charge can be read on the

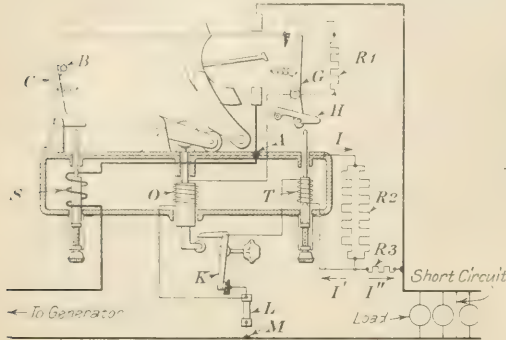


FIG. 3.—DIAGRAM OF INDEPENDENT BREAKER.

combined meter without interfering with any other section. On completing the charge, the low current cut-out opens, disconnecting the battery from the supply.

Circuit Breakers.

Another form of control device made by the Igranic Company is the circuit breaker, a new form of which has recently been put on the market. This is known as the "Igranic Auto-reclose," and it has been poetically described as the "circuit breaker with brains." Certainly it is almost human in its operation, as it will open with certainty on overload or shortcircuit, but will not reclose or try to close until the overload or shortcircuit has been removed from the lines it is protecting. On the other hand, when the circuit conditions warrant it will positively close. In any case

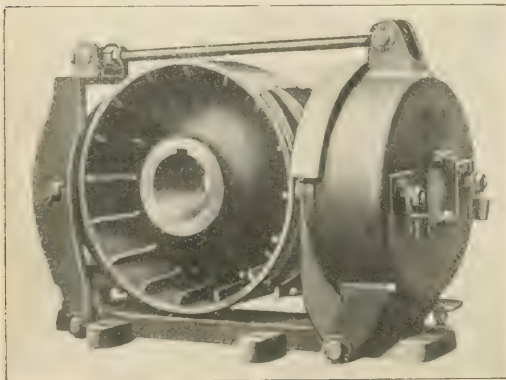


FIG. 4.—VIEW OF TYPE "M" BRAKE.

there is an interval between opening and reclosing, this period being adjustable with accuracy.

The standard patterns of Igranic breakers include independent feeder breakers, tie feeder breakers, and generator breakers. Where hand-closed breakers are used and overloads are of frequent occurrence, the perhaps somewhat natural tendency of an attendant is to either set the trip far too high or block it so that the breaker becomes an expensive portion of the conductor and worse than useless. This operation of the human element is entirely prevented by the use of the Auto-reclose circuit breaker, and for this reason it can be described as a circuit controller. Being magnetically closed, a no-voltage release is an inherent feature of all these breakers. Therefore full protection is given to an

installation under all conditions. The time limit feature for reclosing is a valuable feature where several breakers are used, as the intervals can be set so that various circuits are brought on the line in definite sequence. The protection afforded by the Igranic Auto-reclose circuit breaker is, we are informed, complete, and is maintained without sacrificing continuity of service.

The line diagram of the independent feeder breaker, Fig. 3, shows the principle of operation in simple form. O is the coil which closes and holds the breaker closed. S is the coil for tripping the breaker on shortcircuit or overload. T is the releasing coil to permit the breaker to reclose by tripping the latch A. While the breaker is open there is a shunt path consisting of high resistance R2 and low resistance R3. So long as a shortcircuit remains on the line the division of current through R2 and R3 is such that the greater part will be shunted round coil T, but where the short or overload is reduced to a pre-determined minimum a larger current will pass through coil T, which will operate and allow breaker to reclose.

Shoe Brakes.

As a robust piece of gear for crane and mill service, or any other arduous duty, the Igranic type "M" shoe brake, Fig. 4, is worthy of note. Among the features claimed for this apparatus four are of particular importance:—It has direct magnet action, thus eliminating toggles, bell cranks and levers, and avoiding wear, lost motion and friction. It has a short magnet stroke which

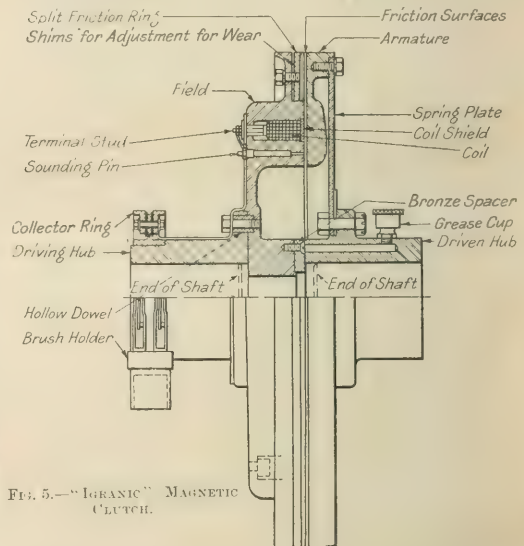


FIG. 5.—"IGRANIC" MAGNETIC CLUTCH.

insures quick and quiet action, with an entire absence of shock on setting or hammer blow on release. It has an elemental simplicity and a rugged steel structure which ensures a minimum maintenance and a maximum of life. It has a compact design and low head room, so allowing its installation where small space is available. These type "M" brakes are built in six standard sizes suitable for use with motors from 1 to 300 H.P., and can be supplied series wound or shunt wound for either intermittent or continuous duty.

Magnetic Clutches.

A similar example of sound engineering is the Igranic magnetic clutch. In this clutch, a diagram of which is given in Fig. 5, the magnet is so located that its direct pull produces the pressure between the friction surfaces. This direct action results in a very simple compact structure without toggle joints, pivoted arms, or sliding collars such as are characteristic of other types of clutches. The elimination of all operating levers, gears, and other auxiliary mechanisms materially cuts down the distance along the shaft which the clutch must occupy. Consequently in many cases it is possible to install Igranic magnetic clutches where other clutches would be too large. Moreover, by the adoption of the direct action and the elimination of all auxiliary devices, the upkeep of an Igranic clutch is, it is claimed, very low. The only care necessary is the renewal of the friction lining. Whilst the clutch is a starting device, the clutch brake—a combination of a clutch and a solenoid operated brake—is chiefly a stopping device. An important field for its application is for rubber mill and similar heavy drives enabling large synchronous motors to be started up light and, when up to speed, to pick up their loads without shock or jar.

Voltage Control for Large E.H.T. Transformer Sets.

The control and means of varying the voltage in the case of large E.H.T. transformers is a condition that arises and has to be met. This is particularly so in the case of large transformer sets linking two H.T. supply circuits between which an interchange of load is required, depending on the conditions at the respective generating stations. It is also necessary in certain instances in the case of large units either step-up or step-down, but not necessarily linking-up transformers.

Such regulating gear must be simple in operation, reliable in action, and reasonably cheap, while it is necessary under many conditions of service that there should be no phase displacement

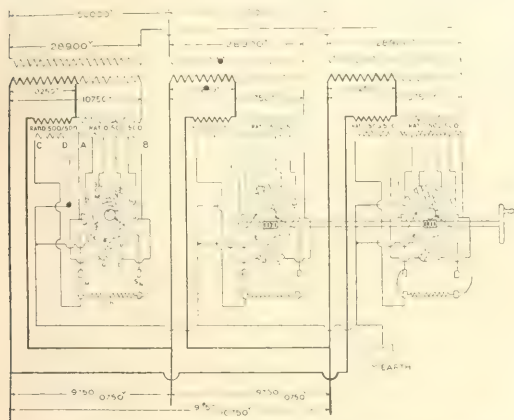


FIG. 1. DIAGRAM OF BERRY TRANSFORMER REGULATING GEAR.

in effecting the voltage control, on account of parallel operation. Further, safety in operation as well as a reasonably high efficiency are essentials.

Either of two types of regulating gear may be used, namely, the induction type or the tapping type. The former is very costly, and while capable of giving a minute variation in voltage between

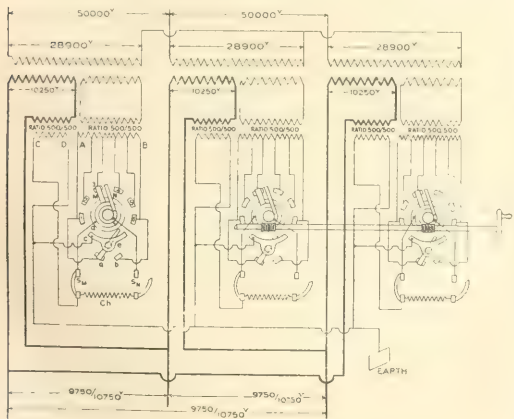


FIG. 2.—ANOTHER ARRANGEMENT OF THE REGULATING GEAR.

its limits, has certain characteristics which do not compare favourably with the tapping type of regulation, and, in general, the efficiency is not so good as for the latter type.

The Tapping Type Regulator.

The tapping type regulator presents some difficulties in the case of high voltage supplies, mainly on account of the switchgear, which, for H.T. working, becomes costly and complicated. To meet this condition the "Berry" patent regulating gear has been

developed by BRITISH ELECTRIC TRANSFORMER COMPANY, the arrangement of which is shown diagrammatically in Figs. 1 and 2.

In Fig. 1 is shown the main transformer set, consisting of three limbs of a three-phase supply stepping down from 50 000 V 3-phase to 10 750 V 3-phase, the secondary winding being provided with a tapping at 10 250 V. Between the tapping and finish of each phase of the main transformer is connected the primary winding of a small transformer, the secondary winding of which is provided with tapplings that are connected to a regulating switch, the latter also being provided with a reversing switch. In series with the primary winding of the small transformer referred to is connected one winding of a second small transformer, the other winding of which is interconnected with the whole or part of the secondary of the first small transformer *via* the regulating switch. A consideration of the voltages given for the various positions of the regulating switch will show that with this arrangement the secondary voltage may be varied from 9 750 to 10 750 V in 10 steps. The number of steps is, of course, determined by those of the regulating switches.

The arrangement in Fig. 2 is similar to that in Fig. 1, except that the connections to the regulating units are from a third winding on the main transformer sets, and not from a part of the main windings. The results under operating conditions are exactly similar in the two arrangements.

The Role of the Regulating Switch.

As will be seen from the diagrams, the regulating switch is connected to a winding entirely disconnected electrically from the main winding of the supply, and can be designed for any suitable low voltage, thus permitting of all regulation being effected in

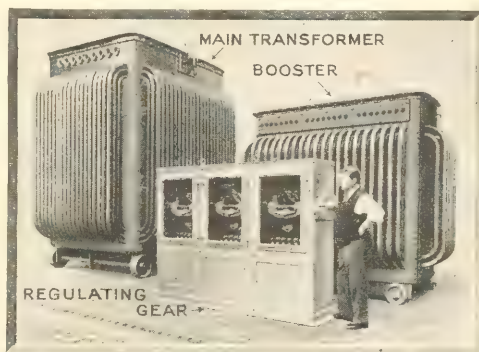


FIG. 3. VIEW OF A STANDARD 3000 KVA INTERLINKING SET OF BERRY TRANSFORMERS, COMPLETE WITH REGULATING APPARATUS.

perfect safety. By this means a cheaper, more mechanical and reliable switch may be used than if designed for high voltage working.

The switch is specially designed of very rigid construction, the main switch being of the dial type, with separate quick break switches for opening and closing the regulating circuits when passing between contacts. For three-phase working the three units are operated by means of one control shaft fitted with worm gearing for the dial switch and cam action for the quick break switches.

A reference to Fig. 3, which is a photograph of a large set consisting of main and regulating transformers with switch complete, shows the design of the switchgear. For very large units the switchgear supplied is of the oil-immersed type. Normally the switchgear is supplied for hand control, but in certain cases remote control is required, to meet which condition a motor operated switch is provided with the necessary remote control. The arrangement has the particular advantage that the regulating transformers and switchgear may be installed at a distance from the main sets.

A Booster Application.

By a simple modification of the general arrangement set out above, booster sets, for use in conjunction with the ordinary H.T. circuits, may be provided, the combination consisting of an auto-transformer (corresponding to the main transformer set), giving part of the boost required, combined with the small regulating transformer and regulating switchgear.

Crabtree Tests and Crabtree Practice.

The CRABTREE COMPANY, in their descriptive catalogue, make the profoundly significant remark that "The diameter of the base gives no real indication regarding the capacity of the switch." It certainly does not, in spite of popular illusions on the subject. In a sense, it is also true that the size of contacts and terminals does not properly indicate switch's capacity, because in a slow-make switch only a small part of the metal surfaces is in contact for a perceptible period of time—a period moreover when the initial rush of current may be five or six times the normal flow.

In calculating capacity it is therefore necessary to consider not only the amount of metal in the contacts, but also the speed of make and break. There are, of course, many rotary switches with both a quick make and a quick break, but the ordinary tumbler switch, although a rapid breaker, has in the matter of making contact generally maintained its dilatory tradition.

With the growing use of gasfilled lamps, the need for a snap-action tumbler switch has become increasingly urgent. A record taken by means of the Duddell oscillograph on a circuit normally passing a current of 6.6 A shows that, at the moment of switching

on, there is a surge of 39 A. This rush of current subsides almost immediately, but a fifth of a second elapses before it drops to normal. It will, therefore, be evident that unless the switch makes almost instantaneous contact, the infinitesimal area of first contact is likely to be overcrowded with amperes. This test was taken by Messrs. Crabtree to prove the necessity of a quick-make switch in an ordinary lighting circuit.

Another test to demonstrate the rapid action of the Crabtree tumbler switch is recorded in the section of cinematograph film illustrated. The film was taken at a speed of 200 exposures per second, and the actual time of each exposure was slightly over one-thousandth of a second (0.0011 seconds). The illustration is absolutely untouched except for the outline of the switch arm, which was treated to show clearly in the reproduction. This film is exactly as run into the camera, and has not been cut or patched up in any way.

Instantaneous in Action.

When the film is shown on the screen at the ordinary projection speed, the movement of the hand in throwing over the switch is slowed down to a crawl. The switch movement, however, is seen as though instantaneous in action. An examination of the actual film, and particularly of the section illustrated, provides the explanation. The throw-over of the switch is so rapid that there is only one exposure between the switch starting to throw over and the completion of the contact. What more positive proof could possibly be provided of the instantaneous action of the "Crabtree" switch?

A careful analysis of many similar exposures show that the switch makes complete contact in less than one-thousandth of a second, while similar tests made on ordinary slow-make switches of the link pattern, switching "on" and "off" in half a second, show that it takes one-tenth of a second to make full contact.

An Analysis of a "Slow-make" Switch.

An analysis of the action of a slow-make switch shows that there is a "dwell" for a distinct period of time, with the contact arm resting at the point of first making contact. Any looseness in the mechanism exaggerates this "dwell." It is at this position of point contact that the greatest damage is done, and arcing first set

up. Every successive "switch on" increases the damage, and a very few operations will burn out the switch on circuits considerably below its rated capacity.

In addition to the standard 5 A and 15 A tumbler switch, the Crabtree Company are now manufacturing many special types of tumbler switches.

The "Crabtree, Junior."

The "Crabtree Junior" is (nominally) a 3 A switch, but is identical in several details with the standard Crabtree 5 A switches,

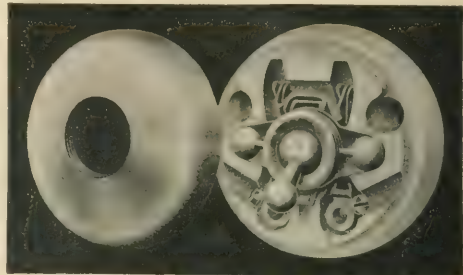


FIG. 2.—VIEW OF THE "CRABTREE JUNIOR."

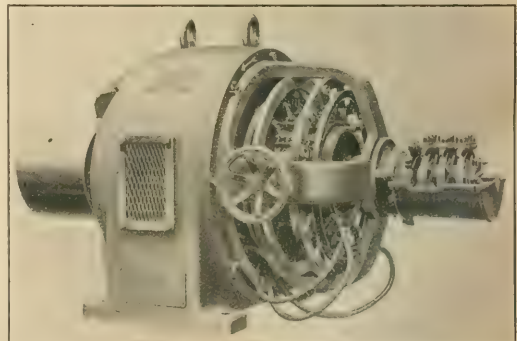
and actually has a higher capacity than many so-called 5 A switches. The base diameter of this switch is only 1½ in. We illustrate it in Fig. 2.

The combined switch and fuse is suitable for train and car lighting service in which a quick make and break action is especially desirable. The switch is either "on" or "off," and cannot be slowly operated by the cleverest "nosy Parker" that ever investigated the equipment of a public vehicle.

Variable Speed A.C. Commutator Motors.

To meet the large demand for a variable speed polyphase alternating current motor, the BATH THOMSON-HOUSTON Co., LTD., have developed a comparatively simple commutator motor which is shown in the accompanying illustration.

The windings of this motor differ from those of an ordinary induction motor in that the primary winding is on the rotor, and the secondary winding is on the stator. Also, in addition to the primary winding, the rotor carries a regulating winding. The leads from the supply are connected to the primary windings through sliprings on the rotor, and the regulating windings are



B.T.H. VARIABLE SPEED A.C. COMMUTATOR MOTOR.

connected in series with the secondary windings on the stator by means of a commutator on the rotor shaft. This type of motor has practically the same characteristics as a direct current shunt wound motor with the exception that the speed of the a.c. commutator motor does not vary with the temperature to the same extent as a d.c. shunt wound motor. Further, in the case of the a.c. commutator motor no external resistance is required for speed regulation.

Means of Speed Variation.

Speed variation is obtained by altering the position of the brushes on the commutator and, for this purpose, a suitably guided brush

rocket is used, operated by an external hand-wheel through rack and pinion gear for hand operation, or, if desired, mechanical means can be arranged for operating the handwheel from a distance.

The normal speed range of these motors is 3 to 1, and the difference between no load and full load speed throughout this range is approximately the same as in the case of a continuous current shunt wound motor.

As neither a rheostat nor a power dissipating contrivance of any description is required throughout the normal speed range, the motor operates with high efficiency at any speed or load. Also, a point which should be noted when comparing these motors with d.c. motors with shunt regulation, the a.c. commutator motor gives a constant torque throughout the whole speed range, the power output being directly proportional to the speed, whereas the d.c. shunt motor would only give its full torque at the lowest speed. This means that a d.c. machine for equal torque must be capable of giving the full maximum horse power at the lowest speed, although this power may not be required at that speed.

Advantages of the New Motor.

The advantages obtained by this motor over the ordinary type of induction motor are that the power factor is higher throughout a considerable part of the speed range and is practically unity at top speed under full load conditions. The commutator motor is also more stable in operation at creeping speeds than the induction motor, due to the fact that the stalling torque is higher than that of an induction motor, and it is therefore less liable to fall out of step with fluctuations in the load. This property makes it particularly suitable for those classes of cranes, hoists, &c., where a steady crawling speed and uniform acceleration are particularly necessary, as, for instance, in foundries.

No special starter is required, the motor being connected straight to the line through an ordinary oil switch, the brushes being set in the minimum speed position in order to keep down the starting current.

The standard ratings of the B.T.H. Type C.H. alternating current commutator motors range from 10 H.P. to 75 H.P. and are suitable for two or three-phase circuits of 25, 40 and 50 cycles up to 600 V, but other sizes of machines are also obtainable.

Owing to the advantages to be obtained, these motors are claimed to be particularly useful for driving fans, pumps, blowers, exhausters, newspaper printing presses, calico printing machines, calenders, tentering machines, papermaking machines, cutters, reelers, chain grate stokers, hoists, machine tools, &c.

A Semi-Automatic Switchboard.

Many millions of units have passed through the by no means reluctant meters of the Kensington and Knightsbridge Supply Company since Colonel Crompton first interested himself in the design of electrical apparatus, and still this pioneer is pioneering. Also the firm that bears his honoured name is constantly producing new designs and devices, from which it is difficult to dissociate the genius of England's premier electric Colonel.

An ingenious semi-automatic house lighting switchboard is the latest product of Messrs. CROMPTON & COMPANY, LTD. This board is arranged to control the equipment automatically after the starting switch is in the charging position. When the battery requires charging the starting switch is moved to the starting position, connecting the dynamo across the battery, and accelerating the engine, after which the starting switch is moved to the charging position and is held there by a voltage coil. The engine and dynamo will continue to supply current to the battery until the battery is fully charged, at which period the starting switch is automatically released, and the set brought to rest.

The instruments are of the dead beat, moving coil pattern with spring control, of high-class design, fitted in nickel-plated cases with glass fronts. The condition of the battery is indicated by a voltage relay, which can be arranged to ring an alarm bell when the battery is low and automatically shut down the set when the battery is full.

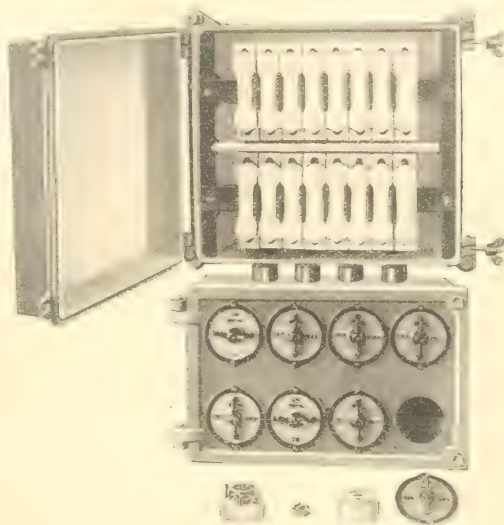
Heavy Power Fuses.

It is evident that no system of power distribution could be perfect which did not include a really reliable fuse system for the protection of the plant and cables. The first activities of PARMITER HOPE & SUGDEN centred, therefore, on the design of a new type of fuse, which, whilst being reliable under all working conditions, could be easily understood, readily rewired without the use of special tools, and required an absolute minimum of attention under all and every condition.

This fuse, which this firm have now marketed for some time under

the name of "Hope's patent Fuse System," is, it is claimed, unique both in principle and design, and has been proved to be the most reliable fuse yet produced for power work.

Having arrived at a solution of the fuse problem, the firm next incorporated the fuse unit in a new type of power distribution board, adaptable to cover the whole field of distribution. The "Fluvent" fuse board, which we illustrate herewith, is readily installed and easily wired by the provision of detachable top and bottom cable troughs. It thus permits of an easy arrangement of the cables, and allows for alternative types of troughs inter-



VIEW OF "FLUVENT" FUSE BOARD FULLY ASSEMBLED.

changeable one with the other to suit other type and class of cable manufactured and every wiring system used from C.T.S. to the heaviest lead-covered steel-tape armoured cable.

The method of carrying the bases by means of steel rods slung from the sides of the case in place of the more usual base fixing screws, leaves the whole of the space behind the bases free for the wiring, and ensures that safety after erection, which is too often lacking in boards of the more conventional type. By the addition of an external switch and fuse, and the necessary pilot-light fittings, the "Fluvent" board is now being installed in large numbers for the protection of crane motors, where its compact form and reliability renders it of exceptional value.

Some New Automatic Control Gear.

Some distinctive features have been introduced into the new types of low tension oil switch and air break circuit breakers recently designed by the PARK ROYAL ENGINEERING WORKS, LTD. Unlike hand-operated gear, the successful use of which can be controlled by the personal element, automatic circuit breakers and oil switches depend entirely upon design for their reliability and accuracy.

Most circuit breakers are kept in the "on" position by the handle lever being over the dead centre, but in the event of considerable vibration the breaker will come out, doubtless at a most inopportune moment. The P.R. "1921" Circuit Breaker, however, has a definite fixed "on" position and can only come out by an overload action, or by a deliberate hand trip through the mechanism provided.

In the low tension A.C. oil switch there is a similar "security of tenure." The switch, which is built on strong simple lines, has the advantage of a visual mechanical indicator showing the position of the contacts "on" or "off." The tripping action on an overload, or by a hand trip, is quick and effective, and the jar of the lever movement is taken up by air cushions, so that an easy and noiseless action is effected. The switch is applicable to either direct or remote control.

A New Deflectional Frequency Meter.

By C. L. L'PMAN.

The "Component Field" Principle.

With the general progress of electrical engineering a great demand has arisen for a deflectional frequency meter that could be read accurately and from a considerable distance. It is the intention of the author to describe a frequency meter in which a new combination of principles is employed. As is well known, resonance occurs in an alternating current circuit when the reciprocal of the product of the self-induction in henries and the capacity in farads is equal to a constant multiplied by the square of the frequency, so that by properly proportioning the inductance and capacity, a resonance circuit may be obtained for any desired frequency and at this frequency there will be neither "lag" nor "lead" of the current with reference to its electromotive force.

This clearly follows from the general equation for the current

$$I = \frac{V}{\left[R^2 + \left(\omega L - \frac{1}{\omega C} \right)^2 \right]^{1/2}}$$

in which V is the terminal pressure applied to a circuit possessing resistance $=R$ ohms, self-induction $=L$ henries, and capacity $=C$ farads, and where $\omega = 2\pi f$.

The general expression for the angle of phase displacement is given by

$$\gamma = \tan^{-1} \frac{\omega L - \frac{1}{\omega C}}{R}$$

The two equations are represented graphically in Fig. 1 as functions of the frequency f , for one set of values arbitrarily given to V , R , L , and C . The latter two quantities, however,

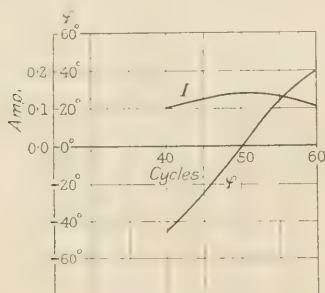


Fig. 1.

were so selected as to cause "pressure resonance" at 50 cycles per second.

It is apparent that for a resonant or nearly resonant circuit there is a rapid change in the power factor of the current flowing through it for comparatively small changes of frequency, and accordingly, if one of the circuits of a phase-meter be tuned to resonance for a selected or normal frequency, any departure from that frequency will be measured by the movable element of the indicator.

New Construction Necessary.

A satisfactory application of the above principle could only be rendered possible by the development of a new construction of phase-meter in which all sources of error have been practically eliminated. The new frequency meter works on what may be termed the "Component Field" principle which is diagrammatically illustrated in Fig. 2.

According to this construction, the production of a "resultant rotating magnetic field"—which is inherent in all other types of phase-meters—is avoided by arranging the field coils with their axes parallel to each other and in parallel planes. The current through the l circuit is made to lag that of the r circuit by approximately 90 electrical degrees.

The M circuit is tuned to resonance for the normal frequency.

The movable system consists of two soft iron vanes fixed to opposite sides of a pivoted spindle bearing a pointer. The portion of the spindle between the vanes is of magnetic material, and the vanes are of quadrant shape and are set with their axes of symmetry at an angle of about 90 geometrical

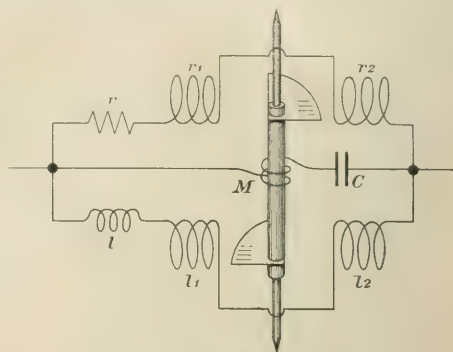


Fig. 2.

degrees. An alternative but equivalent in principle, arrangement, possessing certain advantages, is also being employed in which the M coil forms the field and the r and l coils are arranged to magnetize the "component" portions of the moving iron system.

Openness and Shape of Scale.

One of the most striking features of this instrument is the very open and long scale. The flexibility and simplicity with which any shape and length of scale can be obtained is remarkable. With equal ampere turns in the r and l circuits the deflections will approximately follow the curve γ in Fig. 1. Thus, a frequency range of, say, 40 to 60 cycles with 50 as normal will subtend a total angle of about 80 deg. under this condition. By increasing the ampere turns of the l relatively to the r circuit in correct proportion, a frequency range of 45 to 55 cycles only can be made to subtend the same full angle with particularly open divisions round the normal 50. On the other hand, a practically uniform scale over the full range can be obtained by strengthening the r relatively to the l circuit. The sensitiveness of the instrument

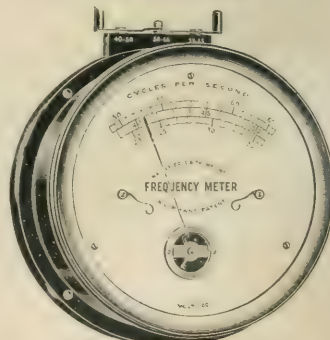


Fig. 3.

can further be varied by altering the proportions of resistance and inductance in the M circuit. Different geometrical settings of the iron vanes relatively to one another will also affect the shape of scale.

It is clear, therefore, that the length of scale per period can

be made to be anything from $\frac{1}{4}$ to 1 in. according to requirements and to size of instrument.

Multi-Range Frequency Meter.

For laboratory use one instrument can be made to cover a wide range of frequency by the provision of two or more scales. This is easily done by retuning the M circuit to resonance for the mid-scale frequency for every range.

An illustration of a three-range frequency meter is given in Fig. 3 covering all frequencies between 19 and 67 periods per second.

Accuracy.

The degree of accuracy obtainable on this type of frequency meter is very high. The slightest change in frequency is instantaneously indicated by the pointer. No moving coils are being employed and all extraneous controlling forces due to conducting ligaments or brushes are thereby entirely eliminated. No rotating field is set up by this construction, and consequently the "rotational drag torque" upon the moving system is not produced and the disadvantages arising

from that torque are obviated. All coils are air-cored, hence the instrument is free from errors due to saturation and losses in the iron.

The instrument shown in Fig. 3 was "cooked" for several hours and no temperature error could be detected. A variation of voltage of plus or minus 20 per cent. from the normal for which the instrument is designed does not affect the readings more than by 1 per cent. For pressures above 200 volts or for frequencies above 100 cycles per second, even a greater degree of accuracy can be obtained. Within the range of wave distortion found in commercial practice no appreciable error is caused thereby. The operating forces are exceedingly high and permit the construction of a recording (graphic) frequency meter. The same principle can be applied with advantage to the construction of capacity and inductance meters.

In conclusion, the author must express his indebtedness to the directors of Messrs. NALDER BROS. & THOMPSON, Ltd., for the most excellent workshop and testing facilities placed at his disposal during the development of these instruments.

Instruments for Indicating and Recording Speed at a Distance.

The speed of operation of machinery is a matter of prime importance to engineers, and while there are a number of instruments that will indicate this at the machine itself, there are very few that will transmit the indication to a distance, and still fewer that will satisfactorily record it.

Messrs. ELLIOTT BROTHERS (London), Ltd., have therefore devoted special attention to these problems, and this has entailed a large amount of experimental and research work.

can be used without affecting the indications. When, in addition, it must be possible to obtain absolutely steady readings when the engine is "ticking" over or running at full speed, and all instruments and generators are strictly interchangeable, it will be seen that the problem solved is no small one. So successfully have Messrs. Elliott Brothers met these requirements that their apparatus has been adopted by the R.A.F. and a large number of sets supplied. Recording speed meters have also been made for testing train equipments for speed and acceleration, and obtaining a graphic record. The performance of ring spinning machines with automatic variable speed control has also been tried out with recording speed meters. It is impossible to give more than a few examples with the space at our disposal, but the above will serve to show the almost universal adaptability of the instruments.

Description of the Instrument.

The general appearance of the Elliott magneto generator is shown in Fig. 1 and 2. The machine illustrated is that designed for general industrial work. The case is watertight, and the spindle passes through a gland. The machine can be driven by belt, chain or gear-wheels, or for certain speeds can be direct coupled. The design is such that once coupled up it can be left practically indefinitely, since the brush gear and bearings require no attention; and if the commutator and bearings are cleaned and inspected, say, once in nine or twelve months, no other attention is necessary.

The power required to drive the magneto is so small that a stout

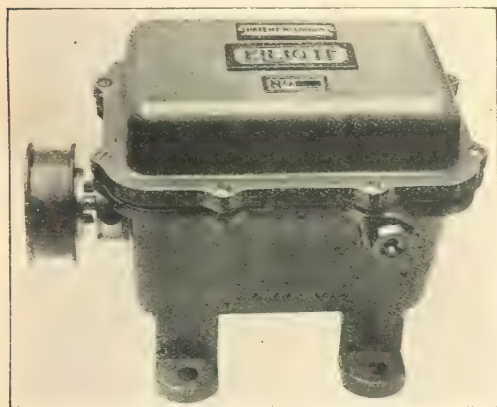


FIG. 1.—THE ELLIOTT MAGNETO GENERATOR FOR INDICATING AND RECORDING SPEED AT A DISTANCE.

As a result of this work it has been found that the best arrangement is one employing a special magneto generator giving a voltage proportional to the speed combined with a suitably designed permanent magnet moving coil instrument.

Apparatus of this nature has been supplied for use in connection with widely differing machines—for example, speed indicators have been made for indicating engine and turbine revolutions in ships' engine rooms and on the bridge, also for turbine driven and electric locos; for indicating and recording the speed of lifts, cranes, capstans; the speed of operation of printing and baking machinery, &c. The design of Messrs. Elliott Brothers' apparatus is such that it is, we are informed, susceptible of high accuracy, and sets have been supplied guaranteed to indicate speed at a distance to within of 1 per cent.

Application to Aeroplanes.

Special instruments of this nature have been designed for use on aeroplanes and airships, and have successfully complied with the stringent requirements of this work. The conditions met with on aircraft are particularly onerous, apart from excessive vibration, which is an exceedingly searching test of the mechanical perfection of the apparatus, the indications must be unaffected by variations of temperature between minus 15 and plus 50°C; the accuracy must be within about $\frac{1}{2}$ of 1 per cent., and one or two instruments

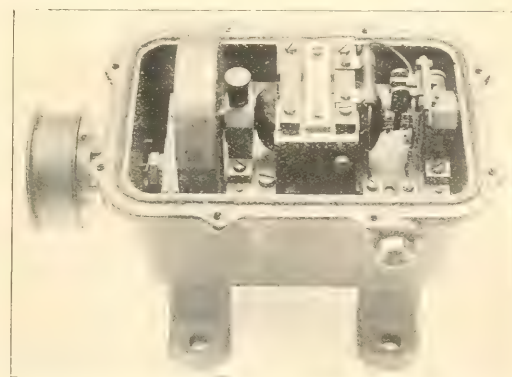


FIG. 2.—THE INSTRUMENT WITH THE COVER REMOVED.

piece of thread is strong enough, and, indeed, the standard drive is by means of a $\frac{3}{8}$ in. wide cotton lamp wick.

The instrument may have a 6 in., 8 in., 11 in. dial or an illuminated sector, and if a permanent record is required an Elliott recorder can also be employed. These sets have been much used in connection with rolling mills, in which case an audible and visual alarm can be employed. This is worked off the magneto to give warning when the speed falls below some fixed limit, thus ensuring maximum efficiency of operation of the plant.

The Resistance Metrohm.

Although the measurement of ohmic resistance received more attention from the earlier physicists, and was possibly brought to a higher state of perfection than any other electrical measurement, yet from the industrial point of view the deflectional ohmmeter has lagged a long way behind its counterparts, the ammeter and voltmeter.

Weird Continental Practice.

In one direction, however, development has made rapid strides, namely, in that of the insulation testing set, in the production of which this country stands supreme, for the so-called "insulation

in series with the resistance to be measured. If the applied voltage were constant the scale could obviously be graduated direct in ohms. As, however, such constancy is unattainable, the effect of any variation is automatically compensated for by making the control itself proportional to the voltage.

Fig. 3 shows the connections in the case of the wide range model. The working coil (WC) is connected in series with the resistance under test across the terminals of a battery, so that the deflecting torque is inversely proportional to the value of the resistance under test. This torque, instead of being opposed by a spring, as in the case of the ordinary moving coil ammeter, for example, is controlled by the coil CC, which is also connected across the terminals of the battery. In this way, any variation in the voltage has an equal effect upon both the working and controlling coils, so that the deflection is entirely independent of such variation.

Mechanical Construction.

Fig. 4 shows, in elementary form, the mechanical construction of the resistance Metrohm. The working coil swings in the narrow air gap between the pole pieces P, and the core C and the controlling coil (CC), attached to the same spindle, moves in the magnetic field due to the two polar extensions X, which form part of the pole pieces P.

In order to give a suitably graduated scale, such as that shown in Fig. 2, the pole pieces P and their extensions X are so proportioned that the strength of the magnetic field is a maximum at the "zero end" of the scale and a minimum at the "infinity end."

Owing to its construction, the resistance Metrohm is perfectly deadbeat, and it is only necessary to connect a few cells to one pair of terminals, and the resistance to be measured to the other pair, for the pointer to fly instantly to the reading in ohms on the dial. The scale is a particularly long one, and for the reasons already given the indication is entirely independent of the voltage of the battery or other source of current.

It will be noticed from Fig. 2 that the resistance Metrohm just

ohmmeters" developed in other countries are so crude as to be quite unworthy of the name. They are, in fact, nothing but low-reading ammeters used in conjunction with a battery or hand magneto-generator, and often are not even scaled in ohms, but are only provided with a curve or table, the indication being correct at one voltage only, so that compensating devices of varying degrees of crudity or complication have to be introduced. In one such instrument, for example, a voltmeter is provided upon which the operator has to keep his eye as he speeds up the generator. In another a tuned vibrating reed answers the same purpose. Or, again, a standardising resistance and magnetic shunt are used; and in still another "design," a mechanical clip is fitted which, as the speed of the generator is gradually raised, grips the pointer so soon as it reaches a predetermined value. In this country such makeshifts have never been countenanced and true ohmmeters are invariably used.

A Recent Development.

THE EVERETT EDGECUMBE Metrohm insulation testing set is too well known to need any description, but the resistance Metrohm recently developed by the same firm will be of interest. It is made in various ranges, so that resistances from a fraction of an ohm up to many megohms can be read on the direct reading scale.

Requirements differ so widely, according to the purpose for which the instrument is to be used, that it is constructed with two different types of scale. These are reproduced, full size, in Figs. 1 and 2. The former shows a scale which is almost evenly divided from zero

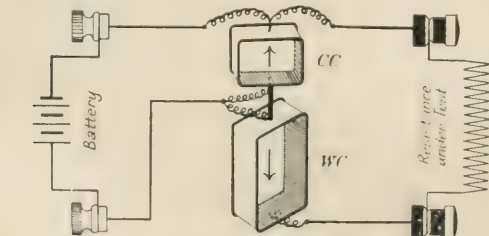


FIG. 3. CONNECTIONS OF WIDE RANGE METROHM.

upwards, whilst the other (Fig. 2) closes rapidly towards the upper end, so that readings of almost the same percentage accuracy can be made throughout the entire range, which is a very wide one. This difference in the "shape" of the scales is attained by the particular method of connections adopted.

Underlying Principles.

The underlying principle of these instruments, in common with the insulation Metrohm, is that of a moving coil instrument connected

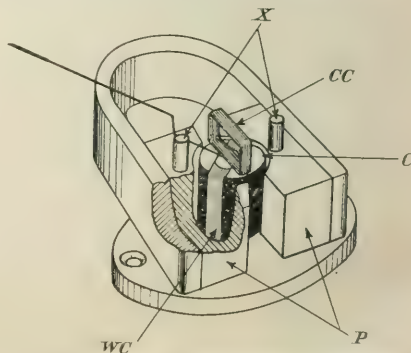


FIG. 4.—MECHANICAL CONSTRUCTION OF METROHM.

described has a very wide range, which, for general testing purposes, is a particularly valuable feature. In many cases, however, especially for routine and workshop testing, a much more restricted range is preferable (that shown in Fig. 1, for example), and for this purpose the connections are somewhat modified. The chief difference is that the resistance under test is connected in parallel with the working coil instead of in series with it. This arrangement has a number of incidental advantages which need not be entered into here, but the main point is that the scale is almost evenly divided (although somewhat constricted at the upper end, as should always be the case).

A Comparison of Advantages.

In comparing the advantages of the two patterns, it may be said that the parallel connected Resistance Metrohms (Fig. 1) are particularly well adapted to low resistance measurements (up to 1000 Ω), and the series connected pattern (Fig. 2) to the measurement of higher values (from 500 Ω up to many megohms). Both patterns can be supplied with more than one range if desired.

The instrument is most conveniently fitted into a portable wooden

case, as illustrated in Fig. 5, but various forms of switchboard case are available where wall mounting is desired.

The Uses of the Instrument.

The uses to which the resistance Metrohm has been applied are too many to be enumerated, but one may be mentioned here, viz., the measurement of the temperature of transformers, cables, or running machinery, under load conditions. It must be remembered that it is the temperature of the windings which actually

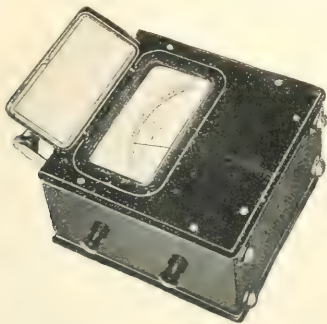


FIG. 5.—GENERAL VIEW OF THE RESISTANCE METROHM.

determines whether the load carried by a certain machine is a safe one or not, and that the measurement of that load by an ammeter or wattmeter is only an indirect and less satisfactory method of arriving at the same result. It is now recognised that the life of the insulation and, with it, of an electrical machine depends upon a very high power of the temperature. It has been, in fact, put as high as the fifteenth power in the case of paper insulation. For this reason, it is becoming more and more the practice to measure the temperature of windings, continuously, by means of embedded thermometers. For this purpose a resistance coil connected to a Metrohm graduated in degrees of temperature forms a most convenient arrangement. It is often desirable to

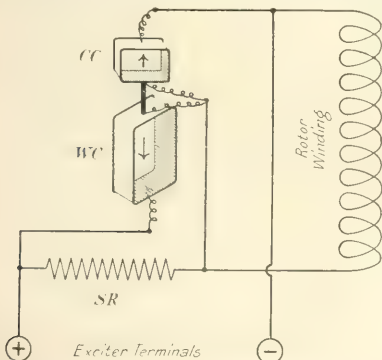


FIG. 6.—CONNECTIONS WHEN USING THE RESISTANCE METROHM FOR TAKING RESISTANCE OF ROTOR WINDINGS.

record the temperature as well as indicating it, and this can readily be done.

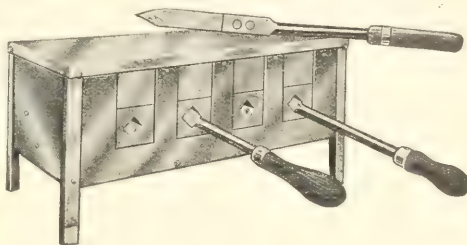
The temperature of the rotor of a running A.C. generator, or, in fact, of any copper winding carrying a direct current, can readily be measured by means of a resistance Metrohm. The connections for such a test are shown in Fig. 6. SR is a resistance in series with the winding, the working coil (WC) being connected across it, whilst the controlling coil (CC) is joined to the terminals of the rotor winding. The temperature co-efficient of copper being known, the resistance of the rotor winding is a measure of its temperature, and the scale of the Metrohm may be graduated to read direct in degrees Centigrade or Fahrenheit. Any overheating is, in this way, at once detected and an alarm bell or other warning can be fitted when thought desirable. This arrangement has proved extremely valuable in many large stations. It may be pointed out that if the resistance SR is non-inductive any sudden change of current flowing through the rotor winding, which is necessarily inductive, will cause a momentary kick of the Metrohm pointer. This is usually no detriment, but, if desired, it is readily corrected by making the resistance SR correspondingly inductive.

A New Soldering Iron Stove.

Electric soldering irons, one must frankly admit, have not so far proved very successful in practice. Their liability to premature "burn out" is a serious handicap, and it does not seem likely that electric irons, with self-contained elements, will ever take the place of the ordinary copper bit, which can be heated almost to melting point without permanent injury.

The electric stove for heating soldering irons is, however, a different and more promising proposition. Such stoves are often inefficient owing to the large air gap which generally intervenes between the iron and the element. In the new stove designed by THE ELECTRIC HEATING COMPANY of Croydon, this trouble seems to be obviated.

The stove is so constructed that the heat is transmitted to the iron direct through a pair of V-shaped jaws closed at the rear end. One jaw is movable so as to provide an expandable heating chamber which can be varied in size to suit irons of different sizes, the arrangement being such that, no matter what size iron is to be heated, the jaws will open and make direct surface contact



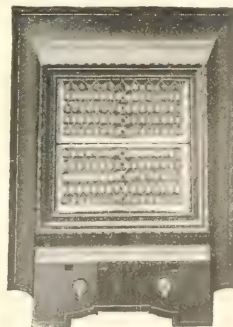
THE LATEST ELECTRIC STOVE FOR SOLDERING IRONS.

therewith. The channels in the jaws can be made any shape to suit any shape of iron, so as to ensure the maximum area of the iron being brought into contact with the jaws. The stove can be made to take any number of irons at one time, and each pair of jaws is lagged with heat resisting material. The connections inside the back of the stove are made of corrugated strip nickel so as to permit of easy movement of the jaws without damage to the connections.

New Carron Electric Fires.

CARRON COMPANY have recently placed on the market a new range of electric fires which should attract much interest on account of their extreme cheapness and simplicity, and also because of the very high degree of radiant heat obtained from them.

The element used consists of a machine-moulded block of Scotch fireclay with grooves running transversely across the face, in which the heating spirals are placed and securely fixed in position. When in use the fireclay quickly attains a cheerful red heat. The elements are fitted to strong cast-iron frames of various attractive designs, the fires being made in sizes varying from 1 to 3 kW. The wiring in the larger fires is so arranged that one bar is left



A TYPICAL CARRON DESIGN OF ELECTRIC FIRE.

"live," but if desired all bars can be controlled by switches on the fire. A good feature in connection with the position of the switches is that they cannot be knocked on and off with the foot.

Carron Company are continuing to manufacture their other well-known patterns of electrical apparatus, but the new range will be particularly valuable in cases where a low-priced and efficient fire is required.

Research, Co-operation and Electric Domestic Appliances.

Shortage of materials, restriction of output, and inability to concentrate upon mere articles of civil utility during the war period produced its inevitable result in connection with the design and manufacture of electric domestic appliances. In the early days of peace British manufacturers of these articles of household utility found their designs more or less obsolete. Foreign manufacturers who had not been handicapped to the same extent during the war began to pour into the country electric appliances which, as regards design, and particularly finish, were admittedly more attractive articles than the British product, which was necessarily still at the 1913 stage of progress, and so the outsider was enabled to obtain a strongly entrenched position in the British markets.

A Survey and its Results.

About that time a survey of the position was taken by the METROPOLITAN-VICKERS ELECTRICAL COMPANY, LTD., Trafford

but insulated from, the sole plate, thus making a short path for the heat to traverse, the result being that correct ironing temperature (about 150°F.) is attained in three minutes after switching on.

Electric Kettle Design.

In designing an electric kettle the chief necessity is the firm clamping of the elements against the heat bottom. It is necessary for the elements to be tight and close so as to provide a short heat path, and the best way to obtain this desideratum is to use studs passed through the kettle bottom. At the same time, however, provision must be made to keep the kettle permanently watertight. In the manufacture of the "Cosmos" kettles and jugs the following method is employed:—Holes are first drilled in the bottom plate. These holes are of smaller diameter than the studs, being afterwards enlarged by punching, so that a portion of the metal is splayed out and projects below the underside of the plate. A

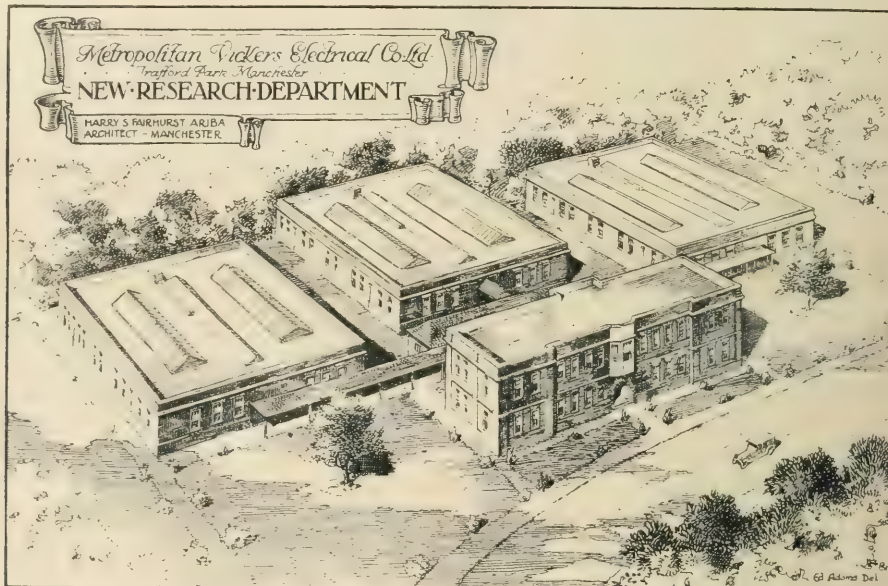


FIG. 1.—GENERAL VIEW OF THE METROPOLITAN-VICKERS RESEARCH DEPARTMENT.

Park, who had acquired the "Cosmos" Works at Brimsdown, Middlesex, and it was found that the problem presented a three-fold aspect.

It was necessary first to investigate thoroughly designs on a scientific basis, with a view to obtaining a maximum thermal efficiency and commercial reliability. Secondly, to improve methods of manufacture so as to produce the appliances at prices competitive with imported goods. Thirdly, to co-operate with the retailer and to give him assistance in the breaking of new ground.

The designs of this company's range of electric domestic appliances were then thoroughly investigated at their newly-built and extensive research laboratory at Trafford Park (see Fig. 1). Exhaustive experiments and tests were carried out on scientific principles with every type of heating and cooking appliance which could be obtained, and the products are now on the market under the well-known name of "Cosmos."

Some Interesting Iron Tests.

Fig. 2 illustrates the "Cosmos" domestic iron, and Figs. 3a, 3b, 3c, and 4 show the result of an interesting experiment. These are untouched photographs of scorch patterns resulting after various makes of electric irons had been placed on white pieces of paper with the current switched on for an equivalent length of time. The scorch pattern for the "Cosmos" iron (Fig. 4) indicates the correctness of the design, for, as will be seen, the heat is evenly distributed over the sole plate even to the point. Pure mica is used as the basis for the heating element, which consists of crimped nichrome wire. The element is clamped tightly against,

glance at the sketch A in Fig. 5 will make this clear. The stud is then forced into place, with the head driven home on to the top side of the plate. It will be seen from the sketch B that the stud has a collar, making a recess between the stud-head and the kettle bottom.

In the next operation the splayed-out metal is caulked into



FIG. 2.—THE "COSMOS" IRON.

this recess, and the whole is then soldered, making a perfectly watertight and rigid joint. It should be particularly noted that the stud is held firm by reason of the caulking, and its rigidity is not dependent upon the solder.

Fig. 6 indicates the special "Cosmos" table kettle, while Fig. 7

shows a type of "Cosmos" jug. With the latter utensils a holder for use when boiling eggs has been recently devised.

Electric Fires.

In considering the design of an electric fire it was found that radiant heat produced electrically is equivalent to the pleasing glowing warmth usually associated with a coal fire when it is burning at its best.

After exhaustive tests and experiments the company designed the "Cosmos" radiant fire shown in Fig. 8. This consists essentially of a polished and lacquered copper bowl, parabolic in section, at the focus of which is fixed a cylindrical heating element, the whole



FIG. 3a.



FIG. 3b.



FIG. 3c.

of which, when the current is switched on, glows with a bright red heat. The heat rays thus produced are reflected from the parabolic bowl in parallel rays, producing instantly a very pleasing warmth at any point in the beam. The bowl is hinged to a stand so that the radiant heat beam can be directed as required in the vertical plane, the whole heater being turned to cover the horizontal plane. A portable fire of this kind is a very useful article in the household, particularly in the nursery and bathroom. There are many occasions where warmth is quickly required in other parts of the house. This fire can not only be carried from room



FIG. 4.—SNOORCH PATTERN OF "COSMOS" IRON.

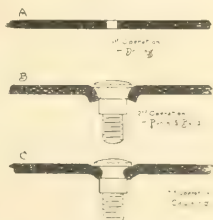


FIG. 5.—HOW THE "COSMOS" KETTLE IS KEPT WATERTIGHT.

to room, but, as mentioned above, its design is such that the heat can be directed to any part of the room at will. By directing the rays to the spot occupied during shaving, dressing the hair, &c., immediate comfort is to hand, and it is quite unnecessary to wait till the chill is off the air and the whole room raised in temperature before this can be experienced. In other methods of heating, where the heat rays cannot be focussed, this delay is inevitable.

Improved Methods of Manufacture.

With regard to improved methods of manufacture we have already drawn attention to the efficient manner in which the



FIG. 6.—THE "COSMOS" KETTLE.



FIG. 7.—THE "COSMOS" JUG.

elements. These are but two instances pointing to the careful attention which has been given to the small details of actual manufacture, which in their sum total make for considerable savings in manufacturing cost and improvement in quality.

The Metropolitan-Vickers Electrical Company, it is interesting to note, believe in co-operation with the retailer and the safeguarding



FIG. 8.—THE "COSMOS" RADIANT FIRE.

of his interests in all their operations. To this end well-equipped showrooms and demonstration centres have been opened up in various parts of the country. A notable example is the showroom recently opened at Bristol. Here, as at other showrooms and stores in the chief towns in this country, probable clients can be sent by retailers to see for themselves electrical household appliances actually at work. All sales effected as the result of such demonstrations are completed through the retailer concerned. This system avoids the necessity of electricians, contractors, ironmongers, &c., carrying complete stocks, especially of large items such as washing machines, vacuum cleaners, and the like.

They further provide a series of window showcards, as well as give away folders dealing with "Cosmos" appliances, which can be overprinted with the name and address of the retailer. Fig. 9

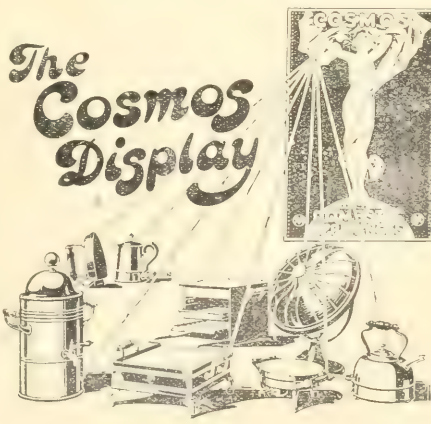


FIG. 9.—A TYPICAL METROPOLITAN-VICKERS SHOW CARD.

Metropolitan-Vickers Company has met the problem of fixing element studs in the kettle and jug bottoms. A further instance worthy of mention is the special machine they have in operation for crimping the nichrome wire used in the kettle and iron

shows an application of one of these showcards which is printed in ten colours, but we are afraid that the black and white illustration fails to do justice to what is in reality a very pleasing and effective display.

B. & K. Success in Dual Capacity.

Writers on the subject of supply economies have often deplored the fact that in the electrical industry there is so little co-operation between the manufacturers of current and the manufacturers of current-using apparatus. The almost complete severance of the two groups has not only been bad from the economic point of view,

For ten years the B. & K. Company have been making cookers, and for ten years they have been installing them on their own mains, where they have been under the continual supervision of the designers. Is it any wonder that, with this special experience and peculiar privilege, the B. & K. Company have been able to produce so good a cooker as the "B. & K."? Not only have they had the benefit of watching the day-by-day use of their cookers by their own consumers, but they have also been blessed in the possession of the B. & K. Restaurant with its completely equipped model kitchens, where every detail of performance and construction could be subjected to the test of heavy service and close and continuous inspection.

What the B. & K. Company Do!

The B. & K. range of manufactures is fully described in a catalogue issued a month or so ago. Herein are listed plate-warmers, urns, fish friers, grills, combined grill and hot cupboard, wall grills, boiling tables, pastry ovens, steaming ovens, steamers, boiling pans, combined hot cupboard and carving tables, and cooking stoves, ranging from the model "D" cooker capable of meeting the "cuisinistic" needs of a family of four or six, to the "E" and "K" models suitable for restaurants and boarding houses.

Model "D" Cooker, which is illustrated in Fig. 1, is an interesting piece of apparatus, and although it has already been described in these columns it will do no harm (and may even do a lot of good) to repeat here the maker's specification:—

The overall dimensions of cooker are:—

	Loadings in Watts.		
	High.	Medium.	Low.
Oven (available space), 15 in. by 13 in. by 12 in.	1200	600	300
Hot Cupboard (available space), 18 in. by 15 in. by 4½ in.	—	—	—
Grill, 9 in. by 7 in.	1200	—	—
Two 6 in. boiling plates, each	800	400	200

Total loading 4000 watts.

The frame is of cast-iron with bright polished facings and top plate. The outside of the oven is panelled with black-enamelled steel sheets. The oven is lined with heavy gauge white-enamelled steel sheets, double cased and efficiently lagged. The heating elements are placed at the sides and are completely shock proof and easily renewable; they are composed of insulated sheets, between which the wire is disposed. No mica is used, and no electrical connections of any description are made in the oven. Meat hook, trays, baking sheet, and drip pan are provided.

The grill comprises a protected spiral which runs at a bright red heat, attached to a refractory insulating material, and arranged to give a high percentage of radiant heat with a minimum consumption per square inch. The hot cupboard is heated by means of the grill, and quickly attains sufficient temperature for warming plates and dishes. The boiling plates are of high efficiency, reliable,

FIG. 1.—THE "B. & K." MODEL "D" COOKING STOVE.

but, in the opinion of many people, has had the serious technical disadvantage of preventing, or at least discouraging, that pooling of technical experience and knowledge which is so essential to any comprehensive improvement in the design and application of electric cooking and heating apparatus.

An Economic Drawback.

The economic drawback lies in the fact that the central station which confines itself to the generation of current is obviously not in a position to compete fairly in the matter of supply charges and facilities with, say, the Gas Light & Coke Company which, if it does not actually make apparatus, sells it on a large scale. On the technical side, there is, in the case of a great deal of the heating and cooking apparatus on the market, evidence that the designers have considered the problem from the aspect of immediate profit rather than from that of satisfactory performance.

It is claimed by those who advocate amalgamation between the supply and manufacturing sections of the industry, that an enterprising company which produced both current and apparatus would be able to do both things better and more economically than is permitted by the present separatist policy.

An Argument for the Anti-Separatists.

The success of the Brompton & Kensington Company in the dual capacity of current suppliers and apparatus makers is an excellent argument for the anti-separatists. The B. & K. Company, through their subsidiary organisation—the BROMPTON & KENSINGTON ACCESSORIES COMPANY, LTD.—have for several years been engaged in the manufacture of cooking appliances. In a technical journal it is hardly necessary to dilate upon the merits of B. & K. apparatus. It has set a standard to which many other manufacturers can do no more than piously aspire.

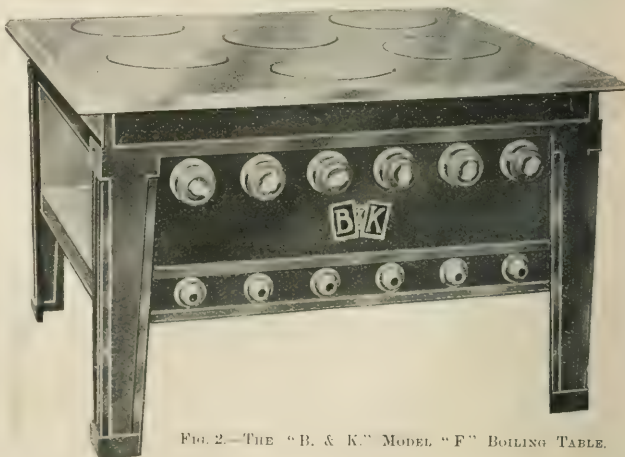


FIG. 2.—THE "B. & K." MODEL "F" BOILING TABLE.

and heat-up quickly. The electrical arrangements are conveniently disposed to facilitate inspection and repair without dismantling the cooker. Four fuses and a pilot lamp are mounted on the cooker in a convenient and accessible position.

There is, perhaps, nothing very revolutionary about this specification, but it should be noted that the description refers, not to

an enormously expensive cooker, but to a cooker of relatively low price and medium loading—well within the means of any middle- or lower-middle-class household. Certainly there are not many other electric cookers on the market comparable with the B. & K. model "D" in equipment, price and utility.

The model "H" oven and model "F" boiling table, which we illustrate herewith (Fig. 2), are yet other examples of modern electric cooking equipment manufactured by the company. They emphasise the fact that in all the "B. & K." designs an endeavour is made to raise the cooking apparatus well above the floor level, not only for convenience in operation, but also to ensure cleanliness.

In the manufacture of electric cookers, as in every other department of industry, success will come to those who accept and put into practice the principle that "the men who know best what is wanted should combine with the men who know best how to make it." This the B. & K. Company have done.

Fish and Chips from "Falco" Fryers.

The FALKIRK IRON COMPANY, Ltd., are enthusiastic over the possibilities of developing the use of electric fryers in fried-fish emporia.

Their well-known "Falco" apparatus for fish frying is made in a variety of sizes—from a single oval pan for small restaurants and fried-fish shops up to large multiple pan suites for canteens, hospitals and large hotels. What may be called the "Fish and Chip" suite consists of two large cast-iron pans, enamelled inside. The legs, top and back are of very sound and solid construction, being of cast-iron, while the cover of the pans and the chip box is of sheet metal. A canopy can be fitted over the whole top if required. Each pan is controlled by a separate switch on an illuminated switchboard fitted with fuses, and various degrees of heat regulation are obtainable. The elements are robust and of strong construction, being of a similar pattern to those that The Falkirk Company have found successful for ship's galley service, than which there is none more exigent.

A lighter type of fryer complete with a canopy in sheet metal is also made. This is fitted with a new open-type element which permits of a lower loading.

The Pleasurances of Home.

Turning from the lurid atmosphere of the fried-fish shop to the more subdued pleasantries of home, the "Falco" Electric Cooker, has been designed to comply with the requirements of the modern electric home, i.e., one containing either a small or a medium-sized family.

The cooker has ample oven accommodation—an important point—two radiant type boiling burners, and a griller, and is complete with switches and fuses, thus forming a compact, serviceable, and reliable cooker, which has the additional advantage of being offered at an extremely low price. The cooker is well finished, and the hob being hinged at the back, can be lifted, thus exposing the whole of the wiring. We are told that the oven is ready for roasting or baking within fifteen minutes of turning the switch on to "high" heat, a temperature of 350°F. being obtained by this time, rising to approximately 550°F. in thirty minutes.

The hob carries two radiant type open-coil boiling burners, which allow of any kind of cooking vessel being used upon them, while, when the griller is in use, the hob plate immediately above it can often be used for preparing food which only requires a low simmering heat.

Cooper Construction.

This cooker is strongly constructed of cast-iron and mild steel, double cased and heavily lagged, the hob edge, grids and door moulding being ground and polished, the remainder of the body being black enamelled. The oven is fitted with side heating elements which are strongly protected with easily removable guards, and is surmounted by a hob chamber, which carries the whole of the connections, fuses, and the various heat regulating switches. These switches control respectively the oven, the grill, and the two radiant boiling burners, the oven and boiling plates all being arranged for three-heat regulation. The grill has one heat only, and is controlled by a single pole switch of similar pattern to the others. The fuses are housed inside the hob out of the way. The fuses can, however, be easily got at by lifting the hob, which is released by undoing one thumb screw. The grill is complete with grill pan and grid, whilst each boiling burner has a nickel-steel reflector as well as the white porcelain enamelled crown plate under the grill. An important point is that the open coil spiral elements in the boiling plates and grill can very easily be renewed when necessary which, we hope, is not often. The oven elements are run at a very low temperature, and so, not surprisingly, have a remarkably long life, and, as they are all parallel wound, any one can be removed or even be out of commission without seriously affecting the working of the oven. The total loading is approximately 5 900 W, of which the oven is responsible for 2 000 W.

A Sunny Vista.

Looking through a batch of pamphlets issued by the SUN ELECTRICAL COMPANY, LTD., one gets a sunny vista of what might be if all electrical firms were as enthusiastic and enterprising in their business, and as persuasive in their propaganda, as the Charing Cross harbingers of a fumeless millennium.

In these artistically printed leaflets, one is introduced to daintily-dressed and exceedingly decorative housewives who cook, launder, heat their rooms, and clean their carpets without disturbing a single hair or impressing a solitary stain or blemish upon their clothes or persons. Needless to say, these ladies pursue the electric way, and, more specifically, are users of Sunco apparatus.

One booklet describes the A.B.C. electric laundress. This has



SUNCO FIRE HEPPLEWHITE MODEL. TWO-BAR FIRE.

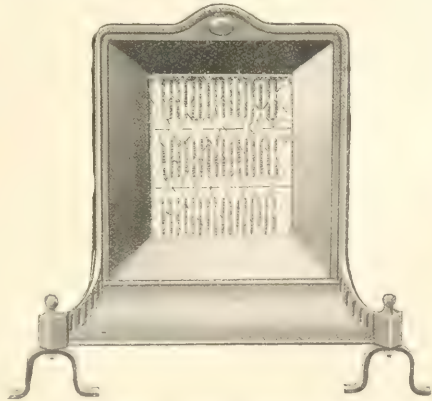
already been dealt with in these columns. It is sufficient here to say that its general principle is a combination of the "lift and dip" and the "rock and toss" methods of dirt removal. Each of these methods is admitted by experienced charwomen to be excellent, and the alternate employment of both in the A.B.C. apparatus entitles it to a high position in the serried ranks of mechanical washers.

Then there is the Sunshine cleaner which, operating purely on the suction principle, will devour the dirt of a dozen rooms in an hour or so; the A.B.C. ironer, which will iron anything ironable, and also many things which could not be ironed by hand; and a charming range of Sunco fires in Jacobean, Adam's, Hepplewhite, which we illustrate, and other designs.

Arora Fires.

The ARORA COMPANY of Loughborough manufacture a very satisfactory range of electric fires. These are supplied in several good-looking types with from one to four fire bars.

The element used in the Arora fires is constructed of extra heavy tape section strip, which would, under ordinary circumstances, remain at a black heat, but with the patented form of



THE LATEST "ARORA" THREE-BAR FIRE.

spiral employed gives, we understand, a pleasing glow at low current density, the maximum of radiant heat being produced. Elements are mounted on fire clay of extraordinary strength. A typical fire is shown in the accompanying illustration.

The Arora element is made in two standard sizes, viz., 750 W and 1 000 W, and for the ordinary standard voltages.

The "Genii" Footwarmer.

The "Genii" footwarmer is made by Nobbs for nobbs and others! The joke was as inevitable as it is weak. However, there is a general impression that footwarmers are intended solely (quite unintentional this time) for the use of an anemic aristocracy. That is entirely wrong. Everybody gets cold feet at times, and a handy (the pen is entirely out of control) little footwarmer such as that supplied by GEORGE NOBBS, Ltd. would be a great comfort in many a middle-class home, especially in the "between" months of autumn. In fact the device might be described as an autumn circulation promotion appliance.

The footwarmer, which we illustrate herewith, is constructed of



NOBBS' MAHOGANY-FRAMED FOOTWARMER.

a solid framing of mahogany with a woven cane panel and four turned legs. The loading is 100 W only, and comprises four low temperature type "Genii" heating elements each consisting of mica strip wound with chrome nickel wire, with nickelled steel connection bands, bolted to a steel frame mounted within the footwarmer. Connections are made solid to two service terminals without the use of any beads or loose wire connections. Easy access is given to the elements (should they ever require to be renewed) through the brass wire frame secured to the under portion of the mahogany frame.

These foot warmers are extremely effective for warming purposes and when used under a table or knee-hole of a desk provide a gentle but ample warmth to the nether extremities of anyone sitting thereat.

A Bedwarmer Too!

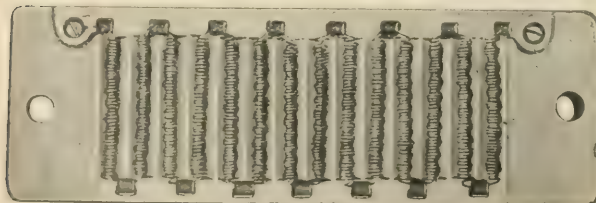
Proceeding from the feet to other parts of the body, the same firm have also designed a "Genii" bedwarmer whose distinctive feature is, as is perhaps as well, "safety first." This warmer is loaded for approximately 20 to 30 W. The construction comprises a polished copper cylindrical container with a corrugated surface to increase heat radiation. "Genii" replaceable elements are inserted through the neck of this container, and consists of the mica wound strip type, being connected by 20 ft. of flexible cable enclosed in rubber tubing to a lamp-holder adaptor. The size of the warmer is 11 in. by 4½ in.

As the chief feature of a bedwarmer is to warm and not over-heat, the temperature reached is important. Tests made with this bed warmer showed that with a thermometer bound directly to the copper container and covered with two flannel blanket bags, and another thermometer placed in close contact between the two flannel bags, a steady temperature was quickly reached and maintained at about 200° at the surface of the copper container, and 180° on the flannel covering.

Sullivan Fires.

It is difficult for the manufacturer of electric fires to be original in any way. As a rule any novel feature means a definite loss of heating efficiency, as, for example, in the heater, which, in trying to simulate glowing coal, sacrifices a deal of radiant heat.

In the SULLIVAN fire there is no pretence to novelty of appearance,



THE SULLIVAN ELEMENT.

but there is the actuality of great efficiency in the production of radiant heat. The heating element, which we illustrate, consists of a metal strip wound in a special form different from that used in any existing electric fire. This construction allows the air to

circulate more freely through the windings, enabling the strip to be safely run at a higher degree of incandescence than is ordinarily employed. The spirals are of thicker section than is usual, and, notwithstanding the high temperature and brilliance at which they are run, have an exceptionally long life. These spirals are mounted on fireclay bars made from highly refractive materials, and the resulting heat is uniformly distributed over the entire surface. Furthermore, red heat is obtained within twenty seconds of switching on.

Heating elements, switches, and terminals are mounted complete on a frame which is attached to the fire-front or case by suitable bolts. This arrangement makes for mechanical soundness and accessibility. The fire-fronts and cases are of distinctive and artistic design and are available in a variety of finishes and colours.

Industrial R-L-M Dispersive Reflectors.

THE BENJAMIN ELECTRIC COMPANY have added to the debt which the electrical industry and the country generally owe them by increasing the number of efficient and well-thought-out designs of industrial light fittings they have placed on the market. Among the most recent of these fittings is the R-L-M dispersive reflector, of which examples are given in the accompanying illustrations.

This reflector is suitable not only for industrial, but other general purposes as well. Its chief feature is that from it a widely distri-



FIG. 1.—THE LATEST BENJAMIN DISPERSIVE REFLECTOR.

buted illumination is obtained, though the contour is such that the actual light source is always effectively concealed from the normal line of vision. In this way glare is avoided and the comfort and convenience of the workpeople are adequately cared for. In the past a widely distributed illumination such as is obtained



FIG. 2.—ANOTHER TYPE OF BENJAMIN REFLECTOR.

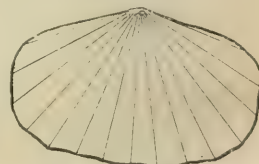


FIG. 3. DISTRIBUTION CURVE FOR NEW BENJAMIN REFLECTOR.

from this fitting could generally only be obtained by employing a shallow reflector in which, of course, the light source was visible, and inconvenience from this point of view was therefore increasingly evident the lower the fittings were mounted above the working plane. This consideration has become of increasing importance with the introduction of gasfilled lamps, and the reflector we have just described is designed to overcome this difficulty while at the same time giving a wide light distribution. This, as will be seen from the accompanying curve (Fig. 3), it is quite capable of doing.

We understand that a very complete range of these fittings is now available, smaller sizes being designed for use with 20 to 30 W lamps, and ranging from these up to the larger sizes which find employment with gasfilled lamps of 1500 W capacity.

It is interesting to point out that the obsolete conical shape is completely done away with by using these reflectors, and it is now possible to get effective light distribution from the smaller sizes of lamps.

SURFACE WIRING SYSTEMS.

Helpful Notes on Existing Methods.

One of the chief hindrances to the proper progress of electric lighting is the high cost of installation. Wages are high and material is abnormally expensive. Wiring contractors may, or may not, be able to justify their charges, but the fact remains that these charges are uneconomic, because they are practically prohibitive for the ordinary householder. If electric light were a luxury like fur coats or plovers' eggs, it would be a different matter. But electric light is *not* a luxury, it is a necessity. Without it all kinds of evils and discomforts must ensue—from the risk of explosion to the certainty of dirt and inconvenience.

Some Advantages.

The most promising factor in the situation is the growing popularity and use of surface wiring. Surface wiring is considerably less expensive to install than any conduit system, not because the materials are necessarily cheaper, but because so much less labour is involved. In completed buildings the use of surface wiring systems is particularly advantageous, since the installation can be carried out with little or no damage to decorations or interference with the normal routine. Apart from the ease and relative cheapness with which surface wiring can be installed, the method has certain electrical and mechanical advantages which should commend its use on strictly engineering grounds.

Several surface wiring systems have been developed. In the main all these systems are alike. They differ, however, in details, such as bonding clamps, fixing clips, and junction boxes, &c.

The "Kingsway" Surface Wiring System.

Wiring systems come and wiring systems go, but it is only just to add that more come than go, and that the tendency of those that have recently been placed on the market is towards greater simplicity and foolproofness, making for cheapness both in

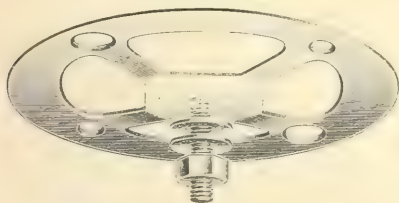


FIG. 1.—THE "KINGSWAY" BACKPLATE.

erection and maintenance. This is all to the good. For a most necessary link in the development of the electrical industry is a wiring system which shall be economical to instal and reliable in operation. The best system of wiring is like the best digestion, one of which we are never reminded. That is an ideal to be worked for, though many modern systems approach it quite closely.

Among the latest recruits in this field is the GENERAL ELECTRIC COMPANY, who, in designing their new wiring system, the "Kingsway," have kept before them not only the necessity of complying with the exacting and often conflicting requirements demanded by a wiring installation, but also the desirability of

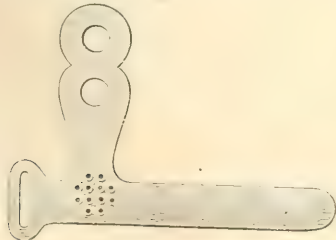


FIG. 2. THE "KINGSWAY" CONTINUITY CLIP.

reducing the number of special accessories and parts to a minimum. Much time and care have been devoted to the perfection of all the details, with the result that the "Kingsway" system may be said to be at once simple in design, easily installed, not unsightly, safe in operation, and moderate in cost. A special feature, or rather lack, is that the varied assortment of small bolts and nuts usually

associated with surface wiring systems is absent, and such apparatus as switches, distribution boards, ceiling roses, &c., are all of the ordinary standard patterns. The contractor is therefore able to deal with a large volume of business without carrying heavy stocks of many special fittings, which should endear the "Kingsway" to him.

Details of the System.

Briefly, the "Kingsway" system is a surface wiring system in which metal sheathed wire and cables are employed. These

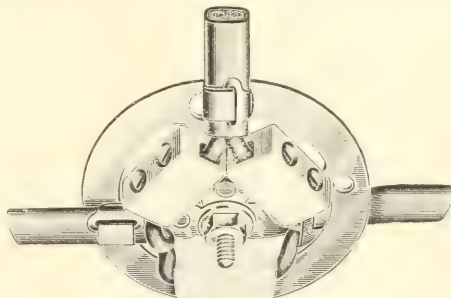


FIG. 3.—"KINGSWAY" BACKPLATE, WITH WIRES AND CONNECTORS IN POSITION, SHOWING METHOD OF BINDING.

cables are of the company's well-known class E.L. grade, lead-covered cables, manufactured at the Pirelli-General Cable Works, Southampton. The wires are fixed to the walls and ceilings by saddles or wiring clips. All connections are made by means of insulated connectors, and the continuity of the metal sheathing is effected by continuity clips attached to a special back-plate. Joints and back-plates are covered either by a "Kingsway" universal junction-box cover, or by a wood pattress.

How the System is Made Up.

Details of the various components can be seen in the accompanying illustrations.

Fig. 1 is the backplate, which is of stout tinned brass. It is provided with a centre screw which acts as an earth terminal, and also as a fixing for either the "Kingsway" junction box-cover or

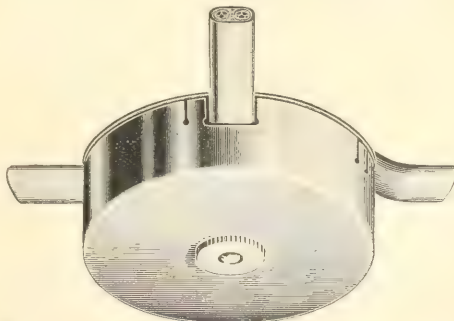


FIG. 4.—THE "KINGSWAY" UNIVERSAL JUNCTION-BOX COVER.

a wood pattress. Two washers and a clamp nut are provided to secure the continuity clips and two large and two small holes in the base allow for fixing in any position.

The "Kingsway" continuity clip (Fig. 2) has been designed to avoid the use of independent binding clamps with their accompanying troublesome small screws and nuts. Only one size of clip is required for providing adequate binding of the metal sheathing, whether the cables enter the junction-box or wood pattress from the side or back. When the cable enters from the side, the hole nearer the end is threaded on to the centre screw of the backplate. For back entry the second hole is used, and the overlap broken off.

The "Kingsway" universal junction-box cover is a neat but robust stamping. This cover can be easily and quickly

adapted, without the use of special tools, for any number of entries up to four, by bending upwards and inwards the tongues of metal formed between the slits in the wall. Four sets of three slits are provided, allowing for single, twin, or three-core cable. A milled nut is provided for fixing, and is permanently attached to the cover to avoid loss. In Fig. 3 is shown a "Kingsway" backplate with wires and connectors in position. The method of binding is clearly seen. Fig. 4 shows a box complete with cover.

The neat wiring clips used in this system are worthy of note. They are constructed of soft tinned brass, the fixing hole being countersunk, so that the heads of screws or fixing pins cannot project above the surface of the clip and cause injury to the metal sheathing of the cable.

The Earthing Bar.

For use at the back of fuseboards, multiple switch boards, and other positions where it is necessary to bond several cables together, a special earthing bar is recommended. This is made of stout tinned brass strip, the connections being made by means of the "Kingsway" continuity clip, which is attached by a flat-headed countersunk screw. A substantial terminal with nut and washers is provided for the earth connection.

Enough has been said to outline the chief technical features of this system. As regards its possibilities from the economic standpoint, the ease with which the "Kingsway" system can be handled and installed without special training or the use of special tools will result, it is claimed, in a great saving of time and labour.

The Henley Wiring System.

The Henley system (W. T. HENLEY'S TELEGRAPH WORKS, LTD.) hardly needs to be described at this stage of its history. It was introduced in 1911, but has since been considerably improved in detail. The system comprises two main classes of wires, viz., "twin" and "earthed concentric." The earthed concentric system is, of course, a great deal cheaper to install than the twin, but it is practically confined to buildings possessing their own generating plants, or where current is supplied through a double-wound transformer. For general purposes the twin system is the one that would be employed. The word "twin" is perhaps rather misleading, because, although twin wire would most commonly be used, single and three-core cables are also supplied. All single cables are of circular section, and the twin and three-core cables are of flat section.

The Henley system comprises all the accessories required for installation, such as fixing clips and saddles, earthing clips, bonding

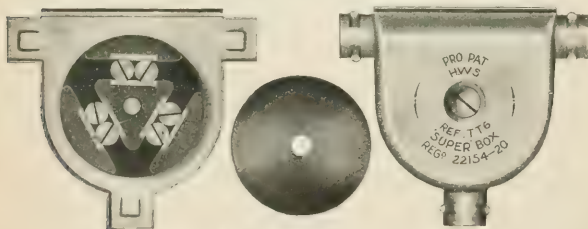


FIG. 5.—THE HENLEY "SUPER" TEE BOX.

clamps, bonding strips, &c.. One or two special features may, however, be described. There is the "Novel" switch. This is for use in cases where it is desired to loop at the switch. The ordinary switch can only be employed for this purpose when in conjunction with a porcelain connector. The "Novel" switch has three terminals, and may therefore be used without an extraneous connector.

The "Super" Tee Box.

Another item of interest to those who study appearances, is the "Super" Tee Box (see Fig. 5). This is small and neat and may be fixed on the surface of any room without shocking the aesthetic susceptibilities of the most exigent housewife.

The points of advantage connected with this box are claimed to be as follows: One screw holds the cover on so ensuring perfect bonding at all outlets. The screw head is always fixed in the cover—whether the cover is on or not—and it cannot be lost. The screw head is self-centering and automatically finds the threaded stud which is permanently fixed to the base of the box, and which passes through a central hole in the insulating block inside the box. The screw head cannot be tightened until the cover is in its correct position. A lip and slot fitting at the top of the box ensures the cover being fitted in the correct position and makes it easy to get it there. In fact, it could be done in the dark.

It should also be noted that the cover forms a spring washer grip on the screw head and prevents subsequent loosening by vibration.

The connecting block inside is made from a practically unbreakable insulating material in which heavy brass terminals are embedded. The binding screws of the terminals are self-centering, and can be placed in position very easily.

The box has, in fact, been designed by practical wiremen having a full knowledge of what is actually needed for quickness and security in jointing, and it should, therefore, help further to cut down the already low time taken in installing the Henley wiring system. The whole box is neat and substantial.

The J. & P. System.

The J. & P. system, produced of course by JOHNSON & PHILLIPS, is beautifully simple. The manufacturers have eliminated every complication and have reduced the number of accessories to the minimum. This does not mean that anything is lacking. On the contrary, the system is absolutely complete. But it does mean that

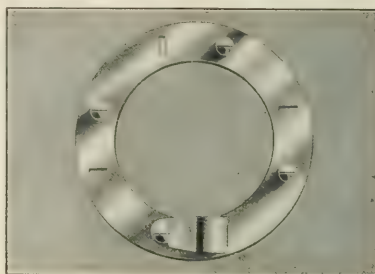


FIG. 6.—THE "J. & P." BONDING RING.

the J. & P. System is singularly free from special devices and tools. A reference to the J. & P. price-list will bear out this contention. This characteristic is obviously an advantage, since it tends to reduce the time and cost of installation.

The J. & P. System cannot, however, entirely avoid the charge of specialization. There is one special feature—the bonding fixture

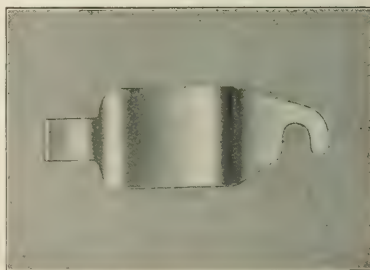


FIG. 7.—THE "J. & P." CLIP USED WITH THE BONDING RING.

(see Fig. 6). This consists of a bonding ring and clips. To fix, the tail of the clip (Fig. 7) is simply inserted in the slot in the ring, the cable placed under the clip, and the notched end of the latter pushed under the screw head. The screw is then tightened up and the cable sheathing is thus securely held, and absolute continuity achieved. A perfect bond in a fraction of a minute—a feat beyond the powers of the most rapid and irreverent registrar!

It is interesting to note that several recent wiring contracts, in which the J. & P. Wiring System has been specified, have been booked at a price of 25s. per point—a figure at least 40 per cent. below the lowest tender for screwed tubing, and considerably below the price for slip conduit.

The St. Helen's C.T.S. System.

C.T.S. cables, endeared to the readers of electrical journals by the quaint conceits of the ST. HELEN'S CABLE COMPANY'S Director of Propaganda, are the basis of what is undoubtedly the simplest of all the wiring systems that ever adorned the interior surfaces of buildings.

There is no need to mention in detail the merits of cab-tyre sheathing. It is impervious to almost every sort of fluid, and affords ample protection to the conductors. Since there is no metal covering, earthing and all the troubles of continuity and bonding, are entirely absent from the St. Helen's System, C.T.S. cable can be run like bell wire, but, unlike the bell wire of common experience, it is extraordinarily durable. C.T.S. cable is usually

run on the surface, but it can be buried beneath plaster, underground, or below floor boards without further protection.

The usual method of cleating is by means of lead strips about 3/8 in. wide and 1/16 in. thick, which can be obtained in coils and cut with a penknife into convenient lengths. Ordinary ready-made clips are also quite suitable. For protection against nails, a patent ebonite covering strip is supplied. Under normal conditions any ordinary fittings may be used with C.T.S. cable, but for use in chemical works, dye works, breweries, &c., the patent "U-Seal" corrosion-proof fittings have been designed.

Many notable buildings are wired with C.T.S. cable, the Houses of Parliament for one. Corrosion-proof fittings were not used in this installation.

The Ediswan House-Wiring System.

The characteristic feature of the EDISWAN Wiring System, of which we gave full details a short time ago,* is the bonding ring (see Fig. 3) for the purpose of connecting together the metal sheathing of the cable at all ceiling roses, switches, or other fittings. It is made of soft tinned-brass in which there are four slits, the sides of which are formed so as to allow the metal-covered cable to pass through. The outer and inner diameters of the bonding ring are the same as the outer and inner diameters of the block, and the blocks are supplied with grooves to fit the bonding ring and cable. When the block is screwed down in the ordinary manner, the cable is gripped on both sides by the bonding ring, and perfect electrical contact is made. No small screws and nuts are required; the necessary bonding is obtained simply by screwing down the wood block by means of the usual wood screw through its centre. It is always possible when inspecting the completed work to see whether the bonding ring has been properly inserted, as the edge and the turned-up portion are visible at the sides of the block.

For back-entry, instead of inserting the cable itself through the slit in the ring, a wing of lead should be turned back from the cable and inserted in this slit. A plain block is then used and, when screwed home, presses the lead and ring tight

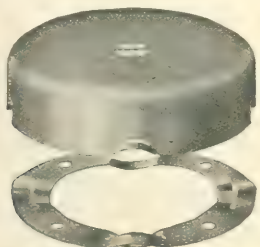


FIG. 8.—EDISWAN BONDING RING AND BLOCK.

together. If there are both side and back-entry cables to the same block, a block with the requisite number of grooves for the side-entry cables only is used, and the spare ways in the bonding ring are employed for gripping the lead of the back-entry cables.

Another feature of the Ediswan system is the cable fixer, which takes the place of the clips and saddles used in other systems.

The Ediswan cable fixer gives, it is claimed, the ideal support; the cable is held by a lead strap, but the mechanical weakness usually associated with lead saddles is non-existent. A lead strap is passed round the cable, a bronzed cap fitted over the ends, and the whole nailed or screwed to the wall or ceiling. The cable is securely held without any possibility of the head of the nail or screw being pressed against it; there are no projecting edges of metal; and the minimum time is occupied in fixing.

For vertical runs and on ceilings, the straps should be used with the heads on alternate sides of the cable to secure the firmest fixing, or the strap may be used as a saddle with a cap at each end.

The Prescott Wiring System.

The Prescott Wiring System (BRITISH INSULATED & HELSBY CABLES Ltd.) presents an interesting departure from ordinary methods of manufacture. Metal-sheathed cables and (more or less) usual fittings are employed, but the wires are paper insulated. Paper insulation has, of course, proved its value for street service work, and there seems (and indeed is) no good reason why it should not be equally suitable for internal wiring. As a matter of fact, the Prescott system is very widely employed in the North of England, and some of the largest housing-schemes are wired throughout with paper-insulated twin lead-covered cable. In one northern town, for example, over 80 per cent. of the private consumers have had their houses wired on this system. Paper

insulation is, of course, less expensive than rubber insulation, and the Prescott system has, therefore, a distinct price advantage over other systems.

The fittings and accessories included in the Prescott system

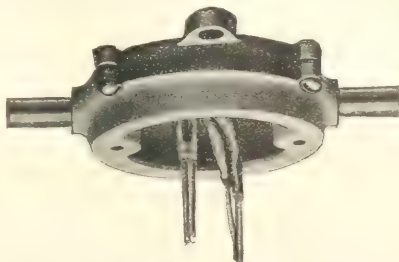


FIG. 9.—PRESCOTT SEALING BASE FOR SWITCH OR CEILING ROSE.

comprise joint boxes, tees, switch and ceiling roses, bases provided with bonding device and distribution boxes. A view of the standard base is given in Fig. 9.

Simplex "Terra-Grip" Continuity System.

The Simplex "Terra-Grip" continuity system has been introduced to provide an inexpensive means of effecting ample and permanent electrical conductivity in light gauge unscrewed conduit installations. In fact, it is stated that an installation erected on this system costs but little more than one on the plain socket joint system.

Each outlet of every fitting has a drilled and tapped boss for housing a steel screw of the formation shown in Fig. 10. After the conduit is inserted into the outlet of the fitting, the screw is driven home, and, by virtue of its structure, the cup-shaped nose of the screw on making contact with the conduit expands, as shown in Fig. 11. In expanding the enamel is automatically scraped off the conduit, thus ensuring a degree of continuity which otherwise could only be obtained by actually scraping off the enamel before insertion. Further, the expansion of the cup-shaped nose automatically locks the screw in position, thus making it impossible to loosen under vibration. This constitutes a very important advantage of the "Terra-Grip" continuity system, and is a feature due solely to the peculiar formation of the screw employed.

Where alterations or extensions are required, it is a comparatively easy matter for the "Terra-Grip" screws to be withdrawn, the peculiar formation of the cup extension piece, which flattens when the initial pressure is exerted for driving the screw home, permitting of this. On reversing the turn of the screw the cup-shaped portion partially reforms, and is sufficient to allow the screw to be withdrawn. Alternatively, the action is that the flattened cone parts at the thinnest portion of the wall, leaving a steel ring interposing between the fitting and the conduit. The screw end is then easily removed, and the conduit can be withdrawn by extending sufficient pressure in order to remove the detached portion of the continuity device.

Conductivity tests on "Terra-Grip" junctions have been carried out by the Electrical Engineering Department of the University of Birmingham, by measuring the potential drop in millivolts



FIG. 10.



FIG. 11.

across a number of conduit "Terra-Grip" junctions in series. Currents up to 40 A were passed through the conduit and junctions, and the average resistance per junction was found to be only three ten-thousandths of an ohm, thus proving the remarkably good conductivity of this type of junction.

While no practical experience with this system extending over a considerable period has so far been obtained, it has been employed in many recent installations, and has given entire satisfaction to date.

A minor advantage not referred to above is that there is no weakening of the wall of the fitting in obtaining continuity; actually the boss housing forms a strengthening point.

The "Stannos" System.

The "Stannos" System of wiring, introduced by SIEMENS BROTHERS & COMPANY, was, as is well known, the earliest metal cased wiring system to find adoption to any extended degree. It is the only system in which the outer protective sheathing is composed entirely of copper. It can be installed very economically and inconspicuously and where concentric wiring is employed only a single sheathed conductor need be run from each



FIG. 12. THE "STANNOS" CLIP IN USE.

point. Moreover, the fact that the outer protective sheathing is in close contact with the insulation gives this system the quality that for a given size of conductor the overall diameter is smaller than a conductor of equivalent area in most other systems of surface wiring without detracting from its protection against mechanical injury and damp. Its flexibility may also be noted in its favour.

A point of considerable importance in considering the question of wiring on the "Stannos" system is that under conditions which

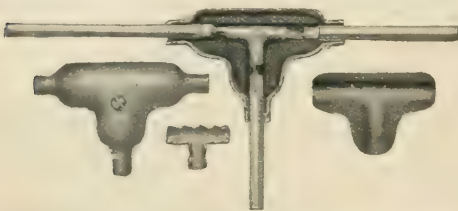


FIG. 13.—THE JOINT BOX, SHOWING COMPONENT PARTS AND METHOD OF JOINING SINGLE WIRE CIRCUIT.

prevail in many installations (*e.g.*, where an earthed return can be employed) the outer sheathing of a "Stannos" wire may be used as such a return, and in fact this property was taken largely into consideration at the time the "Stannos" system was designed. It follows, therefore, that when used in this manner one "Stannos"

are provided. The installation of these fittings requires no greater skill than is necessary in the case of those accessories of a similar character which are employed when either conduit or wood casing is used.

The "Stannos" System of wiring is, it is claimed, proof against the attacks of rats or mice, and is therefore eminently suitable for use in warehouses, store rooms and old premises. If desired, the installation of "Stannos" can be carried out in such a manner that the whole installation is absolutely waterproof, and in support of this statement the fact may be stated that many miles of "Stannos" wire have been erected in the open with no further protection than a coat of paint applied once every three or four years.

"Stannos" wire is installed easily and quickly and, as already stated, it may be bent to conform with the architectural outlines of the surface over which it is run; it does not sag when carried across ceilings or along walls, it can be buried in plaster without further protection, and in suitable soil it may be laid direct in the earth.

The illustrations (Figs. 12 and 13) show the methods adopted for obtaining continuity and also one form of clip employed for the attachment of the wires to the building, as well as the watertight tee joints for use in positions where such protection is required.

The Glo-clad Wiring System.

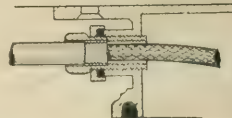
The Glo-clad System (W. T. GLOVER & COMPANY, LTD.) employs a rubber insulated cable sheathed with a lead-alloy which is harder and stronger than pure lead. Glo-clad cables are supplied in single and twin types, together with a complete range of accessories. Continuity is, of course, an essential feature in all metal-sheathed wiring systems. In the Glo-clad System, however, the designers have combined continuity with watertightness.

At all junctions and terminals the Glo-clad cable is bonded and sealed by means of an internally screwed brass gland fixed in a watertight iron box. Sectional views (Fig. 14) of this gland are shown, from which it will be seen that intimate bonding is obtained by screwed contacts and that watertightness is secured, first by screwing the gland into the box, next by screwing the gland back along the cable sheath, and, finally, by means of a gasketed locknut which completes the water seal. No plumbing work is involved, and neither flame nor soldering iron is needed. When installed in an acid-laden atmosphere these glands are enclosed and painted, and the Glo-clad cable is provided with additional protection in the form of an acid resisting braid.

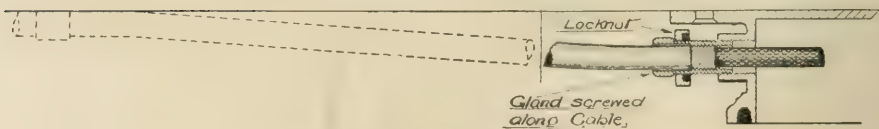
The only special tool required is the Glo-clad die holder (the dies themselves being of the standard "card" type), but



Drawing the cable through the gland.



Correct position of the screwed cable within the gland.



Gland screwed back along the cable sheath.

FIG. 14 THE GLO-CLAD GLAND, SHOWING METHOD OF ATTACHMENT.

wire only need be run over each circuit, thus, it is claimed, effecting a saving in both material and labour.

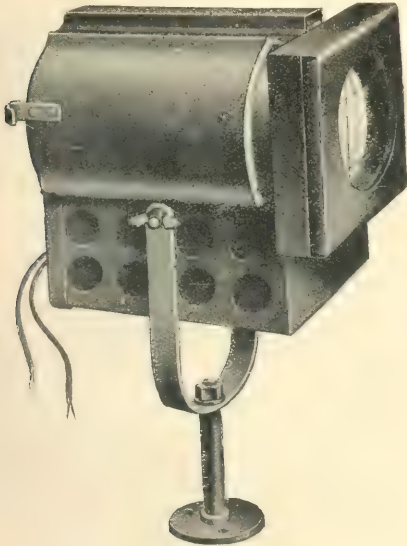
In order to ensure uniformity throughout the whole circuit, certain fittings of simple design and capable of easy installation

attention is also directed to the Glo-clad stripping tool, which was described in our issue of June 24th, 1921. This provides a desirable alternative to the more dangerous pocket-knife method of trimming cables.

The "Baby Spot"—A Miniature Projector with a Hundred Uses.

An entirely new production of considerable importance is the "Baby Spot"—a miniature spotlight projector—shown herewith, and manufactured by the BRITISH THOMSON-HOUSTON COMPANY, LTD. It is intended to meet the demand for a spot lamp equipment for use with gas-filled concentrated filament lamps.

Designed primarily for theatre lighting, the "Baby Spot" can be used in many other fields of lighting work. For instance, it is eminently suitable for the spot lighting of special articles in store



GENERAL VIEW OF B. T. H. "BABY SPOT."

windows, and for the illumination of cinema corridors, clock faces, indicators, small posters, signs, &c.

Although its total weight, including brackets, is only 5 lb. 11 oz., it is very strongly constructed. The body is of sheet steel, enamelled dull black, and the component parts comprise a mirror glass-reflector, with copper back, painted with elastic enamel, focussing device, porcelain holder, lens, and universal bracket. The reflector is of such radius that light reflected therefrom reaches the lens at the same angle as light given direct from the filament. The lens is plano-convex in form, and 4 in. in diameter, and is so arranged as to give a parallel beam with the lamp in focus and a wide beam when the lamp is moved forward. By loosening the wing nut on the underneath portion of the body, the lamp can be moved forwards or backwards according as a "spotting" or "flooding" effect is desired. This wing nut secures both reflector and lamp in any desired position.

The apparatus is extremely compact, and is thoroughly well ventilated. A slide is fitted in front of the lens so that colour mediums may be used when required. This slide attachment is so arranged that it in no way interferes with the beam of light. By a single operation, the colours can be changed as desired in a few moments.

Nottingham Electricity Extensions.

A further sum of £40 000 is required by the NOTTINGHAM Electricity Committee for supply mains and services, and £10 000 for meters. The £30 000 authorised to be borrowed in December last for underground mains and service connections has been spent, and further capital is urgently required for extensions of mains. The committee have already laid extra high-tension mains for supplying various factories and for the first and second sections of the Sherwood housing scheme, in addition to ordinary extensions. The £40 000 now required is for general extension of mains, transformers, and switch gear in connection with the high-tension mains already laid, and for increasing the area of two feeders supplying the Sherwood-street and Derby-road districts.

The "Osglim" Lamp.

The "Osglim" lamp, which is fully described in a new leaflet issued by the GENERAL ELECTRIC COMPANY, presents a successful and interesting solution to the problem of producing electric lamps of really low candle power and current consumption for use on ordinary lighting circuits. For such purposes as night lights, visual indicators, &c., on pressures of 200 V and over, the choice has hitherto been between the 20 W metal filament lamp, and the 5 or 8 c.p. carbon lamp consuming more than 20 W. "Osglim" lamps consume 5 W as a maximum, and produce a light which, although of low intensity, is amply sufficient for the purposes mentioned. The lamps are obtainable in two standard ratings, for 200 to 220 V and 221 to 520 V circuits. The patents covering these lamps are jointly owned by the BRITISH THOMSON-HOUSTON COMPANY and the GENERAL ELECTRIC COMPANY.

An entirely new principle in lamp-making is involved in the design, which consists essentially of two metal electrodes sealed into a glass bulb containing rarified neon gas. These electrodes are connected to an electric circuit (either d.c. or a.c.) by a bayonet cap and b.c. holder in the ordinary manner. The potential difference between anode and cathode produces an electrical discharge across the rarified gas, and as a result of the ionic bombardment a glow of a characteristic reddish-orange colour is produced as a luminous haze surrounding the cathode. The construction of the lamp is simple, and the absence of filament does away with the weakest part of an electric lamp. The mechanical strength is therefore very great, being limited only by the strength of the glass bulb.

Two patterns are made: The "letter" type has the cathode in the form of a block letter, numeral, or simple device about 1½ in. high. This is principally used in simple designs for displaying a word or words, which are claimed to be nearly as conspicuous in daylight as in the dark. The other type, which we illustrate, is for use where merely an indicator or safety light is required, has the cathode with a thick wire spiral wound roughly into the shape of a beehive. The glow is produced both on direct current, when the cathode only shows the glow, and on alternating current when both electrodes are luminous. Some modifications are introduced into the direct-current lighting lamps, however, which make them less effective on alternating current, so that in practice two separate types of this pattern lamp are made. The letter lamps are made suitable for use on either kind of current.

The lighting lamps are primarily intended for dim illumination. They make excellent night-lights in nurseries, sick rooms, and hospitals, and may be used for all-night illumination of corridors



THE "OSGLIM" LAMP

in hotels, ships, &c. On account of their low current consumption and distinctive light, they are satisfactory and economical as pilot lights, circuit indicators on switchboards, &c. For illuminated advertising the letter lamp has a wide field of application, not only on account of the nature of its design, but also because of the small amount of current it consumes. The G.E.C. have designed an attractive range of signs for use with these lamps. A universal adjusting device is fitted to each lampholder so that individual lamps may be turned, raised, or lowered to bring them into correct alignment.

Window Displays.

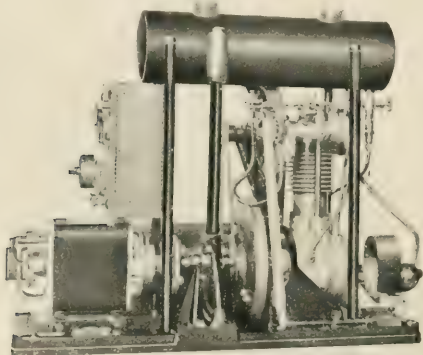
A feature of the General Electric Company's autumn sales campaign is the attractive window displays which the company are offering to loan to their clients. We have seen some of these displays exhibited in the windows at Magnet House, Kingsway, and they combine the merits of novelty and good taste with exceptional publicity value. That designed to advertise OSRAM LAMPS is shown in the accompanying illustration. It consists of a back cloth and various pieces of beautifully painted and shaped scenery, depicting a winter scene in an old English village, and is intended to carry home the appeal of the comfort and attractiveness of good lighting



by Osram lamps. By means of hidden lamps the windows in the model houses may be illuminated, thus adding greatly to the realism and attractiveness of the display. As the whole apparatus is very simple in design, and can be erected in a short space of time without any special knowledge, the company's offer should appeal to all interested in the sale of lamps. A limited number of these displays are available for loan, application for which should be made on the special form attached to leaflet O.S. 2619, which also gives full details and instructions for erecting. These leaflets are being mailed to the trade, but additional copies can be obtained on application to Magnet House, Kingsway, or to any of the company's provincial branches.

The Mark II Bungalyte.

The illustration given below shows the latest type of Bungalyte, manufactured and specially designed by ARTHUR LYON & COMPANY for bungalow, houseboat, and cottage owners, &c., who require a small plant at a reasonable outlay. The Bungalyte comprises a generating set with six-, ten-, or fifteen-light battery, at a cost of £105, £110, and £116 net respectively. The engine is of the four-stroke type, air-cooled, flywheel-governed, $1\frac{1}{2}$ H.P., with a large



shifter and lever mechanical starter. The dynamo has a rating of 350/450 W at 25/35 V when running at 1750 revs. per min. The switchboard is equipped with an automatic battery cut-out, switch and fuses, ammeter and voltmeter, and field regulation for final charge. The engine consumes one gallon of petrol per ten hours on a 300 W load. Only two or three drops of lubricating oil are used per minute. The dimensions of the set are 28 in. by 18 in. by 21 in., and the net weight is 90 lb.

Legal Intelligence.

DAMAGING A SAFETY LAMP.

At Mansfield last week a charge against Geo. Langton, an employee of the Warsop Main Colliery, for damaging an electric safety lamp, was dismissed owing to lack of evidence.

The evidence for the prosecution was that the lamp was issued to defendant in good condition, and at the end of the shift it was returned by someone else, and defendant returned another lamp. The lamp was found to be damaged in two or three ways. Defendant explained that as the lamp did not burn very well he turned it upside down and bumped it against the roof and the floor.

The defence was that it was essential that Langton should have a good lamp for his work. When the lamp was issued to him he found that the light was dim, and the corporal changed it for him, and then the lamp passed on to a third man.

TRAVELLER AND HIS COMMISSION.

In the Shoreditch County Court, on Monday, the Weston Electric Lamp Company sued Mr. A. Stuart, of Ramsgate, a dealer in lamps, &c., to recover £20 11s. 1d. for goods sold and delivered. Defendant admitted £5 8s. 1d. only.

Mr. A. E. Robinson (for plaintiffs) said the amount was £53 13s., and credit had been given to defendant for commission on sales to the amount of £42 1s. 11d., leaving the balance claimed. Defendant was not entitled to commission on returned or unpaid for goods and that was the dispute.

Judge Cluer pointed out to defendant that if there was a dispute he should have put in a counterclaim.

Mr. Harry Fenniman, sales manager to plaintiffs, said there was no dispute that goods had been supplied, but defendant wanted more commission than he was entitled to; they only paid on cash received. They had deducted £15 2s. 11d. for commission on returned goods and bad debts, but defendant seemed to think he had been treated badly.

Defendant asked witness: "Did you not say you were manufacturers of these electric lamps?" Witness: "Certainly not; we are not manufacturers."

Defendant said the whole trouble was that they would send lamps from five or six manufacturers in one consignment, some of them inferior, and, of course, they were rejected. However, witness strongly denied that this had ever occurred. Judge Cluer told defendant that it hardly concerned the case as to whether the lamps were inferior or not. Where goods had not been accepted by the buyer the defendant could not expect to draw commission. There would be a verdict for plaintiffs for £20 11s. 1d. and costs.

Electrical Trades Benevolent Institution.

Sir Tom O. Callender, who will preside over the ANNUAL FESTIVAL of the ELECTRICAL TRADES BENEVOLENT INSTITUTION on the 26th inst., has issued an appeal for contributions to the funds of the institution. Sir Tom points out that the primary object of the institution is to grant pensions to those members who may fall on evil days, the funds being provided out of income from investments. As this is only £650 per annum, the amount available for distribution is very limited. In addition, the institution gives help to certain others in the electrical industry who find themselves in temporary distress. The value of such prompt aid in the hour of need is incalculable, and much real assistance has been given in this manner. He concludes with a special appeal for liberal contributions on the present occasion. Further particulars may be obtained from the hon. secretary, Mr. F. B. O. Hawes, 18 and 21, Park-mansions, Vauxhall Park, South Lambeth-road, S.W. 8.

Industrial League Lectures.

On Wednesday last the INDUSTRIAL LEAGUE AND COUNCIL inaugurated its winter session with an instructive lecture by Mr. Ernest J. P. BENN, C.B.E., on "The Capitalistic System." An important series of weekly lectures on subjects relating to industry and commerce have been arranged. The lectures are followed by debates, in which members of the audience are invited to participate. This has been the practice hitherto adopted by the League with such beneficial results from the point of view of educational propaganda in relation to industrial questions. By this means large audiences were attracted to the lectures given in Caxton Hall last winter, and it is hoped that similar success will attend the series arranged for the next few months.

On the 12th inst., Sir Harry Brittain, K.B.E., M.P., will preside over the meeting, at which Mr. C. Jesson, M.P., will lecture on "The Importance to the Worker of Initiative and Enterprise." This will be followed on October 19 by Mr. E. W. Petter, on "Economic Axioms of Industry," and on October 26, Mr. E. W. Mundy, B.A., will lecture on "Profit Sharing and the Coal Settlement."

The first smoking concert of the season of the ELECTRO-HARMONIC SOCIETY will be held in the Great Hall, Cannon-street Hotel, on Friday next, Oct. 14, at eight o'clock.

The State Transit Commission, which has been investigating the financial position of the NEW YORK CITY TRAMWAYS, elevated and underground railways, recommends the adoption of municipal ownership of the undertakings. There are few municipal councils in the States operating public utilities, and it is doubtful if the recommendation will be adopted.

Electricity Supply.

The WELWYN Garden City, which now has a population of 800, has electricity and gas supplies.

During the week-end GUILDFORD Corporation took over the undertaking of the Guildford Electricity Supply Company, Ltd.

There was a FAILURE OF THE ELECTRICITY SUPPLY IN OXFORD on Monday evening, owing to a breakdown at the power station.

ACCRINGTON Electricity Committee have decided to put four emergency men in communication with the depot by fixing telephones in their homes.

DARWEN Electricity Department has revised its minimum charges, fixing 5s. for the quarters ending June 30 and Sept. 30 and 10s. for the quarters Dec. 31 and March 31.

The Electricity Commissioners have fixed Oct. 1 as the date for the commencement of the operation of the WARRINGTON Electric Lighting (Extension) Order of 1915.

The Electricity Commissioners have issued a special order to the Wye Lighting, Heating, & Power Company, Ltd., for the supply of electricity for public or private purposes.

STEYNING (Sussex) Parish Council has sealed an agreement with the local electric light company for lighting fifty-four street lamps at £2 19s. 6d. per 50 c.p. lamp per annum.

The Ministry of Health has refused the request of ILFORD Urban Council for permission to instal electricity in the new L.C.C. houses on the Dagenham Estate, on the ground of the expense involved.

KEIGHLEY Corporation have agreed, subject to the necessary powers being obtained, to enter into an agreement with SKIPTON Urban Council to give a supply of electricity in bulk in the SKEPTON area.

The York Town and Blackwater Gas and Electricity Company's intended application for authority to increase the electricity charges has been referred by the EASTHAMPTON Rural Council to Councillor R. A. Patterson for inquiry.

BARNSTABLE Town Council has applied for sanction to a loan of £1 500 for the electricity department. The salary of the Borough Electrical Engineer is to be reduced from £425 to £382 10s. per annum, and that of the assistant engineer from £250 to £225.

On the occasion of the visit of H.R.H. the Duke of York to SHEFFIELD, on the 27th inst., when he will be the principal guest at the Cutlers' Feast, arrangements have been made for the OPENING OF THE CORPORATION'S NEW ELECTRIC POWER STATION by His Royal Highness.

In regard to encourage the steel industry, SHEFFIELD Corporation have reduced the price of electric current for furnaces. Many furnaces have been standing idle because of the high price of current, but in consequence of the reduction over a dozen electric furnaces have been restarted.

At LLANDRINDOD WELLS last week an inquiry was held into the application of the Electric Light and Power Company for an order authorising an increase in the price of electricity to 1s. 4d. per unit. The Urban Council and a number of consumers resisted the application.

Additional generating plant, estimated to cost about £2 000, is required for the PORTSTEWART electricity works, and the Lighting Committee of the Urban Council is considering means of providing the money. A more central position for the station is also under consideration.

LUTON Council has given notice that, as the cost of generating electric current exceeds the revenue, and as there is serious deficit for the half year ended September 30, the charge for electricity will be increased from 100 to 125 per cent. above the pre-war rate.

The BOOTLE Electricity Committee has intimated to the Town Clerk of Liverpool that the committee is prepared to consider the question of the amalgamation of the electric generating stations of the two county boroughs on a partnership basis. It is also proposed to transfer the electric lighting of Litherland to Bootle.

At the next meeting of the BURTON-ON-TRENT Corporation they will be asked to approve the scheme for the establishment of a joint electricity authority for the East Midland district. There will be four main stations, at Leicester, Nottingham, Derby, and Burton, with a small station at Newark.

Trouble has arisen at GREENOCK over the proposal of the Electricity Committee to reduce the salaries of the technical staff, and a threat was made by the Electrical Power Engineers' Association to call out the members on Friday last. Fortunately the strike stage was not reached, as the question is to be reconsidered by the Corporation.

A deficit of only £795 (against an expected loss of £2 312) on the SOUTHAMPTON Electricity Department for the past year was announced by Councillor A. C. Howard last week. A satisfactory settlement has been reached with the Pirelli General Cable Works, Ltd., which will mean a substantial increase in revenue to the Department.

CHESTER Electricity Committee have abolished as from September 29 the increased charge of 1½d. per unit, made to meet the increased cost of coal during the coal strike, and a new scale of charges will be considered when the Queen's Ferry scheme is in operation. Consumers have been asked to exercise economy in the use of energy during the month of November.

ASHTON-UNDER-LYNE Electricity Committee, owing to the short time being worked in local mills and workshops, find themselves able to deal with the applications for current from tradesmen and householders which have been held up for some considerable time.

The BIRMINGHAM Electric Supply Committee, having considered the situation created by the loss of revenue during the recent coal crisis, have decided not to increase the charges to consumers at present. It is hoped that an early improvement in trade, and consequent increase in output, will make it possible in the near future not only to cover the loss, but to reduce the charges to consumers. At present the output is creeping slowly upwards.

The scheme for harnessing the water at the Mill Pond to supply power to WALTON-ON-THAMES, introduced by Mr. C. F. J. Baker at the August meeting of the council, came up for consideration at a recent meeting. After listening to a detailed report of the scheme, prepared by Mr. F. G. Ball, the council decided to go into committee and discuss the matter. Ultimately the scheme was rejected on the ground that there would be no available power at near tides four days a month. It has, therefore, been decided to extend the power-house.

A report prepared by Mr. Grierison, Edinburgh Town Clerk, recommends that the area to be supplied from the new ELECTRICITY STATION at PORTOBELLO should include the Lothians within a radius of ten miles of the station. The only existing authorised distributors within the area are the Musselburgh and District Electric Light and Traction Company at Musselburgh, and the Electric Supply Corporation at Dalkeith, and these would take electricity in bulk from the Corporation. The report, which also suggests that the application by the Musselburgh Company to extend its area of supply, should be opposed as unnecessary, has been generally approved by the Corporation Committee concerned.

The SKEGNESS Urban Council has been notified by the Electricity Commissioners that they cannot see their way to recommend the Minister of Transport to grant a further extension of time for inaugurating a supply of electricity. Therefore they propose to recommend the Minister to revoke the powers of the council to supply electricity under their Act of 1914, but before doing so they have invited any further observations which the council may desire to offer. In consequence of this the council has decided to interview a local electrician and hear his suggestions on the matter. In their application to the Commissioners the council stated that the outstanding loans, exclusive of housing, were £102 570, the assessable value of the district being only £26 330. As the municipal gas undertaking is being carried on at a considerable loss, the council desire to protect it from competition, and this is the real explanation of the dilatory tactics employed hitherto. A number of tradesmen of the town have installed electricity, and are giving a supply to their neighbours.

On the advice of the engineer and manager (Mr. John Christie) BRIGHTON Corporation has reduced the charge for electric current for private lighting from 8d. to 7½d. a unit. In the course of his report Mr. Christie stated the recent coal strike caused a loss of £6 200 in revenue, and, with the increased cost of coal, the total loss was £13 000. Since the removal of the restrictions they had been gradually getting into their stride again, and the percentage drop in output for the current year was slowly being reduced. With the reductions which will take place in the cost of fuel for the rest of the year, the saving in wages effected by the reduced awards and bonuses, and the increased revenue from the new cinema theatre, the Hove bulk supply and the general development of the business, there would probably be a surplus profit of some £16 000. They had four efficient turbines in service at Southwick, the last three of which were really modern efficient units, and they could not be replaced to-day for well over £100 000. They were not insured against breakdowns, as the premiums asked for that class of business were prohibitive, and the terms and conditions enforced by the companies too onerous to accept. It would, therefore, be a very wise policy on the part of the council to maintain the price for electricity to all classes of consumers at a sufficient high figure to ensure the earning of an extra surplus profit, which in the course of, say, two or three years, would amount to at least £30 000.

A meeting of BELFAST Corporation was held in committee on the 29th ult., for the purpose of receiving the report of Messrs. Preece, Cardew, & Rider, consulting engineers, in reference to the electricity undertaking. The report of the engineers, who were represented by Mr. J. H. Rider, stated that the capital expenditure on the electricity undertaking, when there was a maximum demand of 23 000 kW to be met, would be £1 835 234, exclusive of work done by local labour under the supervision of Mr. Bloxam, city electrical engineer. The amount was made up as follows:—Harbour power station, £870 144 (including contracts already let or work authorised £580 345, and additional plant £289 799); the existing works at East Bridge-street, £500 474; tramway plant and cables, £183 189; five sub-stations, £82 159; additional cable system; £110 740; extension scheme at East Bridge-street, £86 528. In the course of the discussion it was stated that in the report of last June the loss on the contract for the supply of current to the shipyards, providing their full demand was met, was estimated at £51 000, whereas in the new report the loss was reduced to £18 000. Mr. Rider was asked why the June report was withdrawn, and what were the new factors which had since been considered. Mr. Rider replied that as the June report had been withdrawn, and was consequently no longer in existence, he must decline to state the factors referred to. By eighteen votes to fourteen, the meeting was adjourned until full information on the point was forthcoming.

Electric Traction.

CHESTERFIELD Corporation Tramways Department are to dispense with the services of all female conductors, who have been given a month's notice.

A new electric tramway between the WARRINGTON Power Station and along Mersey, Napier, and Parr streets, is under the consideration of the Electricity and Tramways Committee.

Owing to the unsatisfactory financial position of their tramways, WALTHAMSTOW Urban Council have decided to invite the London County Council to take over and operate the system.

The parcels department of BRADFORD Corporation tramways having made a loss of £4,000 during the last year, the Tramways Committee have decided to call a special meeting to consider the advisability of closing down the department.

THE CHESTER Tramways Committee has been informed by Mr. A. R. Fearnley that he has now seen the Chester track under varying conditions, and if the committee wished he would discuss the matter before making his report. The committee has intimated that it would prefer to receive his report prior to interviewing him.

BIRMINGHAM Tramways Committee held a special meeting last week to draw up a programme of works suitable for the relief of the unemployed. The Committee have completed the current year's programme, but will indicate to the General Purposes Committee various track reconstructions which can be undertaken if funds are available.

The report of Col. J. W. Pringle to the Minister of Transport on the accident which took place at Wapping Station on the EAST LONDON RAILWAY on July 8 last has now been issued. The accident was due to the parting of a steam-operated goods train, six wagons from which ran back along the line and collided with an electric passenger train just as it was moving away from Wapping Station. The motorman of the electric train and an assistant goods guard were killed, and fourteen passengers and two guards were injured. The evidence showed that there was no reason to suppose that any flaw existed in the broken coupling hook which could have been detected by any reasonable means of examination.

The fact that the part of the railway at which the accident occurred is entirely in tunnels made it difficult for goods guards to realise that they were moving backward instead of forward, but Col. Pringle points out that if they had been more on the alert it should have been possible for them to have noticed the direction of the movement early enough to prevent the collision, and that the condition of the brake wheels and brake gear on the van after the collision throws doubt on the guard's statement that he had fully applied the brake. Attention is called to the fact that, though the line is fully track circuited, a mishap of this kind will automatically clear the signals, and that it is a matter for consideration whether a sand drag should not be provided as an additional security.

Institution Notes.

THE BIRMINGHAM AND DISTRICT ELECTRIC CLUB announces that the Eleventh Annual Ladies' Night will be held at the Grand Hotel, Birmingham, on Saturday evening, October 22. A reception will be held by the President, Mr. A. C. Wynne, at 6.30 p.m., to be followed at 7 p.m. by a concert. Members intending to be present, should communicate with the secretary, Mr. T. Birkett, not later than Saturday, October 15.

On the invitation of the promoters of the Commercial Vehicle Exhibition, the INSTITUTE OF TRANSPORT will hold a congress at Olympia on Monday, Oct. 17. There will be two sittings, at 11 a.m. and 2.30 p.m., when the following Papers will be read and discussed:—"Highway Maintenance and Administration under Modern Traffic Conditions," by Mr. A. E. Brookes, O.B.E., M.Inst.T., engineer, surveyor, and architect to Durham County Council; and "The Evolution of the Motor Vehicle for Goods and Passenger Service," by Mr. P. F. Smith, M.Inst.T. Mr. Smith's Paper will be read in the afternoon.

THE GLASGOW CORPORATION ELECTRICITY DEPARTMENT ENGINEERING SOCIETY held its opening meeting for the Session 1921-1922 on Monday last, when Mr. R. B. Mitchell, engineer and manager of the department, and president of the society, delivered his presidential address. Mr. G. Morgan, deputy engineer and chairman of the society presiding. Mr. Mitchell dealt with the progress of the department during the past year, and with its future prospects, and reviewed the effect of certain measures on the development of electricity supply. Mr. R. B. Maccall, secretary and treasurer of the department, and hon. vice-president of the society, was also present and addressed the meeting.

Telegraph and Telephone Notes.

The work of laying a new TELEPHONE AND TELEGRAPH CABLE BETWEEN SWEDEN AND GERMANY was completed on the 28th ult.

H.M.S. "Raleigh" is on a visit to St. John's, Newfoundland, for the purpose of inspecting the Admiralty wireless station, which will be used as a link in the IMPERIAL WIRELESS CHAIN.

The Federal Telegraph Company of San Francisco has now completed the preliminary arrangements for the erection at SHANGHAI of a RADIO-TELEGRAPH STATION capable of sending and receiving messages to and from all over the world. The equipment will consist of two 1,000 kW Federal arcs with six towers, each 1,000 ft. high, and secondary stations at Pekin, Harbin and Canton.

Personal and Appointments.

The Home Secretary has appointed Mr. A. J. McCOLGAN as an Electrical Inspector of Factories.

Mr. J. C. WIGHAM, late general manager of Edmundson's Electricity Corporation, has left for Russia to assist in the organisation of famine relief. He expects to be away for about six months.

Mr. W. T. URTON, of Messrs. Hill, Upton & Company, electrical engineers, of Oxford, has been elected Provincial Grand Treasurer of the Provincial Grand Lodge (Berks and Oxon.) of Mark Masons. Mr. H. WILSON, mains superintendent at Maidstone, has been appointed distribution engineer at Croydon, and he is succeeded at Maidstone by Mr. E. E. POPE, who has been constructional assistant there.

Mr. DUNDAS HEENAN, A.M.I.C.E., of the Power Speciality Company, Ltd., is proceeding to the United States of America on Oct. 15 for general business purposes, and in order to look around and see the latest developments in steam production.

We learn that Mr. J. S. CHILD has resigned his position as joint sales manager to the Edison Swan Electric Company, Ltd., after thirty years' service. For the time being Mr. Child can be found at his private address, Wormley House, Wormley, Herts.

The marriage took place at Chesterfield Parish Church on Sept. 24 of LIEUT.-COLONEL JOHN HOWARD ALEXANDER, M.C., D.S.O., resident engineer at Chesterfield for the British Thomson-Houston Company, and Miss Doris Harrison, only daughter of Mr. Arthur Harrison, of Chesterfield.

The Electricity Committee of St. HELENS Corporation having authorised the Works Committee to appoint a power station superintendent to fill the vacancy caused by the appointment of Mr. F. N. R. Baker as acting electrical engineer, Mr. J. Savage, of Paisley, has been appointed power station superintendent, and Mr. A. McLean engineering assistant, to succeed Mr. J. Cardwell, who has resigned.

We regret to learn that Mr. D. H. DAVIES, electrical engineer and tramways manager of Heywood, recently met with an accident whilst testing a machine watmeter, due to a short circuit on the standard testing instrument wiring starting an arc, which was a dead short circuit across the generator terminals. Mr. Davies and an assistant, Mr. Hadfield, were burnt on the face and hands, and were detained at the infirmary. The burns were not of a serious nature, and Mr. Davies returned home during the week.

The following three candidates for the position of borough electrical engineer of SOUTHPORT figure in the final list for selection:—Mr. W. J. Batchelor, deputy electrical engineer, Kingston-on-Thames; Mr. R. B. Leach, electrical engineer and general manager, Loughborough; and Mr. Edgar Moxon, borough electrical engineer, South Shields. The salary is £2800 per annum, rising by instalments of £50 to £3100 per annum. Before appointment is made a deputation of the Southport Electricity Committee will visit the electricity works at Kingston, Loughborough, and South Shields.

Obituary.

The death occurred on the 22nd ult. of Mr. J. H. BALFOUR BROWNE, K.C., a former leader of the Parliamentary Bar. He appeared for many electricity supply, electric tramway and railway schemes, and was a great authority on railway law.

Mr. RICHARD ERNEST WINKFIELD, an electrical engineer, who was formerly engaged in India, died on the 26th ult. as the result of a fall from the window of his flat in London.

The death is also announced of Mr. ERNEST J. SMALLPAGE, resident engineer at the works of the Northwood (Middlesex) Electric Light and Power Company. Mr. Smallpage was only thirty-eight years of age. The death of Mr. Smallpage's brother, also an electrical engineer, occurred within two days of the event.

The death took place on Saturday last of Sir JOSEPH SAVORY, at one time a prominent member of the Corporation of the City of London, and an ex-Lord Mayor. He was chairman of the City of London Pioneer Electric Lighting Company, Ltd., out of which the present City of London Electric Lighting Company was formed.

The death occurred on the 26th ult. of Mr. CORNELIUS B. HARNES, who was associated in the 'nineties with the electrophatic belt business and the operations of the Medical Battery Company, Ltd. Attacks upon the business by the "Electrical Review" involved our contemporary in a good deal of litigation, from which it emerged victorious.

Business Items, &c.

The Cardiff supply and accessory business of the METROPOLITAN-VICKERS ELECTRICAL COMPANY, LTD., has been transferred to the Old Custom House, Custom House-street.

THE SPEARING BOILER COMPANY, LTD., have removed from 11, Queen Victoria-street, E.C. 4, to larger offices at 20, Kingsway, London, W.C. 2. Telephone: Holborn 5740 and 5741; telegraphic address: Arceturus, Strand, London.

Firms desiring to take space for the exhibition of their goods on the BRITISH EMPIRE TRADE SHIP are asked to make early application to Messrs. J. Jackson & Sons, 7 and 8, Charing Cross, S.W., who have been appointed sole booking agents.

In regard to the establishment of the new firm of Sir CHARLES BRIGHT and PARTNERS, referred to in our last issue, the practice will be that of consulting engineers, and will not be confined to electrical engineering. The firm, whose address is 146, Bishopsgate, E.C. 2, will act in an advisory capacity for engineering schemes or undertakings, &c.

Tenders Invited and Accepted.

UNITED KINGDOM.

EDINBURGH CORPORATION. OCTOBER 10.—Electric light wiring, and fitting of the City Collector's offices. Particulars from the City Electrical Engineer, Dewar-place, Edinburgh.

LOUGHBOROUGH CORPORATION. (a) OCTOBER 31, (b) OCTOBER 17. (a) Steam-raising plant; (b) high and low pressure mains networks. Particulars from Mr. C. H. Wordingham, at 7, Victoria-street, Westminster, S.W. 1; or 11, Moseley-street, Manchester.

NOTTINGHAM CORPORATION. OCTOBER 21.—For North Wilford Power Station: (a) Three 10,000 kW turbo-alternators (for 1,500 r.p.m.), with exciters, condensers, auxiliary plant, &c., and one 1,000 kW turbo-generator alternator, with condenser, auxiliary plant, &c.; and (b) six water-tube boilers, with mechanical superheaters, forced-draught fans, &c. Specifications from Messrs. Preece, Cardew & Rider, 8, Queen Anne's-gate, Westminster, S.W. 1.

EDINBURGH TRAMWAYS COMMITTEE. OCTOBER 10.—Sixteen tram-car bodies. Particulars from the Tramways Manager, 2, St. James's-square, Edinburgh.

FIFE EDUCATION AUTHORITY. OCTOBER 14.—Electric lighting work in connection with new school at Crossgates. Plans can be seen at the office of Mr. H. H. Motion, Union Bank-chambers, Dunfermline.

GLASGOW PARISH COUNCIL invite tenders by Oct. 24 for the supply of electric lamps and fittings, ironmongery, &c., for twelve months. Tender forms from Mr. M. A. Reynard, 265, George-street, Glasgow.

CANNOCK URBAN COUNCIL. OCTOBER 18.—Transformers, switchgear, and cables. Specifications from the consulting engineers, Messrs. Arthur Ellis & Partners, 9, Park-street, Cardiff. Tenders to the Clerk of the Council.

COLNE CORPORATION. OCTOBER 14.—Natural draught-cooling tower. Particulars from the Engineer and Manager of the Electricity Department.

EAST ASHFORD GUARDIANS. OCTOBER 12.—Electric lighting of the workhouse infirmary at Willesborough, near Ashford. Particulars from the Clerk, Mr. Julius Kingsford, 7, Bank-street, Ashford.

LEEDS HEALTH COMMITTEE. OCTOBER 11.—Supply and erection of electric lighting set, comprising 4 B.H.P. oil-engine, 3 kW d.c. generator and accumulators, with switchboard, &c., at Leeds Sanatorium, Gateforth, near Selby. Particulars from the Town Clerk, 26, St. George's-street, Leeds.

PRESTON CORPORATION.—OCT. 15.—Four Edison accumulator electric tipping waggons, similar to the two waggons now in use in the Corporation's Cleansing Department.

SALISBURY CORPORATION.—OCT. 10.—Wiring and fitting twenty houses on the Wain-a-long-road housing site. Form of tender, &c., from the city engineer and surveyor.

AUSTRALIA.

QUEENSLAND, POSTMASTER-GENERAL'S DEPARTMENT. OCTOBER 19.—† Insulated wire.

VICTORIAN RAILWAY COMMISSIONERS. OCTOBER 19.—* Direct-current arc welding plant for Jolimont Workshops (contract No. 34 377), and armature winding machine, with electric motor and starting gear (contract No. 34 378).

VICTORIAN RAILWAY COMMISSIONERS. NOVEMBER 2.—* Storage battery, with accessories and spares (contract No. 34 229).

NEW ZEALAND.

WELLINGTON CORPORATION. OCTOBER 13.—Two water-tube boilers, with feed-water heaters, &c., and a 5,000 kW turbo-alternator, with condensing plant. Particulars from Preece, Cardew & Rider, 8, Queen Anne's-gate, Westminster, S.W. 1.

WELLINGTON, PUBLIC WORKS TENDER BOARD. NOVEMBER 1.—* New or secondhand auxiliary plant for the Rotorua electric supply as follows:—One oil engine (200 to 250 B.H.P.) and one three-phase 50 cycle alternator of 190 kW (power factor of 0.8), with exciter, &c. Also for steel pipe lines and fittings in connection with the Mangahao power plant.

WELLINGTON, CONTROLLER OF STORES, POST AND TELEGRAPH DEPARTMENT. NOVEMBER 21.—* 750 red and 750 white switchboard cords (three conductor, to specification No. 87).

WELLINGTON, PUBLIC WORKS DEPARTMENT. NOVEMBER 29.—In connection with Mangahao electric power scheme. Section 12: Three water-wheels of 6,450 B.H.P., and two water-wheels of 3,225 B.H.P., complete with governors, couplings, and accessories; Section 13: Three 6,000 kVA and two 3,000 kVA alternating-current generators; Section 14: two three-unit exciter sets, each consisting of one 375 B.H.P. Pelton wheel, one 250 kW direct-current generator, and one 350 H.P. asynchronous motor; Section 15: seven 4,000 kVA single-phase transformers and accessories; Section 17: insulators for 110,000 V 50 cycle transmission lines; Section 18: lightning arresters for operation on two 110,000 V three-phase transmission lines; Section 19: switchboard, switches, and accessories.

SOUTH AFRICA.

BULAWAYO (RHODESIA) MUNICIPALITY. OCTOBER 12, NOVEMBER 15.—The date for receiving tenders for the supply of electric light

and plant has been extended to October 12, if tenders are delivered to Davis & Soper, 54, St. Mary-axe, London, E.C. 3, and to November 15, if sent to the Town Clerk.

RAND WATER BOARD'S MAIN PUMPING STATION, VEREENIGING. NOVEMBER 7.—Two steam-driven electrical generating sets of 350 kW capacity, each complete with switchboards and all accessories. Tenders to the Secretary of the Board, Central House, P.O. Box 1 703, Johannesburg.

ADMINISTRATION OF THE SOUTH AFRICAN RAILWAYS AND HARBOURS. NOVEMBER 7.—* For twelve months, from December 31, of 85,560 incandescent train lighting lamps (tungsten filament) for 24 V, 8 to 10 c.p.; 8,125 engine head lamps, 150 W, 32 V (gasfilled $\frac{1}{2}$ W type, with concentrated filament); 50,472 incandescent lamps (tungsten filament); 5,545 incandescent lamps (carbon filament).

MUNICIPAL CORPORATION OF HUMANSDORP, CAPE PROVINCE. NOVEMBER 30.—Machinery and plant. Section A: one water turbine and dynamo, switchboard with connections, battery of accumulators, and accessories for same; Section B: electricity supply main and public lighting; aerial distributing lines, street lamps, fittings and accessories, section boxes, service cut-outs, meters, &c.; Section C: ferro-concrete pipe line; Section D: reinforced-concrete tank; Section E: buildings and foundations. Further particulars from the Town Clerk, Humansdorp.

DURBAN CORPORATION.—OCT. 21.—Four miles single tram track, complete with bonds. Specifications from Messrs. Webster, Steel & Company, 5, East India-avenue, London, E.C.

SOUTH AMERICA.

BUENOS AIRES STATE RAILWAYS. OCTOBER 21.—* Electrical stores for one year.

ARGENTINE STATE RAILWAYS. NOVEMBER.—* One year's supply of railway signal material, telephone and telegraph materials.

ARGENTINE DEPARTMENT OF NAVIGATION AND PORTS.—NOV. 3.—Electrical anemometers and anemographs, thermographs, barographs, tide gauges, and rain gauges. Specification, &c., can be seen until Oct. 15 and obtained on loan after that date at the Department of Overseas Trade, 35, Old Queen-street, S.W.

LONDON County Council have accepted the tender of the Stella Lamp Company for traction lamps for the Tramways Department.

STOCKPORT Education Committee have accepted the tender of the Power and Lighting Supplies Company, Ltd., for the wiring and fitting the Edgeley Council and Parish Church of England Schools.

GLASGOW Tramways Committee have accepted the following tenders:—McFarlane, Strang, & Company, suction piping for new turbo-alternator; Crompton & Company, 50 H.P. motor; P. R. Jackson & Company, Manchester Armature Repair Company and Armature Winding Company, armature coils; J. McLennan & Company and James Cookson, Ltd., trolley cord; Carrick & Ritchie, crane for cable store; Hendry Bros., Ltd., battery truck.

Miscellaneous.

What is claimed to be the biggest electric sign in existence has been installed at WADDON AERODROME, Croydon, to assist pilots landing in the dark. The sign is star-shaped, and measures more than a quarter of a mile from point to point.

We regret that in the article on "Recent Extensions at SUNDERLAND," which appeared on page 414 of our issue of September 30, Fig. 2 was wrongly described as the Regulating Switch for the Kapp Phase Advancer instead of as The Motor Driven Regulator for the 10,000 kVA Turbo Alternator.

Negotiations are still proceeding between representatives of the ENGINEERING EMPLOYERS' FEDERATION and the trade unions on the question of the withdrawal of the war bonus of 12½ per cent for time workers and 7½ per cent. for piece workers in the engineering establishments. The negotiations refer only to the engineering industry and not to the shipbuilding and ship-repairing trades, in which the position is unchanged.

The Medical Correspondent of the "Times," in an article in a recent issue on "Electric Shock: Methods of First Aid and Prevention," emphasises the fact that the prevention of accidents is largely a question of proper equipment and proper supervision, and refers to cases on record where, because some safety device such as a circuit breaker kept operating—thus disclosing a defect—it was actually removed.

The San Benito, the first ELECTRICALLY-PROPELLED SHIP BUILT IN IRELAND, has been built for the United Fruit Company of America by Messrs Workman, Clark & Company, of Belfast. The main generating plant consists of a B. T. H. Curtis turbo-alternator arranged amidships, steam being supplied from three oil-fired boilers. The plant supplies power to a large three-phase synchronous motor fitted in a separate motor-room aft, and coupled direct to the propeller shafts.

The view recently expressed in the "Times" by Sir William J. Noble that only by educating the country on the real FACTORS CONTROLLING THE ECONOMIC SYSTEM will it be possible to get away from columns by Sir Vincent Caillard, who draws attention to the fact the present unsatisfactory conditions, is supported in the same that a praiseworthy attempt is now being made by a body known as National Propaganda, No. 38, Dean's-yard, Westminster, to co-ordinate and regulate the necessary educational work for exposing the fallacies underlying Socialist economics.

* Particulars from the Department of Overseas Trade.

† Particulars from the office of the High Commissioner for Australia.

Catalogues, Price Lists, &c.

GEORGE ELLISON LAMBERT is a comprehensive list of lantern slides illustrating various types of electric control gear, which they are willing to loan to engineering and technical societies and technical colleges on application.

MESSRS. S. H. HEYWOOD & COMPANY, LTD., have sent us Nos. 13 and 14 of their Publications, dealing with "Electric Lifts" and "The Control of Electric Cranes." The booklets are tastefully produced and contain numerous illustrations.

MESSRS. COLE, MARCHENT & MORLEY, of Bradford, have issued an illustrated pamphlet, descriptive of the C.M.M.-Delos air extractors which they have recently made arrangements to manufacture under licence from the Société Condenseur Delos, of Paris. A full description of this air extractor appeared in our last issue.

We have received three leaflets from METROPOLITAN-VICKERS ELECTRICAL COMPANY. Circular No. 1254/1 is a reprint from "Metropolitan-Vickers Gazette" of an article by Mr. W. A. Coates on the "Breaking Capacity of Oil Switches and Circuit Breakers." No. 1266/1 gives details and illustrations of type "G-2" oil circuit breaker, and type "G-11" oil circuit breaker is dealt with in No. 1266/2.

Smokers will be interested in the General Electric Company's leaflet (H. 2599), which contains particulars of the "MAGNET" ELECTRIC PIPE-LIGHTERS. These lighters are supplied in two patterns and several finishes, and both types can be quickly converted for wall mounting. It is claimed that these pipe-lighters offer not only the cleanest and most satisfactory means of lighting pipes or cigarettes, but that they are much cheaper than matches or petrol lighters.

A revised edition of the "Safuse" and "Donlock" SWITCH AND FUSE GEAR LIST has been issued by MESSRS. DONOVAN & COMPANY, 47, Cornwall-street, Birmingham. Particulars are included of the construction, sizes, prices, and other details of the gears, which comply fully with the Home Office regulations, and are suitable for all voltages up to 600 V. All the apparatus mentioned in the list is manufactured under the firm's patents, and is safe in operation and efficient in working. Special attention has been given to the insulation from the cases of the current-carrying parts, and efficient arrangements are made for the proper earthing of the cast-iron boxes. The list contains details of a great variety of gear, sufficient to cover all ordinary requirements in industrial power and lighting.

THE CREDEDA CONDUITS COMPANY have produced for the coming season the Creda electric bowl fire, a feature of which is the efficient way in which the radiant heat maintained from the element is reflected by the bowl and concentrated upon any desired place. The bowl of the fire is made from spun copper, which is mounted by means of a swivel hinge on a cast-iron pedestal base, the base being enamelled in an art green colour. A substantial wire guard protects the element from accidental contact. The element has been designed to be easily replaceable, and consists of a spiral wire winding mounted on a fireclay cylindrical support, with grooves, in which it rests. The element is mounted on a spring support as a safeguard against damage through accidental knocks. It is quite a simple matter either to change it complete with the fireclay support or to fix upon the support a new spiral element. The selling price of this bowl fire is 50s., complete with four yards of flexible cord and lamp-holder adapter. The loading of the element is 600 W, and therefore the fire can be kept on circuit for nearly two hours with a consumption of one unit.

Arrangements for the Week.

FRIDAY, Oct. 7 (to-day).

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, Westminster, London, S.W. Paper on "Colour Vision and Colour Blindness," by Dr. E. Green.

SATURDAY, Oct. 8th.

ASSOCIATION OF ENGINEERS-IN-CHARGE.

6 p.m. At the Holborn Restaurant, London, W.C. Annual Dinner.

BIRMINGHAM AND DISTRICT ELECTRIC CLUB.

7 p.m. At the Grand Hotel, Colmore-row, Birmingham. Paper on "Commercial Efficiency of the Telephone," by Mr. C. G. Findlay.

WEDNESDAY, Oct. 12th.

INDUSTRIAL LEAGUE AND COUNCIL.

7.30 p.m. At Caxton Hall, Westminster, London, S.W. Lecture on "The Importance to the Worker of Initiative and Enterprise," by Mr. C. Jesson, M.P.

FRIDAY, Oct. 14th.

EDINBURGH ELECTRICAL SOCIETY.

8 p.m. At the Philosophical Institute, 4, Queen-street, Edinburgh. Paper on "Electro-Chemistry," by Mr. R. W. J. Stark.

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, Westminster, London, S.W. Paper on "Electric Cranes," by Mr. C. H. Woodfield.

ELECTRO-HARMONIC SOCIETY.

8 p.m. At the Great Hall, Cannon-street Hotel, London, E.C. Smoking Concert.

Companies' Reports, &c.

THE BELL TELEPHONE COMPANY OF CANADA has declared a quarterly dividend of 2 per cent. on the capital stock.

Applications are invited for £300 000 7½ per cent. mortgage debenture stock of the MERSEY POWER COMPANY, LTD., at 97 per cent.

The National City Company of New York is offering \$4 000 000 CUBAN TELEPHONE COMPANY first lien refunding mortgage 7½ per cent. bonds, due 1941, at 95.

Allotment letters for COUNTY OF SOUTHLAND ELECTRIC POWER BOARD 6 per cent. debentures may now be exchanged for scrip certificates at the National Bank of New Zealand.

THE CLYDE VALLEY ELECTRICAL POWER COMPANY has invited during the week applications for an issue of £500 000 8 per cent. cumulative second preference shares of £10 each, at par.

THE SOUTH METROPOLITAN ELECTRIC LIGHT AND POWER COMPANY, LTD., has posted the warrants for the half-year's interest on the 4½ per cent. first debenture stock, payable on the 1st inst.

THE MADRAS ELECTRIC TRAMWAYS (1904), LTD., announce an interim dividend at the rate of 6 per cent. per annum, less tax, in respect of profits for the year ending December 31 next.

The directors of BELL'S UNITED ASBESTOS COMPANY, LTD., have declared an interim dividend on the ordinary shares of 6d. per share (less tax) no account of the profits of the current year. The dividend will be paid on the 21st inst.

THE MONTEREY RAILWAY LIGHT AND POWER COMPANY announces that the plan of reorganisation has been sanctioned by the debenture stockholders. The existing debenture stock is to be exchanged for new debenture stocks at certain prescribed rates.

The directors of the CUBA SUBMARINE TELEGRAPH COMPANY, LTD., have declared an interim dividend at the rate of 5 per cent. per annum (tax free) on the ordinary shares, payable 13th inst.

The net profit of the HALIFAX AND BERMUDA CABLE COMPANY for the year ended June 30 was £18 465, plus £48 595 brought in, making £67 060, less £2 504 expended on repairs. The directors propose to pay a further dividend of 3 per cent., tax free, making 6 per cent., carrying forward £61 556, subject to excess profits duty and corporation tax.

During the week the COUNTY OF LONDON ELECTRIC SUPPLY COMPANY offered for subscription £500 000 7 per cent. redeemable debenture stock at 94 per cent., secured by a trust deed giving a general floating charge on the company's undertaking. The stock is redeemable at par in 1951 or in 1951 at the company's option, for which a sinking fund is to be provided. The issue was over-subscribed in one day, and letters of allotment and regret have been issued.

The receipts of the CIE. FRANÇAISE DES CABLES TÉLÉGRAPHIQUES amounted to 23 870 000 frs. in 1920, an increase of over 6 130 000 frs. The net profit was 10 991 000 frs., of which the sum of 3 799 000 frs. has been divided among the shareholders. The company is interested in the Cie. Générale de Télégraphie Sans Fil and the Société Radio Française. Radio-telegraph stations are to be established by these companies in French Guiana and Northern Brazil.

The profit of the TRAFFORD PARK ESTATES, LTD., for the year ended June 30 amounted to £67 581, which, together with the surplus on the redemption of chief rents (£46 653) and £84 269 brought forward, after deducting corporation tax for one and a half years (£10 900) provides an available balance of £187 603. The directors recommend payment of a dividend at rate of 8 per cent. per annum (£52 000) and to carry forward the balance of £135 603. Mr. Geo. R. T. Taylor has been elected to the board in succession to the late Mr. Balfour Browne, K.C.

The profit of HURST, NELSON & COMPANY, LTD., for the year ended July 16, after deducting repairs, directors' fees, salaries, and other charges, was £94 229, less depreciation, £17 406, leaving £76 823, plus £17 684 brought in, making £94 507. The directors recommend placing to general reserve £20 000, a dividend on the ordinary shares at rate of 2s. per share, and a bonus of 1s. per share (both tax free), to be placed to reserve for payment of interim dividend in May next, £10 000; to special reserve for equalisation of dividends on the ordinary shares, £5 000; carrying forward £17 507.

In the report of the directors of PARSONS MARINE STEAM TURBINE COMPANY, LTD., it is stated that during the past year the works have not been fully occupied. The orders received for marine geared turbines have almost been completed, and, owing to the depression in shipping, great difficulty is being experienced in securing further orders. A land licence has been taken by the company from Messrs. C. A. Parsons & Company, who have placed orders with the company for the manufacture of turbines, &c., for use in connection with land installations. The profit for the year, including royalties and dividends on investments, and after providing for taxation, for depreciation, &c., amounts to £42 581. The directors recommend a dividend at rate of 20 per cent. per annum (tax free), of which an interim dividend of ½ per cent. for the six months to Dec. 31, 1920, was paid in February last, absorbing £42 256, and leaving to be carried forward £21 422.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Bankruptcy Information.

ENDALL, George Williams (trading as Endall & Company), Canal Motor Works, Canal Bridge, Church-street, St. Helens, electrical, mechanical, and automobile engineer. Date of receiving order, Sept. 27, debtor's petition.

KERFOOT, Edwin, 103, Cobden-street, Moston-lane, Blackley, Manchester, electrical engineer. Date of receiving order, Sept. 26, creditor's petition.

MASKILL, Alfred, 43, South-avenue, Halfpenny-lane, Pontefract, electrician. First meeting, Oct. 7, 11 a.m., Official Receiver's Office, 21, King-street, Wakefield. Public examination, Nov. 10, 11 a.m., Court House, Wood-street, Wakefield.

NICHOLS, Frederick Charles, electrical and motor engineer, carrying on business at 19, South-street, Scarborough, in co-partnership with PARKS, Margaret (widow), under the style of the Scarborough Motor and Accessories Supply Company. First meeting, Oct. 14, 12.30 p.m., Official Receiver's Office, 48, Westborough, Scarborough. Public examination, Oct. 25, 12 noon, Court House, Castle-road, Scarborough.

Notices of Intended Dividends.

BELL, John Vincent, 21, North-bar Within, Beverley, electrical engineer. Last day for receiving proofs, Oct. 19. Trustee, Edward Peter Dutton, Victoria-chambers, Bowalley-lane, Hull.

DRYSDALE, William, 24, Paxton-street, Barrow-in-Furness, electrician. Last day for receiving proofs, Oct. 14. Trustee, Henry Mossop, 4, Ramsden square, Barrow-in-Furness.

Company Winding-up Voluntarily.

RENEW LAMP COMPANY (EASTERN) LTD. H. D. Carey appointed liquidator. Particulars of claims by Nov. 2. Meeting of creditors at 3.4, Great Winchester-street, E.C. 2, on Monday, Oct. 3, at noon.

Liquidator's Notice.

WESLEY & COMPANY, LTD. The creditors of the above-named company are required to send particulars of claims by Oct. 15 to A. B. Chater, 5, Alexandra-street, Cambridge, liquidator.

Edinburgh Gazette.

MANN (ALBERT) & COMPANY, electricians, 124 and 326, Main-street, Maryhill, Glasgow. The trustee in this sequestration intimates that an account of his intromissions to Sept. 9, 1921, has been made up by him and audited by the Commissioners, and that a first and final dividend will be paid within the chambers of Walter and W. B. Galbraith, C.A., 87, St. Vincent-street, Glasgow, on Nov. 10, to those creditors whose claims have been duly lodged and admitted. W. B. Galbraith, Trustee.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors, we do not report subsequent county court judgments against him.]

ARGENT, ARCHER & COMPANY, 89, Abbey-road, St. John's Wood, motor and electrical engineers. (Remitted action.) £76 18s. 5d. July 29.

ASHTON, J. William, 6, Timberbottom Farm, Tonge, Bolton, electrician. £14 9s. Aug. 24.

BARNCROFT, Thomas Moore, electrician; BARNCROFT, Marion (his wife); and TALBOT, Martha (widow), 7, Mayor-street, Bolton. £10 10s. Aug. 24.

HARGREAVES, J. W., 10, Belle Vue-road, Leeds, electrical engineer. £43 7s. 6d. Aug. 18.

HOWELLS, Harold Ernest, 7, Union-street, Hereford, electrician. £10 11s. 1d. Aug. 16.

LANE, —, Star Hotel, Gravesend, electrician. £20 7s. 8d. Aug. 19.

Bill of Sale.

[The undermentioned information is from the Official Registry. It includes Bills of Sale registered under the Act of 1892 and under the Act of 1878. Both kinds require registration every five years. Up to the date the information was obtained it was registered as given below; but payment may have been made in some of the cases, although no notice had been entered on the Register.]

BANCROFT, Thomas Moore, 7, Mayor-street, Bolton, electrician. Sept. 29. £30.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

Mortgage Satisfaction.

VERITYS, LTD., Birmingham, electricians and mechanical engineers. Satisfaction reg. Sept. 24. £600, reg. May 1, 1913; and £400, reg. Dec. 9, 1918.

Bankruptcy Proceedings.

WATKINSON, Matthew, WATKINSON, Harold, and WATKINSON, Arthur, electrical and mechanical engineers, trading under the name of Watt & Company, at 22 and 24, Palmer-road, Sheffield. Unsecured liabilities amounting to £869 and assets estimated to produce £328, leaving a deficiency of £541, were disclosed at the first meeting of creditors held recently. Matthew Watkinson is the father of the two other debtors, and they started business as mechanical and electrical engineers in August, 1919. At that time the prospects were good, and the business was successful until September, 1920. Four or five hands were employed up to March, 1921, but since that time trade has been bad, and a number of orders have been cancelled. Debtors attributed their failure to bad trade during the last six months, defective materials, and shortness of capital.

In Voluntary Liquidation.

SPENSERS, Ltd (in voluntary liquidation), Conduit-place, Paddington, London, W., lighting engineers. A meeting of creditors was held on September 30, at Cannon-street Hotel, E.C., called by Mr. F. A. Caddick, 74, Laurence Pountney-hill, London, E.C., liquidator of the company. According to the statement of affairs, the unsecured liabilities amounted to £20 759, of which £8 646 was due to the trade, and £10 708 was owing to cash creditors. The balance of £11 405 represented the deficiency as regarded the second debenture holders. The assets were estimated to realise £27 580, from which had to be deducted £1 307 for preferential claims, and £11 152 for the first debenture holders. This left assets of £15 121 to meet the claims of the second debenture holders, which amounted to £15 525. The assets comprised cash in hand, £679; plant and machinery at book value, £3 000; furniture, fittings, and fixtures at book value, £519; stock in trade, loose tools, and work in progress, estimated on the basis of a going concern, £16 000; and book debts, expected to produce £7 382. No value was placed for the moment on the patent rights. It was pointed out that as the assets were insufficient to fully discharge the claims of the debenture holders, there was nothing available for the ordinary unsecured creditors. The issued share capital of the company was £30 000, there having been issued £60 000 ordinary shares of 10s. each, which were fully paid. The deficiency as regarded the shareholders was £50 759. The company had been in existence for a number of years, and the shareholders had found substantial sums in cash for the business. Debentures had been issued by instalments since 1912. The last issued was April, 1920, and amounted to £11 000 for cash. The creditors decided to confirm the voluntary liquidation of the company, with Mr. Caddick as liquidator.

Benn Brothers' Journals.

SOME FEATURES OF THE CURRENT ISSUES

"The Cabinet Maker": "Show-Window Backgrounds for Furniture Displays"; "The Furnishing of the Drake Hotel, Chicago"; and "New Ideas in the Design of Lampshades." "Chemical Age": "Chemical Industry and the Stability of Peace," by Major V. Lefebure; "Catalysis, with Special Reference to the Newer Theories of Chemical Action"; and "Lubricating Oils from Coal Tar."

"Farm and Home": "The Burden of Taxation"; "Basic Slag Supplies"; and "Utilising the Soya Bean."

"The Fruit Grower": "Die Back Disease of Fruit Trees"; "Research and Experiment"; and "Freights and Trade Revival."

"Gardening Illustrated": "Watering Palms in Rooms"; "Cinerarias in Winter"; and "Ornamental Pruning Trees."

"The Gas World": Annual Meeting of the Society of British Gas Industries; "Some Work of the Institution of Gas Engineers."

"Hardware Trade Journal": "Ironmongers' Federated Association: Quarterly Meeting"; "Lawn Mower Grinding"; and "Drill Chucks II," by Fred Horner; and "Advertising and Selling."

Forty Years Ago.

(THE ELECTRICIAN, OCTOBER 8TH, 1881.)

ELECTRIC LIGHT AT LEIS.—In connection with the approaching demonstration in honour of Mr. Gladstone, at Leeds, the Crompton arc light is to play an important part.

EASTERN TELEGRAPH COMPANY.—The traffic receipts of this company for the month of September, 1881, amounted to £47 407, against £41 717 in the corresponding period of 1880, being an increase of £5 690.

CONDUCTIVITY OF METALS.—Professor Lorenz, of Copenhagen, confirms the experiments of Messrs. Wiedemann and Franz as to the conducting power of metals for heat and electricity, and finds that the ratio of the conductivities at 0 deg. and 100 deg. is almost constant. In metals of low conducting power it increases with decreasing conductivity.

New Companies.

The following list is compiled from information supplied by Messrs. Jordan and Sons, Ltd., company registration agents, 116 and 117, Chancery Lane, London, W.C. 2.

L. T. ALLEN (ORMSKIRK AND PENRITH) COMPANY, LTD. (177 015), 15 Moor-street, Ormskirk, Lancashire. Registered September 28. To acquire and carry on business of electrical and mechanical engineers. Nominal capital, £1 000, in £1 shares. Directors: L. T. Allen, H. Salisbury, and C. Rider. Private company.

BORDSELEY ELECTRICAL ACCESSORIES COMPANY, LTD. (176 962), 162, High-street, Bordseley, Birmingham. Registered September 26. Electricians and mechanical engineers. Nominal capital, £5 000, in £1 shares. Directors: F. H. Pountney, W. J. Rigbey, and W. Pountney. Private company.

INTERNATIONAL ELECTROLYTIC PLANT COMPANY, LTD. (177 014). Registered September 28. To acquire patents for inventions relating to electrolytic apparatus for producing oxygen and hydrogen. Nominal capital, £11 000, in 10 000 £1 preference shares and 20 000 1s. ordinary shares. Director: A. E. Knowles, Deanscourt, Heswall (chairman). Private company.

JESMOND ELECTRICAL AND GENERAL ENGINEERING COMPANY, LTD. (176 936), 239, Back Jesmond-road, Newcastle-upon Tyne. Registered September 23. To acquire and carry on business of electrician and general engineer. Nominal capital, £1 000, in £1 shares. Directors: T. Sloan and Cecilia M. Sloan. Private company.

SELECT-O-PHONE, LTD. (176 994), 122, Tooley-street, S.E. 1. Registered September 27. Electricians and mechanical engineers and manufacturers. Nominal capital, £100, in £1 shares. Private company.

SHOREHAM AND DISTRICT ELECTRIC LIGHTING AND POWER COMPANY, LTD. (176 995). Registered, September 27. Electrical engineers. Nominal capital, £18 000, in £1 shares. Directors: John van Mehr (27, St. James's-square, S.W. 1) and S. Easter. Private company.

Prices of Metals, Chemicals, &c.

		TUESDAY, OCT. 4.	
		Price.	Inc. Dec.
Copper—			
Best selected	per ton	£69 10 0	5s. Od.
Electro Wirebars	—	£74 10 0	—
H.C. wire, basis	per lb.	0s. 11½d.	—
Sheet	—	0s. 11½d.	—
Phosphor Bronze Wire (Telephone)—			
Phosphor-bronze	—	—	—
wire, basis	—	1s. 3½d.	—
Brass 60/40—			
Rod, basis	—	0s. 8d.	—
Sheet, basis	—	0s. 10½d.	—
Wire, basis	—	0s. 11½d.	—
Pig Iron—			
Cleveland Warrants	per ton	£6 10 0	—
Galvanised steel	—	—	—
wire, basis 8 SWG	—	£23 0 0	—
Lead Pig—			
English	—	£24 5 0	—
Foreign or Colonial	—	£23 5 0	—
Tin—			
Ingot	—	£157 10 0	5s. Od.
Wire, basis	per lb.	2s. 1½d.	—
Sulphuric Acid—Per cwt. 65% 60s.			
Saltpetre (Flowers)—Ton £13.	Copper Sulphate.—Per ton £30.	—	—
.. (Roll-Brimstone).—Per ton	Boric Acid (Crystals).—Per ton	£65.	—
£13.	Sodium Bichromate.—Per lb. 7½d.	—	—
Sulphuric Acid (Pyrites, 168%).—	Sodium Chlorate.—Per lb. 3½d.	—	—
Per ton, £9 17s. 6d.	—	—	—
Rubber. —Para fine, 1s. 1d.; plantation 1st latex, 9d. lb.			

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber prices by W. T. Henley's Telegraph Works Co., Ltd.

The Editorial, Advertisement and Publishing Offices of "THE ELECTRICIAN" are at 8, Boulevard Street, London, E.C. 4. Telegrams: Benbroctric, Fleet, London. Telephone: City 9852 (5 lines). The subscription to "THE ELECTRICIAN" is £2 12 0 per annum in the United Kingdom, and £2 14 0 per annum Abroad. Advertisement Rates can be obtained on application to the Manager. Advertisement copy and blocks should be received on the Friday preceding date of publication.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by MESSRS. MEWIBURN, ELLIS & CO., Chartered Patent Agents, 70 and 72, Chancery-Lane, London, W.C.

COMPLETE SPECIFICATIONS.

- 133 707 PORTABLE ELECTRIC CURRENT PATENT CO. Dry battery cells. (10/10/18.)
- 141 073 DEAN, J. R. Compound anode for electro-plating and method of making the same. (12/12/17.)
- 141 367 MARTIN, E. Electric soldering apparatus. (8/4/19.)
- 141 710 TURCAT, L. Automatic telephone exchange systems. (6/3/19.)
- 141 792 MISTRY ELECTRIC CO., LTD. High-frequency electrical signalling. (21/8/15.)
- 166 267 MARKS, E. C. R. (Koehler Manufacturing Co.). Electric storage batteries. (1/10/19.)
- 166 268 MARKS, E. C. R. (Macfarlane Communications Corporation). Electric system of train communication. (1/10/19.)
- 166 269 MARKS, E. C. R. (Koehler Manufacturing Co.). Electric lamps. (12/10/19.)
- 166 278 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). Electric heating apparatus. (10/10/19.)
- 166 286 ILLINGWORTH, W. H. Electrical cut-out or circuit breaker. (19/1/20.) (Cognate Application 14 413/20.)
- 166 300 MACROBIE, A. K., and SHEARING, G. Transmitters for wireless telegraphy and telephony. (11/2/20.)
- 166 301 CARTWRIGHT, P. R., and GLANVILLE, E. T. Sparking-plugs for internal-combustion engines. (12/2/20.)
- 166 311 WOODS, R. S. Means for securing the ends of electric cables. (13/3/20.)
- 166 311 SMITH, E. A. LAYTON. Construction of magnets for ignition purposes. (25/3/20.)
- 166 317 FORD, J. M. Electro-magnetic induction micrometers. (31/3/20.)
- 166 351 AUTOMATIC TELEPHONE MANUFACTURING CO., LTD., and MERCER, R. Distributing arrangements for use in connection with telephone systems. (14/4/20.) (Cognate Application 29 164/20.)
- 166 358 TAYLOR, J. R. Wireless telephone transmitters. (15/4/20.) (Cognate Application 21 354/20.)
- 166 365 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). Electron discharge devices. (20/4/20.)
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- 166 407 HICKLEY CHEMICAL CO., LTD., and BREEDEN, F. V. Operating handles of electrical resistance boards or frames, switchboards and the like. (18/5/20.)

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- 13 094 HARDY. Electric arc welding.
- 13 117 SYKES. Electro-magnetic apparatus for recording sound.
- 13 173 SOC. ANON. DES ATELIERS DE SICKERON & MEYFARTE. Braking d.c. series motors with recuperation of energy. (18/12/20, Switzerland.)
- 13 181 DISTRICT CHEMICAL CO. & BOVER. Flux for welding or depositing metals electrically.
- 13 182 BLONDEL & TOULY. Generation of continuous waves for wireless telegraphy and telephony.
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- 13 192 NIBLETT. Apparatus for production of electrolytic compounds and their employment.
- 13 202 BELL. Electric illumination.
- 13 231 LISTER. Trolley guiding device for electric tramcars, &c.
- 13 232 LISTER. Electric switches for motor vehicles, &c.
- 13 245 B. T. H. Co. Windings of a.c. machinery.
- 13 255 MARKS (Soc. Anon. Constructions Electriques de Belgique). Electric locomotives.
- 13 270 COMBATON & RAILING. Apparatus for cancelling electric signals.
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- 13 280 ALLEN & NORTH. Magneto-electric machines.
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- 13 294 HITCH. Electromagnetic radiation or induction.
- 13 304 MACGREGOR. Electrically-propelled ships.
- 13 335 BEST. Electrical apparatus for remagnetising magnets.
- 13 345 TAYLOR. Interline electric power stations. (Application dated 2/2/21.)
- 13 349 & 13 350 TAYLOR. Electrical distribution in a.c. systems. (Applications dated 7/2/21 and 9/2/21 respectively.)
- 13 351 FRANCIS. Electric combined lock and bolt.
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- 13 398 & 13 399 GABRIEL. Accumulators.
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- 13 517 ART. C. R. BROWN, ROYAL CR. Apparatus for protecting electric supply circuits comprising aerial lines. (15/5/20, Germany.)
- 13 488 NORDMANN. Commutation of electric machines.
- 13 492 SEGANT. Transforming a.c. electric supply to a supply having a larger number of phases.
- 13 495 COWIN. Method of distributing electric power.
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- 13 513 TURCAT. Automatic telephony. (12/5/20, France.)
- 13 516 SALWAY. Arrangement for electric lifts, hoists, &c.

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Notes of the Week.

The Belfast Muddle.

HITHERTO Belfast has enjoyed a good reputation for business capacity and for a fairly sound system of municipal government, but the proceedings at last week's meeting of the Corporation are calculated to make us wonder whether this reputation is justified. The whole political atmosphere in Belfast is somewhat electrical at present, and this may account for the drastic decision to dispense with the services of their consulting electrical engineers followed by the rescission of the resolution on Monday. When anything goes wrong in Belfast it seems to be the fashion to put down a motion to dismiss someone. For instance, there was a suggestion to dispense with Mr. BLOXAM's services in 1913, when there was a shortage of supply, and about two years ago Sir JOHN SNELL similarly came under the ban.

A Chequered Career.

THE local electric supply undertaking has had a somewhat chequered career, mainly owing to municipal mismanagement. The original station in East Bridge-street was badly located, and as long ago as 1911 it was decided to build a new station. Then ensued a long battle about the eligibility of sites, so that the war had broken out before anything substantial was done, it being only in 1915 that a definite site was secured. In the later stages of the war there was a great and increasing demand for electric power in the shipyards, and contracts were entered into with the shipbuilders which have now turned out to be unremunerative. In addition, complaints have been made about a 5 000 kW generator which was purchased during the war and about the excess expenditure incurred on the new power station building.

Foolishness No Solution.

NATURALLY, necessity for finding money to pay interest and sinking fund on the heavy and unproductive

capital expenditure, coupled with the slump in the ship-building demand, has caused a somewhat big deficit in the electricity accounts, hence the origin of the present trouble. The position is an unfortunate one, brought about mainly by the war and the high prices after the Armistice, and it would have been wiser to get some relief from the Electricity Commissioners by suspending the operation of the sinking fund until the new station was in full working order. At all events, the Corporation are not likely to improve matters by attempting to make Mr. RIDER the whipping-post for all these failings, or by changing their consulting engineers in the middle of an important scheme.

Insulation from the Chemical Standpoint.

IT is no doubt a little trite to say that future electrical development will depend to a great extent upon our knowledge of the insulating materials we employ, or may employ, and of what we can learn of their behaviour from both the physical and chemical points of view. Nevertheless, it is true, and for that reason the article by Mr. W. H. NUTTALL, which we publish on another page of this issue, is opportune. Mr. NUTTALL considers the problems of insulation solely from the theoretical chemical standpoint, and in so doing lays down the following conditions: That an insulator should have its molecules in a high state of association, that it should consist of highly stable chemical compounds, *i.e.*, these compounds should be inert, neutral and chemically saturated, and that in accordance with practical experience all insulators should be in the colloidal state. As in the past, electrical engineers have largely chosen their insulating materials on the evidence that they are non-conductors and can undergo certain tests as to their dielectric strength, it is interesting to consider how Mr. NUTTALL's point of view may lead us to change our views on this subject.

The Shortcomings of Common Insulators.

SHELLAC, for instance, which up to now has been widely used, comes under his ban on account of its chemical instability, which cause it to possess acid-forming properties,

and so bring about not only corrosion of the copper, but a rapid fall in its own resistance. Oil varnishes, on the other hand, satisfy Mr. NUTTALL's chemical conditions, provided the acid-forming properties of the gum they contain can be counteracted. This will probably be effected, in Mr. NUTTALL's opinion, by using neutral gums of the ester or synthetic types instead of those generally employed. From the chemical point of view, even rubber is unsuitable owing to its instability. This can, however, be overcome by the addition of sulphur, *i.e.*, by vulcanising it to form ebonite or vulcanite, though the use of these products is restricted owing to the effect of heat upon them. Altogether, chemically considered, the ordinary insulating varnish or rubber compound seems to be found wanting. An exception to this is synthetic gum, from which Mr. NUTTALL expects a great future, and which, from a chemical point of view, fulfils all conditions. Owing to the interest and importance of this subject, we hope that the work thus started by the Vickers Technical Research Committee will be continued and extended to cover a greater number of materials than have up to now been dealt with. Such work is not only of value in a limited chemical way, but may profoundly affect the methods and materials used in electrical manufacture.

Useful Propaganda.

THE "Report on the Use of Electricity in Working Class Dwellings," which has recently been issued by the British Electrical Development Association, is a good deal more than its title would imply. It takes a typical "housing scheme" house and gives the relative cost of equipping this dwelling alternatively with coal heating only and with coal in combination with either gas or electricity. It shows that the cost of an installation in either of the latter categories can be met out of the saving on the fabric obtained by omitting chimneys and fireplaces. It thus eliminates one of those bogies that some people love to erect to frighten those who advocate the domestic electric idea. It is, therefore, propaganda of the most useful kind, and copies should be ordered by all those interested for distribution among their staff.

Relative Costs of Heating and Cooking Methods.

BUT this is not all. Not only are arguments in favour of electricity put forward by the architects concerned, Messrs. G. BLAIR IMRIE and T. G. ANGELL, but carefully detailed bills of quantities are provided showing exactly how it is all done. The electrical portion of the data is due to Mr. ALAN KIRK, who has long been an advocate of the wider use of this method of costing in electrical work. It certainly has this advantage, that it enables a close check to be kept on stores, labour and extras, and allows the cost of any item that may have been included in the original scheme, or have been added afterwards, to be accurately determined. It eliminates rule-of-thumb methods, and perhaps will tend to a reduction of those large profits that were considered to be legitimate perquisites where extras were the rule. But that is, after all, a good thing, for trade development will best come about through a reduction in price, and one of the surest ways in which that can be effected is by a careful system of determining the cost of producing and erecting each item.

The Drawbacks of D.C. Distribution.

THE lot of those whose duty it is to administer a direct current distribution system is not a happy one. After

years of complacency and basking in the tonic air of envious glances they have now found that there are disadvantages in having a system which inflexibly refuses to be extended without more capital expenditure than can in these days be faced with equanimity. This state of affairs is, of course, in greater part due to the development of the domestic load, which has led to an overstrain of the copper provided in most towns. But even if this strain were overcome by an heroic duplication of mains, the necessary extension of the sub-stations would still have to be faced.

The Mercury Rectifier as a Remedy.

FORTUNATELY, a way out of these difficulties has arisen in the development of the mercury rectifier. This apparatus, possessing, as it does, the advantages of small floor space and low-running costs, combined with the elimination of constant attendance, should go far to permit a better use to be made of existing d.c. distribution systems and to allow the necessary extensions to be undertaken at a minimum cost. The description which we give on another page of this issue of three installations of this kind which have recently been set to work in this country are therefore of interest. It will be seen that the apparatus is of quite commercial size and works efficiently in conjunction with other auxiliary apparatus. An important point is that it is particularly suitable for dealing with traction loads. In our view the possibility of using this type of equipment very largely in the future should be carefully explored.

The Trade Paper and the Trade.

IN our last issue we dealt with the subject of Trade Promotion from what may be called the objective point of view. That is, we opened our columns to opinions from engineers, contractors and manufacturers on this all-important subject, and so illustrated what was being done to improve trade throughout the electrical industry by means of new designs and better methods of manufacture. But on the old principle that the ox that treads out the corn must not be muzzled, we strike another note in the article which we publish on another page of this issue. In fact, we become personal. For while it is certainly true that at this stage of affairs the Press can very greatly assist the development of industry, it is none the less true that the trade can, and should for its own advantage, assist that part of the Press which deals week by week with its own particular politics, troubles and technical achievements.

A Welding of Press and Industry.

THE necessity for a close connection between Press and industry is in these latter days generally recognised. There is, indeed, an increasing realisation of the fact that we must live, if we are to live at all, on the experience of others. This is no time for ploughing lonely furrows, but it is the time for conducting our operations in the full light of day with the assistance of everyone who is engaged on a similar line of work. The research associations which have recently been established are but one example of modern thought on such matters. But still we of the Press want to know more about what everyone is doing, not only to provide the necessary stimulant for industry, but to assist in the genesis and fertilisation of that somewhat nebulous entity, editorial opinion. For editorial opinion in its essence is only what everyone is thinking, diluted and purified perhaps, so as to bring about a crystallisation of ideas which the individual cannot effect for himself.

The trade journal, and more particularly the technical journal, is very much like a research department, and a research department is most healthy when it has the support of both the brains and the finances of the industry.

The Press Congress of the World.

THIS is evidently a matter not of local or national, but of international interest. Any trade paper worth the name has its tentacles on the doings of every country throughout the world, not only with a view to giving the best of news services, but of assisting in no indirect way the building up of British export trade. Moreover, it establishes friendly relations with similar journals in other countries, and so by a process at once of combination and dissociation tends to bring about industrial development and establish friendly international relations. The Press Congress of the World, which is being held in Honolulu this month, is but an outward and visible sign of a movement that is always going on. This congress gives publicity to a public service, which, though constantly throwing light on the work of others, operates in an obscurity whose profundity is not realised until it is examined. It is therefore doing a service to a cause of world-wide importance.

Diluted Benevolence.

IN ten days' time the Electrical Trades' Benevolent Institution will be holding its annual festival, at which, among other things, speeches will be made and the amounts which have been collected from the prosperous and those who are making both ends overlap for the benefit of those who are not so fortunate will be announced. This year precedent is to be discarded and ladies will be present at the dinner. It is a sign of the times. And we certainly hope that the presence of the more charitable sex will cause a sharp rise in the load curve of donations and subscriptions. Speaking frankly, the support given to the Electrical Trades' Benevolent Fund is a disgrace to the industry. It is time it ceased to be a disgrace. Ladies are great reformers. Perhaps they will take the matter in hand?

Encouraging Window Dressing.

IN a better world than this the zeal of the Southport Electricity Committee would be commended. As it is, it is more likely to be misunderstood. To provide a successor for Mr. BLACK, who has migrated to Ipswich, not only was the usual procedure of advertisement and eliminating interviews adopted, but it was decided that a deputation of the committee should visit the undertakings where were employed those favoured engineers who had been placed on the short list. The deputation's deductions from these excursions were then to be a determining factor in the committee's selection. The idea is a good one. But we seem to remember an apothegm about *trop de zèle* which is not inapplicable. We hope the deputation had fine weather. It is not improbable that the outlook of its members will be enlarged. But we rather doubt whether their choice of an engineer is any the wiser than if it had not taken place. For a whitewashed generating station, impressive offices and a spruce staff are not everything. However, the committee may think that a man who dresses his window to the best advantage for such an occasion is the best man for a place like Southport. There may be something in that, but we wonder what the rate-payers think.

Pessimism and Policy.

THE proceedings at the recent conference of the Municipal Tramways Association, of which we give a full account in this issue, were distinguished by almost unrelieved pessimism. This state of mind, however common it may be among individuals, is so unusual at a gathering where men of many temperaments come together and where it is necessary, for strategical reasons, to show a bold front to the world, that it deserves an examination as to its causes.

Depression not Unexceptional.

We must begin by admitting that the tramway industry is in a bad state, for it is stated that only five out of the municipally owned undertakings now in existence are paying their way, and that the plight of the privately owned undertakings is even worse. But, then, so is that of a number of other industries, at least temporarily. Yet almost without exception those responsible for the conduct of these latter prophesy better times in store, and, however little foundation there may be for that optimism in the facts now before them, refuse to believe that things can get much worse or that the present conditions have any permanency about them. Why, then, it may well be asked, is pessimism so prevalent in the tramway industry? How does it differ from other industries in lack of resilience? Is it impossible that no policy, however wise, that can be adopted will lead to an improvement in present conditions?

Historico-Psychological.

The reasons are, if we may so express it, partly historical and partly psychological. The tramway industry has a history, checkered and marred by ineptitudes, by bad management and by lack of foresight. On the one hand, the privately owned undertakings have been mulcted in subsidies as the price of a concession which was considered a virtual monopoly, for it is not so long ago since the tramway was considered to be the most modern and, indeed, only form of traction that could be used by an up-to-date township. It naturally followed that to allow a company to operate tramways in a town was as good as to make them free of a gold mine on the proceeds of which it was only equitable that the public or, at any rate, the municipality, should to a large extent exist.

The Gold Mine Theory Analysed.

This gold mine theory was not without a grave effect on the policy which controlled the development of many municipally owned tramway systems. The municipal authority, being the road authority, had (or such was the view) obtained by putting down its own tramways such a monopoly that nothing could prevent the tramway from conferring great benefits on the public not only by transporting them quickly and cheaply, but by reducing their rates. In a word, the tramway was not only a blessing of civilisation, but an excellent method of influencing votes at local elections. But even before the war this roseate dream had begun to fade.

Politics the Stumbling Block.

For, as is not unusual, the political element on the town council has been mainly responsible for the disastrous state in which many tramway undertakings now find themselves. For this influence caused fares to be kept at an uneconomically low level, allowed the relief of rates to take precedence of reserve funds and permitted extensions to depend on votes rather than upon profit-earning capacity. We, of

course, refer more particularly to the municipally owned system, though in a more indirect way the same factors have had a profound influence on the privately-owned undertakings.

The Harvest.

Now the result of all this is what might be expected. The breath of adverse financial conditions has brought the apparently firm structure of many a tramway undertaking toppling in ruins, and those who are familiar with better days (perhaps not unnaturally, with the house falling about their ears) think that the end of the world is near.

This deplorable state of affairs is commonly ascribed to two causes—one the war, the other unfair competition, or, in other words, the motor-buses. But, however much we admit the truth of both these contentions, they do not tell the whole story. The war has certainly caused a large increase in wages and other operating expenses; but even before the war many tramway undertakings were by no means sound financially, and all the conflict has done in their case has been to accelerate the pace downhill and not to change the direction.

No Easy Way Out.

There is, we fear, no easy way out of this difficulty. With few exceptions, the increased fares permitted a short time ago have brought no large increase in revenue. Further increases—the most obvious suggestion for making ends meet—are more likely to result in a decrease than an increase in income. Decimalisation of the penny has been suggested as a solution. But surely this cannot be meant seriously. We have the highest regard for Mr. ALCOCK, and view favourably the ideas which he so ardently and persistently tries to inculcate, but unless there is to be a decimal penny (if that is the correct term) for tramways only, and for no one else, we fail to see how this arrangement can make matters one jot better. That idea should be dropped at once in favour of more practical methods.

Has the Tramway Finished Growing?

It seems generally to be supposed that on the engineering side the tramcar and its auxiliary equipment have finished their development. But surely this is not the case? There are many methods that could be introduced to bring about greater economy in working, and none of these should be left unexplored. The tramway is not dead yet. If it is moribund it is largely the fault of those who have been managing it.

The Competition Question.

It is said that whatever chances the tramway might have in future under better conditions are quite neutralised by the competition that nearly every undertaking has to suffer from the motor-bus. We agree that tramway undertakings have a grievance. They have to pay for the roads which the motor-bus uses for almost nothing and damages severely. They have to submit to competition from a more flexible and more popular competitor. The problem is certainly one which ought to be tackled and adjusted. But here again we regret to see a narrowness of view on the part of those concerned in the matter on the tramway side. Such a question cannot be dealt with by punitive legislation, even could such legislation be obtained. But competition must be answered by competition, and the motor-bus beaten at its own game. In deploring unfair competition municipal tramway undertakings have a conveniently short memory. The remedy for competition is greater efficiency. Taken in this way, it is a tonic, not a poison. The time has come for tramways to wake up.

Slow Progress on Research.

JUDGED by its sixth annual report to the Privy Council, comparatively little new work seems to have been undertaken during the past year by the Advisory Council for Scientific and Industrial Research. Indeed, the most important development has been the efforts made to co-ordinate researches which are of civilian interest as well as of importance to the fighting forces, and to direct the expenditure of money provided for research for Government purposes. The report further informs us that owing to the necessity of limiting public expenditure it has been found advisable to proceed with caution, and that owing to the difficulty of securing research workers of high qualifications and of introducing a new and experimental system of co-operation between different departments of State the progress has been slower than will be the case after further experience has been gained and time has been given for working out a well-considered programme. The co-ordinating boards are now engaged on a survey of the existing research activities of the Government and in promoting an interchange of information in order to lay a sure basis for the future.

Festina Lente.

In fact, the general impression we gather from all this is that the work is proceeding in a leisurely way, though we are told that the results, so far as they have gone, are encouraging, and that the final effect will be economy of effort and expenditure. We trust that this anticipation will be realised without the sacrifice of any vital national interests, though the curtailment of expenditure will no doubt lead to the postponement of a certain amount of useful work and to a considerable limitation of the original programme of the Council. This is to be regretted, as research does not lend itself readily to changes in programme. Under the circumstances, however, it is perhaps unavoidable, and we can only hope that the money available will be used to the best advantage by being employed on work of first-class importance.

Whence Real Progress will Come.

But it is to the new research associations rather than to any Government-controlled institution that we look for real progress in genuine research work, *i.e.*, research work which will be of advantage to civilian undertakings and to general industrial enterprise. On this basis the Advisory Council's main functions should be to co-ordinate existing research organisations, to encourage the formation of industrial research associations, to facilitate the exchange of information between associations, and to assist in the publication of results.

New Research Associations.

We are glad to learn that substantial progress has been made with the formation of new research associations. Six such associations obtained licences from the Board of Trade during the past year, making the total number established to date twenty-four. Two others have been approved, and will shortly be incorporated, so that there are now twenty-six associations for the purpose of undertaking and carrying on research work of interest to the industries concerned in their organisation. The amount of useful work done so far seems to be small, and the sum of our knowledge has not been greatly increased, even by those associations which were established three years ago. No doubt this is due to the necessity for establishing a sound basis on which to start work, to the scarcity of suitable research workers and to other causes. We are glad to learn,

however, that the associations are concentrating their attention more and more on the fundamental principles underlying the methods and processes of their trades, for it is in this way genuine progress is likely to be made rather than by searching for results of immediate commercial value.

Good Work by the Electrical Association.

The most important, and certainly the most vigorous and enterprising of these new organisations, is the British Electrical and Allied Industries Research Association. It was fortunate in being the inheritor of the work already partly executed and of a programme mapped out by the Electrical Research Committee. Readers of *THE ELECTRICIAN* are kept informed of the activities of the Association by the issue of periodical bulletins by the Director of Research, Mr. E. B. WEDMORE, and they are thus able to obtain an idea of the progress made from time to time on the investigations which are being made upon insulating materials, switchgear and other electrical apparatus. In many respects the B.E. and A.I.R. Association is a model to the others, and, though one of the most recently organised, is already engaged on an extensive programme of useful work.

Need of Co-operation.

As regards the work of the other associations, the British Scientific Research Association has found it necessary to form links with the Medical Research Council in connection with the manufacture of X-Ray apparatus, with the British Electrical and Allied Industries Association in order to arrange for co-ordination in electrical researches of common interest to both, and also with the British Non-Ferrous Metals and the British Cutlery Associations. Co-operation is secured by the appointment of joint committees for the supervision of work in which two or more associations are interested.

National Physical Laboratory.

Naturally, a substantial part of the present report is devoted to the work of the National Physical Laboratory, which continues to increase in scope and importance. As is well known, among its activities is the large amount of special research undertaken on behalf of technical institutions, research associations and private firms, and extended use is being made of the laboratory in the conduct of research required by the boards and committees of the Department of Scientific and Industrial Research, and some "free service" work is also undertaken for the Home Office, Board of Trade and other Government departments.

Fuel Research.

Important work has been carried out by the Fuel Research Board; a series of experiments on the effect of steaming three widely different types of coal in vertical gas retorts has been completed, and the results have been published. The experiments show that by the use of steam under conditions which can be accurately specified for any given kind of coal there is not only a gain in the conversion of the heat units of the raw coal into gas amounting from 25 to 50 per cent., according to the coal used, but there are also substantial gains in the by-products, tar and sulphate of ammonia. In addition, experiments have been conducted on the carbonisation of peat at low temperatures and in vertical retorts at high temperatures. The results obtained are stated to be of an encouraging character, and it is anticipated that some of the details of this work, as well as the results of the inquiries of Dr. MARGARET FISHENDON into some of the problems of domestic heating and of the experimental work of Mr. A. H. BARKER on the efficiency of cooking ranges, will shortly be published.

Work of Co-ordinating Boards.

The research programmes of the various fighting services have been examined by the Physics, Chemistry and Engineering Co-ordinating Research Boards, but it is reported that few instances of overlapping have been discovered, and good results are likely to follow from bringing the representatives of the departmental research establishments into closer touch with one another. The Physics Board has made arrangements for carrying out researches in sound location, and it has assumed the responsibility for financing the experiments in the development of leader gear for another year. It has also formed a sub-committee to consider the application of X-Ray methods in the examination of materials, while the National Physical Laboratory is undertaking the development of photographic plates and fluorescent screens for X-Ray work, and also work on optical research, searchlight carbons, alloys for compass correctors, non-magnetic steels, &c., while research is also being instituted or encouraged with a view to the production of high-class insulating materials in this country. The Engineering Board has made arrangements for the conduct of fundamental researches at selected universities into the fatigue of materials, and investigations have been organised into motor springs, bearing metals, soft solders, the effect of heat treatment on nickel steel, &c. Among the activities of the Chemistry Board is the formation of a sub-committee, consisting of members of the three fighting forces, acting in co-operation with the British Electrical and Allied Industries Research Association, in order to examine the possibilities of further research into the development of accumulators and dry cells; but no further Government research on the fixation of nitrogen is to be undertaken at present.

Radio Research Work.

While satisfactory progress has been made by committees of the Radio Research Board, complaint is made of the lack of experienced investigators with sufficiently high qualifications to enable them to undertake the type of research required. The work of the sub-committee on the Propagation of Waves has, therefore, been confined mainly to theoretical considerations of the problems involved. Investigations which are being carried out at the National Physical Laboratory include the improvement of methods for measuring high-frequency currents and resistance, the development of the Bloch principle of the accurate measurement of wave lengths, and a comprehensive investigation into the origin and fundamental nature of "atmospherics." The co-operation of seven university and technical colleges and four Government establishments has been enlisted in a scheme for making simultaneous observations in various parts of the country on the transmissions of certain fixed stations. The various methods used in directional wireless are also being investigated, and grants have been made for research upon problems connected with the fundamental properties of the thermionic valve.

Though the report is singularly lacking in detail, and seems to be mainly composed of vague general statements, yet the programme outlined above is an important one, and good results are likely to be achieved if the whole of the work can be carried out by properly equipped workers. Unfortunately, the policy of the Advisory Council seems to be, niggardly towards private research, and little encouragement appears to be given to university graduates, the class from which the small and select band of qualified research workers are likely to be recruited.

INSULATING MATERIALS.

Some Theoretical Chemical Considerations.

By W. H. NUTTALL, F.I.C.

Chief Chemist to the Vickers' Technical Research Committee on Insulating Materials.

The reliability of electrical machinery is largely dependent upon effective insulation, and with the modern tendency to ever higher voltages and larger units, the question of insulation becomes of paramount importance. It is fitting, therefore, that at such a time the study of electrical insulation is beginning to emerge from the empirical stage. The theoretical study of insulating materials has now for some time engaged the attention of various workers, and as a result of their experience, certain broad generalisations are beginning to come to light which not only enable dielectrics apparently varied in character to be grouped together, but which it is hoped will suggest profitable fields of work in the search for new and more reliable insulators.

Insulators and the Electron Theory.

Considered in the light of the electron theory, the difference between an "insulator" and a "conductor" is rather a matter of degree than of kind, and the ideas underlying the theory of electrical conductivity are also applicable to insulation. According to the electron theory, the conductivity of any substance is dependent upon the presence and motion of electrically-charged "ions." Accordingly, a good insulator should

- (1) not be capable of electrolytic dissociation; that is, it should be as free as possible from dissociated ions;
- (2) it should not be capable of ionisation under an electrostatic stress;
- (3) it should offer a high mechanical resistance to the passage of ions.

The Conducting Properties of an Electrolyte.

1. An electrolyte in aqueous solution is a conductor by virtue of its state of ionisation—e.g., dilute hydrochloric acid. But the same electrolyte dissolved in a non-ionising solvent—i.e., a solution in which the molecules of the solute are in a state of association—is practically a non-conductor—e.g., hydrochloric acid in chloroform solution. It is desirable, therefore, that an insulator should have its molecules in a high state of association, and whilst this point is probably of little value so far as inorganic substances are concerned, it is of great importance where we are dealing with organic materials, for with such it is frequently possible to bring about a high state of molecular association through the process of polymerisation.

The Applicability of Ohm's Law.

2. When an insulator is submitted to a difference of potential, Ohm's Law is probably only valid so long as the conduction is due to the ions initially present. So far as gases are concerned, if the voltage is increased progressively, the field will eventually become sufficiently intense to liberate electrons, when the resistance will rapidly fall, the molecular structure will be disintegrated and the insulator is said to have "broken down." It may, perhaps, be fairly assumed that the breakdown of liquid and solid insulators represents a not dissimilar process. In any case, a good insulator should consist of highly stable chemical compounds. They should be inert, neutral, saturated in a chemical sense, having no free valencies. They should not be affected either by a moderate rise in temperature or by the action of dilute acids and alkalis.

The Colloidal State Necessary for Insulators.

3. Conductivity depends not only upon the presence of free ions, but upon their motion from molecule to molecule. If this is retarded, the conductivity is decreased. Resistance to ionic migration is a function of the internal friction or viscosity of the material under consideration. In other words, the material forming an insulator should be, as far as possible, in the colloidal state. Practical experience bears this out for, with the exception of air, all insulating materials are colloidal in character. This is in spite of the fact that the colloidal particles contained in a colloidal solution carry an electrical charge considerably higher than does the ordinary ion, which enables them to travel in an electric stream (electrophoresis), and bestows a certain distinctive electrical conductivity upon colloidal solutions which is additional to

the conductivity of the dispersion medium or of the electrolytes usually contained therein. Nevertheless, this distinctive conductivity is most evident in dilute solutions. In the colloidal form in which insulators are usually employed the resistance to movement offered by the great internal friction (viscosity) of the material reduces very considerably this inherent conductivity. It may be, however, that it is this special conductivity of colloid matter which is responsible for the charging or displacement current encountered in condenser work, the measurement of which under standard conditions gives the specific inductive capacity of the dielectric.

Consideration may now be given to some of the commoner insulating materials at present employed in the electrical industry in order to see how far they satisfy the three main desiderata for dielectrics, outlined above.

Insulating Varnishes.

Insulating varnishes are of two classes:—

- (a) Spirit Varnishes, and
- (b) Oil Varnishes.

A spirit varnish usually consists of a solution of shellac in methylated spirits, to which occasionally a certain proportion of an alcohol-soluble gum is added. Shellac is a colloid, and so satisfies condition No. 3. Its initial insulating properties are good. It is, however, not a very stable chemical compound, being easily hydrolysed by very dilute alkalis. Accordingly, it has somewhat marked acid-forming properties, especially under an electric stress, which become evident by the greenness developed with cotton-covered copper wires which have been treated with a shellac varnish. The presence of much acid, thus produced, is liable to cause a rapid fall in resistance.

Oil Varnishes.

An oil varnish consists of a natural gum—e.g., copal, which, after heating to remove water and easily volatile matter, is dissolved in linseed oil, which itself has been submitted to a previous heat treatment. This heat treatment is usually one of two kinds: (1) Heating with the object of oxidation, as in the manufacture of "boiled oil" or "double boiled oil," or (2) heating as far as possible in the absence of air with the object of inducing polymerisation. Whilst this distinction is purely an arbitrary one, as in both cases a certain amount of oxidation and polymerisation results, yet, from what has already been said, an oil in which polymerisation (i.e., the aggregation of several molecules) predominates, should be superior as a dielectric to one prepared by oxidation, and there is a certain amount of experimental evidence to countenance this view. The gum itself is a colloid, and its solution in the oil, however prepared, is a colloidal one. Generally speaking, therefore, an oil varnish satisfies the conditions laid down above, and experience has shown that it is a reliable insulator, whether used as an impregnating varnish or in the form of varnished cloth (e.g., Empire cloth). The weakest part of an oil varnish is undoubtedly the gum. The natural gums are not very stable compounds chemically. They are of the nature of organic salts or esters, and are easily hydrolysed. They have thus acid-tending properties, and it is rare to find an oil varnish which is not acid. Some varnishes, however, tend to develop further considerable quantities of acid under the effect of an electric current. Probably, at some future date, varnishes prepared from more stable, neutral gums of the ester or synthetic type will greatly supersede those at present in use. Ordinary colophony, on account of its loose chemical nature, should never be employed in an insulating varnish.

Rubber, Ebonite, Vulcanite, &c.

Rubber is a natural product of unknown composition. A somewhat similar material can, however, be prepared synthetically by the polymerisation of various unsaturated organic compounds, of which isoprene $\text{CH}_2 = \text{C}(\text{CH}_3) \cdot \text{CH} = \text{CH}_2$ may

be taken as an example. Whilst such synthetic rubbers will probably never be of any technical importance, yet they afford some clue to the composition of natural rubber, which is undoubtedly a polymerised product. It is also a colloid. These two facts would suggest, therefore, that it should be a dielectric, and this is well known to be the case. The use of rubber as such is to some extent restricted on account of its somewhat unstable nature. It is an unsaturated compound and chemically far from suitable. By saturating its double bonds by combination with sulphur (vulcanisation), the rubber molecule can be considerably stabilised, and the resulting products (ebonite, vulcanite) are valuable dielectrics. Their use, however, is somewhat restricted as they soften on heating and are affected by oils.

Synthetic Gums.

Synthetic gums are becoming of increasing importance as electrical insulators, and their nature is not without interest in the light of the preceding theoretical considerations. The first of technical importance to be introduced was a condensation product of phenol (or cresol) and formaldehyde (or its derivatives). The condensation takes place in stages, a liquid, semi-liquid and finally a solid product, being obtained, according to the extent of the condensation. The solid product, if the condensation has not been taken too far, is soluble in alcohol, but on further heating a change takes place, the melting point gradually rises until an infusible gum

results, which is then also insoluble in all solvents except strong alkalis or acids. The value of gums of this class is that they can be applied in an alcohol-soluble form, and after the solvent has been removed by evaporation the soluble gum can be converted into the stable insoluble variety by stoving under suitable conditions. The insulated article will then withstand a temperature up to about 200 deg. C., and is unaffected by oil. As to the constitution of the ultimate phenol-formaldehyde condensation product, much has been conjectured but little is known definitely. The earlier stages in its production are attended by the liberation of water, whilst the change from the soluble gum to the insoluble gum is unaccompanied by the loss of water and is undoubtedly a case of polymerisation. Wöhl ("Berichte," 45 (1912), p. 2046), has suggested that the final gum is derived from polymerisation products of CH_3 : $\text{CH}=\text{CH}_2 = 0$. However derived, the final gum is certainly a polymerisation-product, and it is undoubtedly a colloid. Further, it is a peculiarly stable compound, so that its high insulating value is not surprising.

Other types of synthetic gums are already on the market, but their technical value requires to be tested out. Probably the use of various synthetic gums will be greatly extended in the future when the advantages which they afford are more fully realised. New types of synthetic gums are certain to be introduced sooner or later; the main road to their discovery is now fairly clear, namely, a readily accessible and unsaturated compound and its polymerisation to a gum.

Changing rôles.

Cheap Electricity and Beautiful Gas.

By "ELECTROCYNIC."

Some years ago there was, I think, a very general feeling that you went to electricity for the virtues of beauty and adaptability, and to gas for the solid qualities of utility and economy. Gas apparatus was not good to look upon, but it served its purpose with an admirable, if smelly, efficiency.

Electric light in those days was considerably more expensive than gas, but it certainly was better-looking. The gas-electric controversy of, say, fifteen years ago was in many respects a battle between utilitarianism and art. The electro-fanatic took pride in his fanaticism. Was he not bearing the banner of beauty in a world given over to the worship of the stark gasometer and the ugly gasolier?

Battle of the Lights and Heats.

Times have changed, and with them the protagonists in this battle of the lights and heats. Great advances have been made in the efficiency of electric lighting and heating. In the former application electricity is more economical than gas, and very little more expensive in the latter. But in the matter of artistry, it seems to me that gas at the moment has all the advantage. Electricity has become cheap and useful, while gas has taken on a new beauty and an unaccustomed charm.

One has only to study the apparatus displayed in the West End showrooms of manufacturers to realise the truth of this assertion. In the gas showroom one finds nowadays an array of really beautiful apparatus, which, in design and workmanship, is infinitely superior to the ill-made and rococo exhibits of the maker of electrical appliances.

A few days ago this aspect of the matter was forced upon my attention by the contiguity of rival showrooms. The windows of the gas showroom contained cookers, fires and fittings of most delightful appearance. Worthily made, cleverly designed, and with no superfluous ornament or imitative effect, they appealed both to one's sense of beauty and sense of fitness. I will not divulge the name of the manufacturer, but the apparatus was in no way special or peculiar. It was absolutely typical of the present standard of high-class gas apparatus.

A Repulsive Riot.

For some minutes (I was waiting for a 'bus) I gazed into this window and feasted my eyes, and then, moved by an impulse of morbid suspicion, I looked into the window of an electric showroom a few doors away. I wanted to compare while my impressions were fresh upon me. I came, I saw, and I wept bitter tears at the repulsive riot of bad design, absurd imitation and rotten workmanship which confronted me in this second window. Here again, from my knowledge of the trade, I was uneasily aware that the things I was looking at simply represented the average standard of beastliness.

In the middle of the window reposed a curious structure which, after close inspection, I took to be an imitation log fire. It consisted of a cylindrical piece of earthenware, or fireclay, coloured to simulate

the bark of a tree. A section had been cut away, and in the centre of this most unwood-like log had been placed a heating element.

Futile Philistinism.

I have been told that electric fires of this sort are popular. I refuse to believe it. In the mouth of an electrical contractor the word "popular" often means nothing more than that he has sold two or three of a particular article. This imitation log fire, for one thing, was quite unlike the real thing; but even if it had appeared to be a chip off the old and genuine block, there would still have been no excuse for such rank and futile Philistinism. Surely it is fundamental to all decent design that the thing designed should look itself and not try to ape something quite different.

The log fire was (to modify a familiar *cliché*) the centre of repulsion, but the other apparatus in the window was almost equally unworthy. Cookers there were that looked like hay-boxes and were priced like Eagle ranges. Thinly constructed, shabby in appearance, and insufficiently equipped with boiling rings, they afforded a derisive comparison with the finely-made gas cookers which could be purchased at similar prices three doors away.

It was not merely that the electric cookers were ill-looking; they were so evidently inadequate to the requirements of even the smallest and least exigent families. The only high-grade thing about them was the price.

A Better Showing.

In the matter of lighting fittings, electricity certainly made a better showing, although even in this department, where gas is so heavily handicapped, electric fittings were by no means superior in appearance. The designers of gas fittings must be given great credit for the way in which they have overcome the difficulties imposed by the nature of their illuminating medium.

There is no need to describe these windows in further detail. The moral is the important thing; and the moral of the story may be expressed interrogatively. What shall it profit the electrical industry if it achieve an efficiency of 100 per cent. and lose its beautiful ideals? Of course, efficiency and beauty can co-exist—gas engineers have proved it; but the mind that is too narrow to harbour both conceptions had better concentrate on beauty.

An Unappreciated Fact.

The manufacturers of electrical apparatus have yet to appreciate the fact—glaringly apparent to every other section of the nation—that the ordinary buying public prefer to buy articles that are good-looking and possibly inefficient, rather than those that are ugly and theoretically efficient. I am not arguing in favour of inefficiency—far from it. Efficiency is a most excellent quality, but it is not as a rule the determining factor in any retail transaction.

There has, of course, been no actual retrogression in the design and appearance of electrical apparatus; but we have allowed the gas people to get a long way ahead, and that is a great pity and an infinite discredit to the electrical industry.

ANNUAL MEETING OF THE MUNICIPAL TRAMWAYS ASSOCIATION.

Financial Difficulties Discussed at Salford.

The Annual Meeting of the Municipal Tramways Association was held at the Technical Institute, Peel Park, Salford, on Wednesday and Thursday, Sept. 28 and 29, 1921. The President, Mr. G. W. HOLFORD, General Manager of the Salford Corporation Tramways, occupied the Chair throughout the whole of the proceedings.

Wednesday, Sept. 28.

This morning the delegates were welcomed by the MAYOR OF SALFORD (Ald. F. Hampson, J.P.), who, referred to the increased influence which the Association was exercising on the tramway undertakings of the country. He trusted that its sphere of usefulness would be still further enlarged as time went on. He also referred to the work of the Association in settling labour disputes, and hoped that as its work in this connection became better known and understood, disputes of all kinds would be less frequent and easier of settlement. The tramway industry of this country, to his mind, was destined to be a vital link in the transport system, and he was glad to learn that the Association was working in co-operation with the Ministry of Transport in the interests of efficiency and the well-being of the industry. He referred, with regret, to the late Ald. H. Linsley, who passed away in August last.

After THE PRESIDENT had briefly thanked the Mayor for his welcome, he delivered his Presidential Address, which we give below.

Presidential Address.

Mr. HOLFORD began by recalling that it was twenty-five years since he had entered the service of the Corporation; he associated himself with the Tramways Committee in extending to members a hearty welcome to Salford. The industry, in common with others, was struggling against the backwash of the war. Results were adversely affected by the general trade depression and the steady mounting of costs. Although last year a revenue of £27 101 301 (an increase of £4 044 356 over the preceding year) was obtained, only five undertakings had succeeded in paying their way after making due provision for renewals. There was also competition from other forms of road transport which were free from the heavy burden of road maintenance. A new problem was introduced by the contemplated action of the railway companies, who also proposed to come upon the public roads and furnish further competition. They had just emerged from the biggest inquiry ever made in this country into the financial conditions of tramways, and they had acted wisely in confiding their case to practical representatives.

It was satisfactory to find that the Ministry of Transport had not insisted on treating tramways as identical with other vehicles in regard to additional lighting, licences, &c. But the question of folding steps for new cars was a matter in dispute, and the Association contended that this device would not help in regard to efficiency or rapidity of movement and safety.

Wages and Finances.

The National Council had done good service in promoting industrial peace between employers and employees. Wages still constituted the biggest item in ordinary expenditure. The tramways industry was not a primary one, but was demanded by the presence of primary industries. Hence it could not grant higher wages than were paid in the industries it served. Adjustment of the war bonus was now in operation, but there was general agreement that post-war wages would not be allowed to fall to pre-war values. The present scheme of wages adjustment could not, however, be modified until March, 1922.

Cost of permanent way renewal and reconstruction were severe, and the alternative of trolley-buses upon routes where traffic was not very heavy were being seriously considered. Such vehicles would escape obligations for the cost of road maintenance and renewal. The question of the payment of road-maintenance by all users of roads might be considered. Such charges could not cease to exist, they could only be transferred.

The Commercial Aspect of Competition.

Mr. Holford then referred to the wider question of the commercial aspect of competing forms of road passenger transport, quoting a recent statement of Lord Montagu to the effect that tramways on main roads were an anachronism. Mr. Holford contended that tramways were public utility services and existed to meet the needs of vast populations of working people. They enabled workers to live outside the industrial area, the congested portions of towns and cities being thus relieved. They could not be thought of in terms of village life or country roads. The magnitude of the tramway

undertakings was illustrated by the fact that the Association represented a capital of £57 993 898; it included practically all municipally owned and operated tramway undertakings, of which there were 102 in this country. During the past year they had carried 3 632 million passengers, and the track operated amounted to 1 705 miles. During the last twenty years the Association had played a most useful and effective part in the tramway world.

A vote of thanks having been passed to the President for his excellent address, THE SECRETARY (Mr. J. Beckett) read a paper by Mr. J. M. McElroy (Manchester), on "Some Phases of Tramways Development in the Past, and the Outlook." This we give in abstract below.

Some Phases of Tramway Developments in the Past and the Outlook.

By J. M. McELROY.

There can be no doubt that the utility of main roads has been greatly increased during past decades by the laying down of rails for tramways. Growth continues at a great rate—so quickly that attempts to reduce it to a formula are frustrated. Invariably estimates so conceived are exceeded. Such rapid growth brings new problems, which the author illustrated by comprehensive data relating to tramway systems in Glasgow, Liverpool, Leeds, Sheffield, Nottingham and Bradford and Manchester. These data are assembled in tabular and diagrammatic form in an appendix, the chief items being:—Average revenue per head of population, average fare per passenger, average journeys per head of population, average passengers carried per car mile, operation costs per car mile. The following summarised data are typical:—

	Liverpool.		Leeds.		Manchester.	
	At 1914 compared with 1904.	At 1921 compared with 1904.	At 1914 compared with 1904.	At 1921 compared with 1904.	At 1914 compared with 1904.	At 1921 compared with 1904.
	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.
Fare per passenger	1.8 in-crease	39 in-crease	2 de-crease	54 in-crease	12 de-crease	32 in-crease
Revenue per head	23 "	152 "	31 in-crease	177 "	31 in-crease	141 "
Operation costs	14 "	206 "	13 "	209 "	6 "	185 "
Journeys per head	16 "	72 "	33 "	82 "	35 "	73 "
Passengers per car mile	22 "	66 "	2 "	36 "	22 "	63 "

The general conclusions to be drawn from these statistics are (a) before the war there was (1) a tendency towards reduced fares, and (2) towards increased operation costs, and (3) a growth in the journeys and revenue per head. All these factors illustrate the soundness of the policy of reduced fares which resulted in increased travel and greater revenue, such as more than met increasing operation costs.

The War and Costs.

It also appears (b) that after the war started there was accelerated growth (1) in the journeys and revenue per head, (2) in the passengers per car-mile, and (3) in the operation costs. The increases in fares per passenger lagged behind until the war was practically over, and the percentage increase in the average fare per passenger in all the cities is a long way below the percentage increase in operating costs. Owing to the facts that the unit is the penny fare, and we have not a decimal coinage, it has been difficult to increase fares by easy stages. There are forty-five municipal undertakings charging a penny fare (average distance $1\frac{1}{2}$ miles to 696 yds.), thirty-four undertakings charge a minimum fare of 1½d. (average distance 1 mile 1 130 yds. to 987 yds.). Eleven undertakings have a minimum fare of 2d. (average distance 3 miles to 1 mile 140 yds.). Sufficient time has not elapsed to decide which is the soundest policy, but a minimum 2d. fare appears to involve some risk of lessening the riding habit.

As regards the future the high cost of permanent way construction must put strict limits to extensions, and favour the development of the motor-bus or trolley-bus. In instances where tramway

tracks require reconstruction these alternatives will require careful study.

The Tramcar and Traffic.

It is admitted that tramcars are the most efficient means of handling traffic up to a given density. Beyond that point traffic must ultimately be carried underground. The provision of a tramcar service to meet peak-loads involves providing plant and special cars which are used for a few hours each day. On arterial routes when saturation point is reached at peak loads and the traffic still cannot be adequately dealt with, one must have (a) parallel tramway routes or (b) motor-buses or (c) underground railways. The running of motor-buses, however, tends towards congestion of streets to the prejudice of private road-users. It has been suggested that normal traffic should be dealt with by motor-buses and tramcars used only during the peak period, but the proposition is absurd. Reasonable fares at peak-time are only possible if the undertaking is carried on as a business concern and the plant, &c., is run at maximum efficiency. A municipal tramway undertaking must also fulfil obligations imposed by Parliament, namely (1) to maintain paving between rails and 18 in. outside them, and (2) to pay local rates in respect of rails laid in the streets; it has also a tacit obligation to run cars at all times in practically all directions, and in short to meet all legitimate demands of the public for passenger transport. If private enterprise may step in and compete without obligations such as these the useful services capable of being rendered by tramway undertakings may be curtailed.

Decimal Coinage.

In reading the paper, the SECRETARY, dealing with the adoption of the decimal coinage system, mentioned by the author, said that Mr. McElroy did not refer to the proposal considered by the Royal Commission, and turned down by them, but rather to the proposal to decimalise the shilling, thus increasing the value of the penny by 20 per cent. That was a proposition which had been submitted by Mr. H. Alcock, and he had seen nothing anywhere to withstand the weight of the arguments in its favour. He asked the members to study the problem and see whether it was worth while giving it a trial.

DISCUSSION.

Mr. J. DALRYMPLE (Glasgow) suggested that the Executive Council of the Association should be asked to go fully into the question of coinage. There was no doubt that it was a mistake to have an initial fare paid by two coins, and what was wanted was a coin which would purchase something more than the present penny, and something less than three-halfpence. Mr. Alcock's was the simplest proposition that had yet been put forward.

Mr. A. BAKER (Birmingham) said the author's figures showing the increase of operating costs and fares, due to the war, were particularly interesting when compared with those given by him in 1915. He had then mentioned that in order to meet the extra operating costs in Birmingham it had become necessary to increase the fares in the city. That was at a time when expenses had only gone up by about 10, 15, or 20 per cent., but to-day the costs had increased by something like 200 per cent.

The Past Finished With.

Mr. J. B. HAMILTON (Leeds) said the past was finished with. The tone of Mr. Baker's Paper in 1915 was that plenty of money was about, and the tramways had better have some of it. That was what had led to the great rise in the cost of living, and, incidentally, the great troubles from which we were suffering to-day. As to the proposal to decimalise the shilling, they must co-opt some specialist on coinage, so that they might come to some definite resolution to recommend to the members of the Association. The single coin, as the sheet-anchor of tramway finance, would go a long way towards settling on a uniform basis the difficulties portrayed by the author. It was a great pity that more uniformity had not been shown amongst municipal authorities throughout the country with regard to the alteration of fares.

Mr. H. MOZLEY (Burnley) said that an alternative to decimalisation had been proposed by Burnley by separating the half-mile sections into an independent fare list—the penny fare stage only—keeping it entirely independent from the ordinary fare list. This was working exceedingly well, without any difficulty on the part of the conductors.

Small Increases at Bolton.

Mr. J. BARNARD (Bolton) said in Bolton they had stuck to the rigid mile-and-a-half for a penny, and until April of this year had never had occasion to touch that fare, and then had only raised it by a ¼d. per stage. They now had a minimum fare of 1½d., but in the following week they were giving concessions back to the travelling public. With regard to the coinage, it was obvious that they had been able to charge with a coin of the value of 1½d. or 1¼d., it would have carried them over their difficulties.

Decimalisation Explained.

Mr. H. ALCOCK said it must be appreciated that the growing poverty of the tramway passenger would mean that he would refuse to pay the high fares demanded. On the other side, there would immediately arise a demand for the restoration of the penny fare, and, so far as he could judge, the finances of the various undertakings would not permit of a return to the penny fare, because of the permanent higher cost of

labour. Therefore, there was a good opportunity for tramway men to advocate, not a new system of coinage, but simply an adjustment of the existing coin values to bring them more into harmony with present-day requirements. His proposal was simply to make the existing penny coin worth more; no other coin need be altered. A penny would simply be worth a tenth of a shilling instead of a twelfth. The passenger would consider it a substantial concession to have his penny fare back, and the manager would appreciate that every penny fare would bring in 20 per cent. more revenue.

After luncheon at the Town Hall, Pendleton, by invitation of the Chairman and members of the Salford Corporation Tramways Committee, the discussion on Mr. McElroy's Paper was resumed.

How to Reduce Working Costs.

Mr. W. MURRAY (Walthamstow) dealt with the question of working costs, and the fact that many undertakings were showing a loss. In recent years they had been striving to increase revenue by increasing fares, but he thought they would all agree that this could no longer continue; were they to increase the fares further the probability was that they would not only lose passengers, but probably revenue also. The only alternative was to do something definite towards reducing costs, by reducing wages, readjusting conditions of service, or by improving efficiency. He would not discuss the reduction of wages, but a lot could be done towards increasing the efficiency by educating the men and closer supervision. This would mean that increased revenue and decreased costs would follow as a natural corollary.

Educating the Staff.

Ald. W. WALKER (Sunderland) also urged the importance of educating the tramway staffs, and said that if they were all agreed on the matter of the decimalisation of the shilling they should go forward with a resolution.

Ald. W. C. SHIPLEY (York) hoped that the conference would not go forward with the coinage revision proposal without giving it due consideration. To consider that it was possible to induce the powers that be to alter the currency to accommodate the tramway system of the country was too silly for words.

Mr. A. T. EARDLEY (Stockport) asked whether there was any difference between Mr. Alcock's proposal and the metric system. Referring to the Sheffield statistics, it had often been said that an increase of fares resulted in decreased revenue. In the Sheffield case, however, the increase of 66 per cent. in the fare per passenger in 1921 as compared with 1904 was higher than in any other of the five towns mentioned, and the increase of 272 per cent. in the revenue per head was also higher than in any other of the five towns, which showed that increase of fares did not necessarily result in a decrease in revenue. It did show, however, that tramway men must have regard to the particular industries carried on in a locality. Probably Sheffield had been doing very well at munitions, which might account for it.

Significant Differences.

Mr. A. R. FEARNLEY (Sheffield) said the differences referred to by Mr. Eardley were really very significant. The point was that the fares in Sheffield were the lowest coins which could be used, the halfpenny and the penny. The distances were half a mile for a halfpenny, and three miles for a penny. That large increase in fare of 66 per cent. was not really the result of an increase, seeing that in doubling the halfpenny fare the distance was also doubled.

Mr. R. H. WILKINSON (Bradford) pointed out that the figure given in the paper for the increase in journeys per head of population in Bradford, namely, 96 per cent., was the highest increase of all the selected towns, with the exception of Sheffield. He had plumped for the twopenny fare twelve months ago, and it had been a great success. The increase in income in the first week following the increase to 2d. was 32 per cent., and the average for the twelve months working on Oct. 1st next would be about 25 per cent. gain as against what was earned when the 1½d. fare was taken off. That fact, coupled with the increase in the number of journeys per head, should be convincing proof that so far as Bradford was concerned the 2d. fare was the right fare to adopt.

Mr. J. B. Hamilton, C.B.E. (Leeds), then read his Paper on "The Operation of Tramway and 'Bus Undertakings under Statutory Powers, in Relation to the Roads Act, 1920." This we give in abstract below.

The Operation of Tramways and 'Bus Undertakings under Statutory Powers as Affected by the Roads Act, 1920.

By J. B. HAMILTON.

Parliament has consistently sanctioned great extensions of tramway routes, and many authorities have also obtained powers for the operation of motor-buses and railless traction in areas where the capital cost of tramways was not justified by sufficient density of population. Frequent opposition was made by railway companies in the early stages of such developments, but in no case has this been permanently successful. Railway authorities apparently now recognise that tramway authorities cater for a different class of people, i.e., short distance travellers, and in fact act as auxiliaries to railways. It is not generally recognised how great may be the contributions of tramway authorities in respect of roadway maintenance. In Leeds the amount reaches £124 per car per annum

for rating assessment on lines only and £168 per car per annum for annual cost of paving and repairs and renewals, making a total of £292 per car per annum. These figures are comparable with £70 £80 paid annually by a motor-bus. The termination of hostilities left tremendous arrears of permanent way requiring repair and renewal and the cost became almost prohibitive. Hence fares have been increased.

A Curious Anomaly.

Until 1916 the curious anomaly prevailed whereby privately-owned vehicles, of identical type and road-wearing effect as municipally owned ones, could be run without any corresponding charges being made. In that year powers were conferred under the Emergency Road Legislation Act to enforce a road-maintenance charge. This Act continued in force until Aug. 31 last, and gave some protection to municipal operators. But with the birth of the Roads Act, 1920, a new set of conditions has arisen. The effect of this Act is that applications for a licence must be granted unless there are valid reasons for refusal. These grounds of refusal include danger to the safety of the vehicle and persons therein, or to other traffic on the highway, and unsuitability of the highway for the vehicles proposed. It does not appear that competition with another transport service would be regarded as valid ground of objection, and there is no remedy for a local authority or private company operating under statutory powers which may be prejudiced. The authority may refuse to license, but the applicant has then the right to appeal to the Ministry of Transport.

Mr. HAMILTON contended that indiscriminate competition, involving duplication of services where present facilities are adequate is not "healthy competition," and that for economical working a monopoly of transport on the highways, properly safeguarded, is essential to economical working. A parallel is to be found in other public utilities such as electricity, gas and water supply where no overlapping or competition is permitted.

The present peril is not directed against tramways *per se*, but against municipalities or private companies which operate under statutory powers tramways or bus-services on routes which they have established often at great cost. It is evident that action must at once be taken by Parliament to prevent the menace of uneconomical competition and waste of public expenditure which is now liable to occur.

Appeal to the Ministry of Transport.

At the conclusion of the reading of the paper, Mr. Hamilton proposed the following resolution, which indicated the form which the Executive Council thought the remedy for the difficulties dealt with in the paper ought to take:—

"That in the opinion of this Association the competition of motor vehicles with tramways upon inequitable terms relating to (1) local taxation; (2) road maintenance charges; (3) statutory fares for ordinary passengers and workmen; and (4) regularity of service, will result in further increases in tramway costs and consequential fares, and that, therefore, representations be made to the Ministry of Transport urging the statutory regulation of such competition in the public interest."

Mr. T. B. GOODYER (Croydon) seconded.

Ald. C. HIGHAM (Blackburn), in supporting the resolution, dealt at some length with the position of the municipally-owned tramway undertaking at the present time owing to competition from other vehicles.

Councillor R. L. BERRY (Aberdare) said some time ago application had been made to his council by people living some distance outside their area for power to travel over the roads of the district. This the Council refused, but when the applicants appealed to the Ministry of Transport, the Ministry advised the Council to draft the licence subject to the licensees not taking up passengers on the roads served by the Council's tramways. That was a concession towards the object of the resolution, and he mentioned it as showing what might be done.

In the Melting Pot.

Mr. E. S. RAYNER (Hull) said that they were undoubtedly in the melting pot, and he had never heard three more appropriate papers discussed at the Association's conference than those which were before them on this occasion. Municipal authorities had to prove to Parliament the necessity of a service before they were granted powers, but in no case was a man who proposed to run omnibuses asked whether an adequate service already existed along the particular route for which he was applying for power. That, to his mind, was the crux of the whole thing. This unfair competition was going to force them either to run a reasonably cheap service and throw the loss on the rates, or else to run such an expensive service that it would be no use to the workmen. If the motor omnibus people were asked to prove that there was no adequate service along the routes they proposed to serve, it was one of the strongest preventives possible.

After some further remarks the conference adjourned until Thursday.

An Amended Resolution.

Thursday, Sept. 29.

This morning the conference resumed the discussion on Mr. Hamilton's paper.

Mr. HAMILTON, dealing with the resolution, which had been put to the meeting, said that it had been the subject of consideration by the Executive Council since the meeting adjourned, who had felt that it

was a little too narrow as it based their case upon unfair competition alone. Therefore he would propose a resolution which would place their position on broader lines than the one submitted on the previous day. It was not a question for the municipal tramways only, but for the whole of the travelling public. Therefore, they would like to take up the position, first, that the operation of the Act was contrary to the spirit of Parliament, and, secondly, that it would be wasteful and most unfair to the public forms of transport they had to carry on. They had seen in the Press that morning a statement which he hoped those wishing to speak would absolutely nail to the table, as being improper and absolutely incorrect. It was a statement to the effect that tramways had passed away. He would say that the tramway, for urban services, and for density of population, was unequalled, and would be unequalled for many years to come in regard to the service they could give at low fares.

The resolution was as follows:—

"That in the opinion of this Association, representing the whole of the Municipal Tramways of Great Britain, the Roads Act of 1920 encourages wasteful and overlapping competition with statutory undertakings, which will inevitably result in increased travelling charges to the public, and is contrary to the intentions of Parliament, and that, therefore, representation be made at once to the Minister of Transport urging the statutory regulation of such competition in the public interest."

Mr. A. L. C. FELL (L.C.C. Tramways) seconded.

An Accusation of Slackness.

Councillor E. LEE (St. Annes-on-Sea) supported the resolution, which, he said, was much better than the previous one. But it appeared to him absolutely incredible that the Association had not exerted itself to the utmost, or the Roads Act would never have passed through Parliament in the form it did. He held that competition was good for everybody, but it must be fair competition.

Mr. L. C. F. BELLAMY (St. Helens) said that in the last session Mr. Hamilton had claimed that Parliament had never intended that motor buses, company or municipal, should pay anything more than the Excise licence. The St. Helens Corporation had had inserted in their Bill, and it was in other Bills which came afterwards, a clause which provided that they must pay for the adaptation of the roads over which they intended to run. The result was that they had powers to run their buses, subject to the Lancashire County Council or the Ministry of Transport telling them how much they must pay towards the adaptation of the roads. That was very improper.

Ald. E. H. SELLERS (Huddersfield) emphasised the unfairness of the municipal undertakings having to contribute to road maintenance, whereas private undertakings did not, whilst at the same time, private undertakings could run their vehicles at irregular intervals.

Optimism at Last.

Councillor A. D. WILLOUGHBY (Hull) said that during the course of the next two years the tramway undertakings would recover. They were only in the same position as every other great industry at the present moment. They were looking at the matter to-day purely from the vested interests standpoint. Probably there was another point of view to which expression had not been given, and that was that it was imperative, so far as the community was concerned, that improvements should be given. The question of dealing with large crowds of people attending football matches, &c., had been brought out. Very few tramway undertakings were capable of dealing with such large crowds alone, and to his mind, in his own city, it was a very good thing that they could have charabancs to move the passengers. They could not deal with them alone, and so far as he was concerned, he rather welcomed the charabanc in the city. They had allowed unrestricted competition with the trams by the charabanc people, and in the main it had not affected the tramway undertaking.

Mr. W. T. YOUNG (Dundee) impressed upon the meeting that if they were to ask for legislation, they must have something sufficiently comprehensive to include traffic both inside and outside the cities which was competitive.

Mr. W. MURRAY (Walthamstow) expressed the hope that for their own sakes those from the provinces would not make the mistake of under-estimating the danger of this competition, because even though some had heard what was happening in London, they could not fully realise the conditions existing there between tramways and motor buses. He suggested an amendment to the resolution, that after the words "will inevitably result in increased travelling charges to the public," the words "prove ruinous to the tramways industry and finally result in imposing intolerable financial burdens on tramway-owning municipal authorities" should be added, in order to strengthen it.

Councillor W. J. SQUIRES (L.C.C.), supporting the resolution, contended that no form of transit or transport which was going to compete with municipal tramways should be permitted to operate until they conformed to the regulations and conditions which were placed upon municipal undertakings. It seemed to him that the only remedy was the one which the resolution would embrace, and that was, to go to Parliament.

Not Afraid of Competition.

Mr. J. S. D. MOFFET (Belfast) also supported the resolution. What they were up against, he said, was unregulated, irresponsible, free-lance competition. Given fair competition, he was sure there was no motor vehicle to hold its own under the conditions they themselves had to operate.

Councillor W. T. NEWLING (East Ham) referred to the sufferings of the metropolitan boroughs from unfair competition. He did not

think Mr. Murray's amendment was any too drastic; something of a very drastic nature was required in the resolution to bring the position home to the Government.

London—A Lonely Furrow.

Mr. A. L. C. FELL (L.C.C.) said that in London they had been ploughing a lonely furrow. They had had to go before all sorts of commissions and committees to try to stop the wasteful competition going on in London, but they had had very little support. When he said that today the L.C.C. had still something over 700 buses competing directly with them on their routes, simply robbing them of traffic they ought to carry, the members would imagine that the situation was serious. Competition was not getting worse; they were holding their own, and they would be able to bear all the burdens put on to them if they were not robbed to the extent they were. When it was considered that on the tramway routes in London they had had to pay £820 000 for widening streets, over which the omnibuses ran, in addition to £140 000 a year on permanent way rates, and the buses were paying nothing, it was simply a scandalous position.

Ald. D. J. DAVIES, J.P. (West Ham) said the only solution of the whole matter was that local authorities should have the last word in respect to allowing other people to run through their routes.

The Resolution Carried.

Mr. Murray's amendment was put to the meeting and defeated by a substantial majority.

The resolution as already given was carried unanimously. It was further resolved "That copies of the resolution be forwarded to the Prime Minister, the Minister of Transport, and to every municipal corporation that owned and operated tramways."

The conference then adjourned and the members proceeded to the Town Hall, Manchester, where they were entertained to luncheon by the Chairman and members of the Manchester City Tramways Committee.

In the afternoon Mr. W. CHAMBERLAIN (Oldham) read his Paper on "Permanent Way—Public Road—Maintenance," of which we give an abstract below.

Permanent Way (Public Road) Maintenance.

By W. CHAMBERLAIN.

The Paper begins by recalling that in 1870, when permission was first accorded to tramway authorities to use public roads, on the understanding that they should maintain the portion of the road used, every vehicle on the road was horse-driven and of light construction. Turnpike trusts were still common, and each vehicle

paid toll according to a rough estimate of the wear and tear it entailed. The conditions have been imposed by every subsequent private act, until last year, but they are no longer founded on any sort of principle. When roads are disturbed by any undertaking they are under statutory obligation to reinstate the road, and no authority desires to escape this duty; but maintenance is a different matter and, in this respect, conditions have become progressively worse for tramway undertakings.

Estimate of Road Traffic.

It is estimated that the amount of traffic conveyed by roads, both passengers and goods, is, probably, at least three times as great as that conveyed by railways. Also a recent traffic census has shown that the percentage of trams to other vehicles does not exceed 24 per cent. Mechanically propelled vehicles have a very serious effect on concrete foundations and the area between the curbstone and the 18 in. margin of the tramway may become almost impassable for mechanically propelled vehicles—with the result that the bulk of the traffic is carried on that part of the roadway maintained by the tramway authority. Where tramway tracks are in want of repair the remaining portion of the roadway is commonly in an even worse condition.

The principle contended for is that imposed in the Finance Act, 1920, which imposed a graded system of excise on all mechanically-driven road vehicles.

Statistics quoted by the author show that permanent way costs form as much as 24 per cent. of tramway revenue, and that tramway concerns, although the minor users of the roads are the major contributors to their cost. The withdrawal of tramways would not cause any less wear and tear of the roads. On the contrary a large additional cost would have to be borne by the Roads Fund. It has been argued that tramways do not contribute to the Roads Fund by means of taxation. The cost of an excise licence for a tramcar is 15s. but if desirable, tramways would make further contributions in this form, if an equitable graded system were adopted. Tramways are a commercial concern and should depend on their own earning power. They should not be asked to bear a burden imposed by other road users, including competitors. Road maintenance, at least on first-class and graded roads, is no longer born by local taxation, but is spread over the actual users of the road through the medium of excise licences. These licences, however, should be extended to embrace all users of the roads.

Owing to the shortness of time, the paper was not discussed.

Some Recent Arc Rectifier Installations.

The relatively high efficiency of the mercury arc rectifier over a wide range of output, and its ease of operation, together with extremely low maintenance, are advantages that cannot be overlooked by those contemplating extensions to their sub-station plant. When the strong position occupied by the rotary converter and motor generator is considered, the advance made by the mercury arc rectifier is almost phenomenal. That the rectifier has come to stay and will eventually largely supersede the older types of rotating converters is the opinion of those having many years' experience with such plant. The rectifier is in many ways specially suited to traction and similar conditions, and it is common knowledge to those intimately connected with them that they are so insensible to heavy fluctuations that any type of load, however severe, can be handled with the greatest ease.

As an instance of this we may give some details of three interesting mercury arc rectifier equipments which have recently been installed at Ipswich, Birmingham and Wolverhampton by POWER-RECTIFIERS, LTD. Though now quite a common sight on the Continent, these rectifiers are the first to be set to work in this country.

The Ipswich Installation.

The first plant was installed some six months ago at the new works of E. R. & F. Turner at Ipswich, and though, in this case, only of small output, it is quite typical of its class and has operated quite satisfactorily. It has a capacity of 120 kW at 470 to 475 V, the three-phase a.c. supply being obtained from the Corporation at 3 000 V and 50 periods. The load is of a highly fluctuating nature, consisting of cranes, compressors, &c. Fig. 1 shows the rectifier with its vacuum pump set and ignition converter in the immediate foreground. In the middle distance is the low tension a.c. and d.c. panel containing the usual instruments, back-of-board type of main circuit-breaker, and most of the rectifier's standard auxiliary gear. Next to it is a plain panel containing the automatically-operated induction regulator, the controlling element of which is the well-known Brown-Boveri automatic pressure regulator. This is seen mounted in the centre of the d.c. panel. With this automatic gear the d.c. pressure is maintained constant at 475 V at all loads. In the distance can be seen the H.T. panel, and next

to it the Corporation cubicle. Behind this, the main step-down transformer is placed. A noticeable feature of the panels is that they are entirely self-contained and of very pleasing appearance.

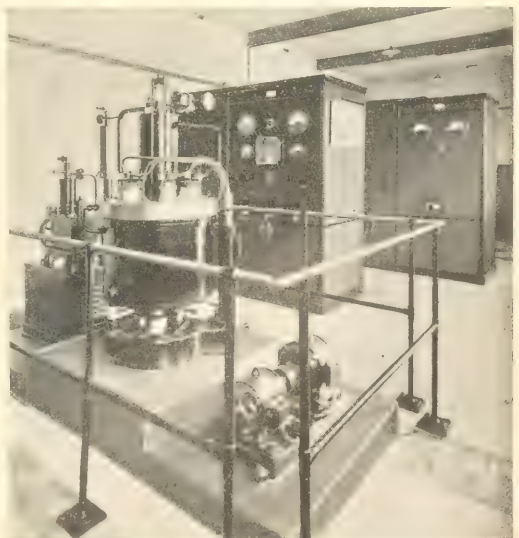


FIG. 1.—120 kW 475 V RECTIFIER AT IPSWICH.

The little substation is a model of its kind and can be commended to those who too often throw such places together and expect to obtain the very maximum of benefit with little expenditure.

The Birmingham Rectifier.

The second set to be put to work is on the Birmingham Corporation's system, and is installed at their War Lane Sub-Station,

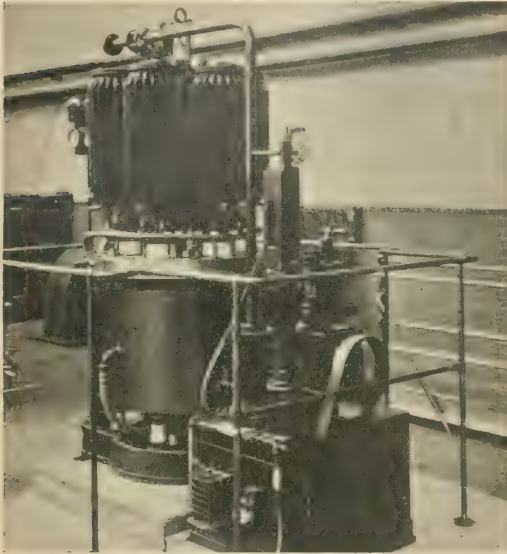


FIG. 2.—225 kW 450 V RECTIFIER AT BIRMINGHAM.

Harborne. It is seen in Fig. 2, and is rated for 500 A at 450 V (225 kW). The current rating, which is the basis upon which the output of a rectifier is figured, has since been increased to 600 A

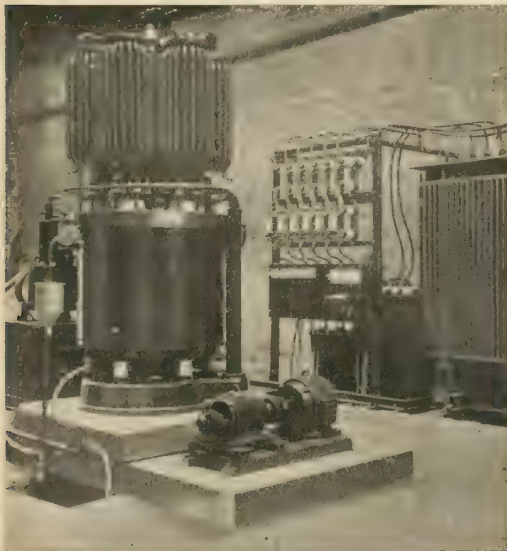


FIG. 3.—220 kW 440 V RECTIFIER AT WOLVERHAMPTON.

continuously, because experience has shown that the additional capacity can be obtained without impairing its efficiency. In this instance, the primary supply is three-phase at 5 000 V and 25 cycles.

The larger rectifiers are characterised by the long anode radiator coolers seen in the photograph. This set has been in operation for upwards of three months on the lighting and power three-wire distributing network. It is run connected across the outer conductors of the network in parallel with the station battery, and also with rotary converters. Balancers are used between the outers and the neutral wires. The voltage regulation on the rectifier has proved to be quite satisfactory and variations in the load are automatically shared between the rotaries and the rectifier. The experience so far gained points to the apparatus being eminently satisfactory. The overall efficiency is high over a wide range of load, while its silent working is particularly noticeable, practically the only noise being due to the belt-driven vacuum pump. In the future, even this will be eliminated because the new pumps are to be direct-coupled. It is proposed later on to experimentally transfer the apparatus from the lighting supply to the overhead tramway traction supply at a pressure of 550 V, the higher pressure being, of course, obtained by altering the tapplings on the three-phase transformer.

The Wolverhampton Set.

The last set is at the Tettenhall Sub-Station of the Wolverhampton Corporation. It has, however, only been in operation a short time, so that it is too early to form any definite opinion, though indications so far are satisfactory. The technical particulars are approximately the same as for the Birmingham plant, with the exception that the frequency in this case is 50 cycles. Fig. 3 illustrates this—the six-phase main transformer with anode fuses and disconnectors are shown on the right of the rectifier. This set is running on the three-wire lighting and power network and runs in parallel with a rotary converter.

A fourth set is at present in course of erection, while others will rapidly follow.

The Trade Paper and the Trade.

VERY grave responsibilities rest upon industrial leaders in this period of recurring crises in the history of human development. These responsibilities are by no means confined to presidents and officers of trade association, to trade union leaders, or to the executive heads of big corporations. They filter right through and down to the employer of three or four hands and to the smallest manufacturer, tradesman, or commission agent in the land. Every man amongst us, if he is true to the position which he holds and to the opportunity that has been given to him, is required at a juncture like this to put forward the very best that is in him. Whatever Prime Ministers and other great persons may do, the prosperity of the country, and indeed of the world, depends, and will always depend upon the degree of intelligence, initiative, and enterprise that is to be found in the lower as well as the upper ranks of industry and commerce.

The Margin the Important Thing.

The economists have showed us that the really important thing is a margin; a 5 per cent. under supply or over supply will have an altogether disproportionate effect upon the other 95 per cent. A few small orders sent to the stock market for Consols will have the effect of increasing or decreasing the price of the vast mass of these securities. So it is with business; a few little men place a few little orders and immediately there is an appearance of vigour and activity which sets everybody thinking that trade is on the mend. The importance of the little orders even to the little men may be negligible, but the effect upon the whole mass of trade is full of consequence. There is nobody in business to-day who when he reads of unemployed, can evade a share of the responsibility for this state of affairs. Under these circumstances we ought each and every one of us to be searching our brains to devise fresh ways, however small, in which we can set somebody to work, realising that, just as a pebble causes an ever widening circle of movement when thrown into the water, so our little bit of business brings help to an ever widening circle of human need.

The Journalist's Responsibility.

The responsibility of the trade and commercial journalist at time like these is heavier than ever. He always carries rather more than his share of responsibility for good or evil, but never before has the load been so heavy, or the opportunity so great. The success or failure of business depends upon the application to it of right or wrong ideas, and it is the business of the business journalist to provide and circulate ideas. We are in a position to know that there never was a time when the business newspaper was so eagerly sought after or so diligently read and studied as it is to-day. We realise that every line which appears in our pages is fraught with possibilities for good or for bad, and when the bad is so

prevalent and the good so sorely needed the effort to sort the one from the other is more than usually strenuous.

An Important Item.

Our readers cannot fail to have noticed the recent steady growth in that section of our columns which deals with commercial information. The stream of reports of bankruptcies, failures, and credit arrangements has swollen in recent months to proportions which have not been since the days before the war. This is part of the process of deflation, part of the return to normal conditions, and is, of course, in the whole good, inconvenient and distressing as it may be to those immediately affected. But in this respect the trade journal may sometimes, by spreading pessimism, do more harm than good, unless the information given from week to week is read with understanding and the lesson which it teaches properly applied. The knowledge that Cary Street and those whose business it is to look after bankruptcy matters are getting back to a condition of pre-war activity, should act as a tonic to the rest of us. We cannot do our best in business unless we realise its risks, and we have not done our best for several years past, because, thanks to an unsound financial basis, the risks have been so low. The psychology of the matter is very simple and very unpalatable. Just as the worker works better when he is reminded of the possibility of unemployment so the business man is a better business man when he is aware of the risk of failure.

Business Promotion.

But passing to more cheerful subjects, there is no more powerful agent in business promotion than the business newspaper. If we are wise, we live very largely on the experience of others, and in business matters we can learn of that experience through our business papers. Some industries are more highly trained in this respect than others; they realise more fully the responsibilities and the benefits associated with their trade press; they are careful to see that every activity in which they indulge is promptly reported to the trade paper office, and thus each member exchanges his little bit of success or experience for the combined success and experience of all the other members of the industry. The business man who sees that copies of all his circulars, catalogues, and other announcements are regularly despatched to his trade paper, and who makes a point of writing to the editor when some new idea or development is in the air, does a little bit of advertising on his own account, it is true, but he really does far more than this; he acts as a stimulant to every other reader of the journal in question and becomes the pebble which sets the ever widening ring of commerce in motion. There was a time when the man in business was foolish enough to imagine that if he happened to be busy he should keep it to himself for fear that his competitors might take his business from him. Those ideas disappeared with the last century and we are now old enough in the arts of industrial development to know that success breeds success, and that the best way to be a successful man is to belong to a successful trade.

The Responsibilities of the Press.

We of the business press are keenly alive to the fact that responsibilities rest upon us and opportunities are now open to us which were never dreamed of by our fathers. The business press stands to-day in relation to the community in a position of far greater importance than ever before, and we are determined so far as is within our power to rise to these responsibilities and these opportunities. When the complications of business to-day are compared with the simple buying and selling which caused our grandfathers to consider themselves busy men, this fact emerges that there is more thinking required to carry on even a modest enterprise than any one brain can be expected to do. One mission of the trade paper is to do what might be described as the "surplus thinking" for the trade which it serves. The business journalist is in a position to take a view of the whole of his industry, get it into proper perspective, and draw conclusions and notice influences which are beyond the vision of the individual overburdened with the details of the particular section or department of the trade in which he happens to be engaged.

The Research Department of the Trade.

The trade journal has been described as the "research department of the trade." Its business is to collect and arrange and present the broad facts affecting an industry, facts which none but the largest corporations can hope to collect, arrange, and study for themselves.

It is not often that we in these pages talk about ourselves, or about the work and the duties of a trade journalist, but these things are very much in the front of our mind at the moment, and we give a little space to them because we want our readers to know the direction in which we are travelling and to give us their goodwill and their help. There is a special intimacy, a mental intimacy far closer than that brought about by personal contact between an editor and his readers, which makes us feel that we are sometimes permitted to talk in this way.

Correspondence.

WATER-POWER PROBLEMS.

To the Editor of THE ELECTRICIAN.

SIR: The article on "Water-Power Problems" which appeared in your issue of September 16th, which was an outcome of the inspiring Paper read by Prof. A. H. Gibson, before the British Association in Edinburgh should not, at a time when the subject of water power is receiving so much more attention in this country, be allowed to pass without comment, owing to the fact that some of its contents are liable to be misunderstood by the users of power if not by those interested from the engineering point of view in its development.

From the point of view of Great Britain, those who have given much study to the subject of water power in the British Isles will hardly agree with the statements in the paragraph headed "Hydro-Electric Conditions in Great Britain," wherein can be seen a marked terror of transmission problems—ghosts which are quite capable of being laid.

It is not to be supposed that old industries will be uprooted in order to enable them to use water power, but there is no reason why new industries or extensions and even revivals of old industries should not spring up even in the remote fastnesses of Scotland, Wales and Dartmoor. And if those industries can be installed, and if, as has been shown to be possible, those industries can be supplied with power as cheaply from water as from coal, it is surely in the interests of national welfare that water shall be used, and the coal either conserved or sold abroad, or in districts where water is not so readily available.

There is also in your contributor's paragraph dealing with "The Need for the Expert" the somewhat sweeping remark, "Unfortunately, in this country those experts are not available."

That Great Britain may not have all the engineers she might like to have, possessed of "expert knowledge of the variety of problems connected with water-power development," will be admitted; but none the less she has a great number of engineers possessed of those qualifications. Our own engineers are constantly examining water-power schemes in this country and abroad, but we will not deny that we are very busy training others, and an excellent supply of young engineers is forthcoming from English and Scotch Colleges, in which the training given forms a very sound foundation for the more specialised training that hydro-electric engineering requires. I am, &c.,

For Sir W. G. Armstrong, Whitworth & Co., Ltd.,

London, September 30th.

DOUGLAS SPENCER.

[This letter could not be published in our last issue owing to lack of space. Ed.]

THE NEGLECT OF FRENCH PRODUCTS.

To the Editor of THE ELECTRICIAN.

SIR: I have often noticed how active Swiss, German, Dutch, Swedish, Norwegian and even Austrian firms have been with their publicity and their representatives in this country and how seldom we hear from the French.

The War proved that none of the others had all the brains. How seldom we hear of French motors, transformers, or even lamps being supplied to us, as compared with machinery, &c., from the other European countries mentioned.

I think we should, and would, offer a warmer welcome to the engineers and products of our very gallant Allies in the late War. I am, &c.,

C. T. ALLAN, Assistant Manager,

South Wales Electrical Power Distribution Co.

Cardiff, October 1st.

THE SHIPPING, ENGINEERING AND MACHINERY EXHIBITION.

To the Editor of THE ELECTRICIAN.

SIR: Now that the exhibition is over and Olympia quite cleared I should like to take the opportunity of expressing my sincere appreciation of the hearty manner in which the exhibitors have co-operated with the management from beginning to end.

The technical Press are unanimous in their commendation of the completeness of the exhibition at the time of

opening, and equally eulogistic regarding the high-class character of the exhibits. It is a remarkable fact that on no previous occasion during the whole of my many years' experience has any exhibition called forth such a volume of praise regarding the display of goods and the arrangements generally, the universal opinion being that the exhibition was on a higher level than any previous Engineering Exhibition. All this must be exceedingly gratifying to the exhibitors, who alone are responsible for the excellence of the machinery and goods displayed. The exceptionally good attendance of those who take a practical interest in shipping and engineering matters is the most satisfactory proof that the exhibition attained the end for which it was promoted, not the least pleasing feature being the unusually large attendance of Indian and overseas buyers. The visits of practically every engineering Institution and Association, and the intensely gratifying opinions expressed in every case by the members, are

further satisfactory indications of the high esteem in which the exhibition is held in those quarters where pronouncements in engineering affairs are invaluable.

I cannot adequately express my intense appreciation of the courteous and sympathetic consideration shown to me by the exhibitors without exception, and the admitted success of the exhibition is one more evidence of the benefits of co-operation.

It is perhaps to be regretted that the resources of Olympia were not equal to the demands for space, many machinery exhibits of a heavy character being excluded owing to lack of ground floor accommodation, but these will receive due attention in connection with the exhibition in September, 1923, after the exhibitors on this occasion have had an opportunity of either retaining their present positions or securing others if desired.

F. W. BRIDGES.

London, Oct. 8.

Machining Electric Fan Spindles.

It is not generally realised that the modern capstan lathe is capable of doing work very accurately. Indeed there are still many conservative engineers who believe that accurate and concentric work can only be done on the ordinary lathe between centres.

As an instance of what can be done on the No. 4 capstan lathe, made by ALFRED HERBERT, LTD., we give below a description of the tooling operations on an electric fan spindle which are of more than usual interest. One of these machines, with a special outfit of tools, was recently supplied to the British Insulated and Helsby Cables of Prescott, Lancs, for machine spindles. A dimensioned drawing, which shows the layout for the first operation is given in Fig. 1.

The castings are of hard gun-metal, and, in addition to the close tolerances which are imposed, a high degree of concentricity is demanded between the hole and external diameters. At the first operation the casting is gripped on the intermediate portion by

3. Is a two-diameter four-flute boring reamer which takes the first cut in the 1 in. diameter and the counterbore.

4. Is a single point boring tool for truing up the 1 in. diameter bore.

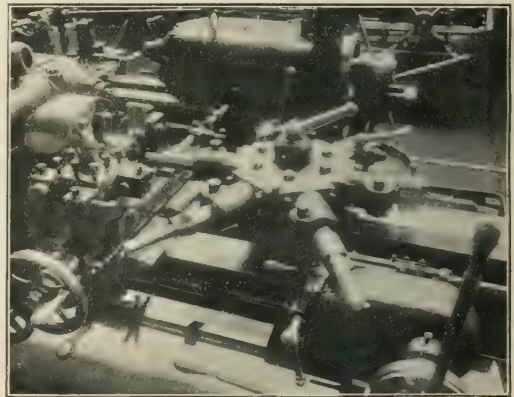


FIG. 2.—THE "SET UP" OF THE FIRST SET OF OPERATIONS.

Towards the back this bar is enlarged so as to fit the hole bored by the single-point cutter, and it thus acts as a steady whilst the tool to the rear takes a second cut in the counterbore and finishes the face at the bottom.

5. Is a boring-bar piloting in the semi-finished 1 in. hole and carrying a cutter for boring the thread diameter and finishing the large bore at the front.

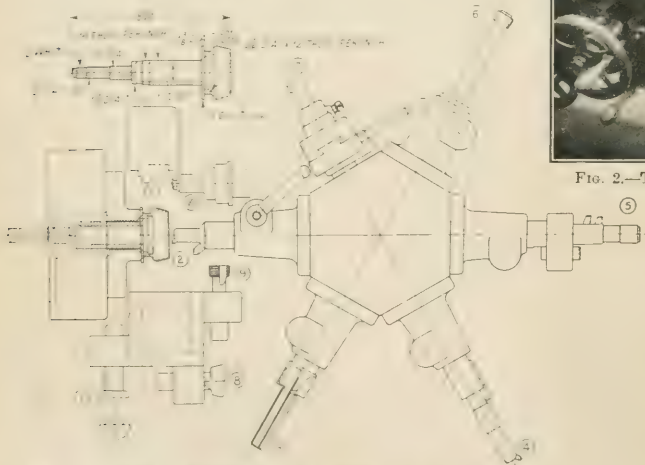


FIG. 1. LAYOUT OF HERBERT NO. 4 CAPSTAN LATHE FOR MACHINING FAN SPINDLES.

special jaws on a 9 in. "Coventry" chuck, these jaws being bevelled off at the mouth so as to allow the flange to set back against them and thus obtain an end location. The tooling is as follows:—

1. Is a special reaming tool in the square turret, used for removing the scale from the external contour and the internal formed recess.

2. Is a two-diameter boring bar for opening out the bore at the front and for starting the 1 in. diameter bore true. The boring bar holder in which this tool is held is provided with a locking handle for the pad bolt, which facilitates changing the starting tool with the revolving steady No. 10, used later.

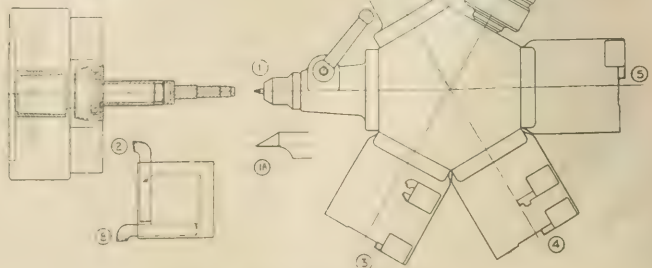


FIG. 3.—CHUCKING FOR SECOND OPERATION

6. Is a "Herbert" standard boring bars with adjustable floating cutters for sizing the 1 in. bore
7. Is a standard recessing tool slide with a circular cutter for recessing the back of the internal thread and chamfering the front.
8. Is a large circular recessing tool for finishing the internal form.
9. Is a chaser for cutting the internal thread, which is too short to be tapped.
10. Is a revolving steady for supporting the work during the application of the form tool No. 11.
11. Is a dovetailed form tool carried in a standard form tool holder on the back of the cross slide.

The time for the first operation is thirteen minutes, the set up being shown in Fig. 2.

In the second operation (see Fig. 3), the method of chucking is specially noteworthy. The chuck is fitted with a standard liner, and in this is driven a long locating plug, the end of which is a nice sliding fit in the 1 in. bore. A shoulder on this plug locates the work endways, and gripping is done on the finished flange by soft jaws. The location of the work is therefore effected by the

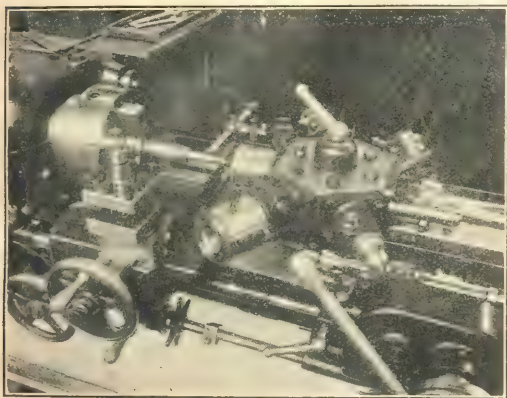


FIG. 4.—TOOL LAYOUT FOR SECOND SERIES OF OPERATIONS.

locating plug, which, being perfectly true, ensures concentricity between the work done at the first and second operations. The tooling for the second operation is as follows:—

1. Is a centring tool for the end.
- 1A. Is a dead centre which is interchanged with tool No. 1, and supports the work during the preliminary turning operations which start the boxtool.
2. Is a standard turning and facing tool which trues up the end of the work and the intermediate diameter for the purpose of starting the boxtools. This tool also rough faces the shoulder.
- 3, 4 and 5. Are flat steady boxtools which deal with the turning of the various diameters.
6. Is a $\frac{3}{4}$ in. "Coventry" self-opening diehead for cutting the small thread.
7. Is a 1 in. "Coventry" self-opening diehead for cutting the large thread.
8. Is a standard tool for finish facing the shoulder.

The time for the second operation is seven minutes, and the tool layout is portrayed in Fig. 4. Fan spindles machined by this process satisfactorily pass the inspection tests.

The Capitalistic System.*

By E. J. P. Benn, C.B.E.

It seems almost impossible in these modern times for a politician to make a speech without some reference to the "System." Newspaper articles are almost as bad. We have all fallen to talking of something which we call the "System," and most of us are engaged in either amending or abolishing the "System." The amount of thought that is put into the "System" seems to be almost negative, except by way of criticism. The result of this state of affairs, as I see it to-day, is that we are all of us gradually losing heart in our work, losing interest in our day-by-day occupation. We are getting back to the condition of the old-fashioned Christians who, you remember, mournfully toiled through this brief vale of tears only on condition that there was an early release to some happier world beyond.

The result of this attitude of mind, economically, seems to me

* Address delivered before the Industrial League and Council, at Caxton Hall, Westminster, on Wednesday, Oct. 5, 1921.

to be extremely serious. It explains what Mr. Lloyd George told us last week—the fact that we are only giving 80 per cent. of our pre-war output, when we know that our capabilities in the matter of output are very much in excess of the pre-war figure. The fact is that this constant tilting at the System has taken most of the enterprise out of us, and it is the exception rather than the rule to find either a working man or an employer who is putting his best, his intelligence and his heart as well as his hand, into the job that he has to do.

There is a further reason why I suggest that it is our duty in this generation to inquire very closely into what is called "Capitalism." It is that we are in a better position than any previous generation; a better position, I hope, than any future generation will be in, to study the workings of economic law. We have been through Armageddon and been subjected to every conceivable sort of experience and experiment, and we are therefore the better able to discuss this matter.

Capitalistic System founded on Exchange.

Now what is called the Capitalistic System has its foundations in exchange. Exchange is at the very bottom of it. Early man, when he produced a bag of corn and required a sheep, was under the necessity of going out among his neighbours and finding somebody who not only wanted a bag of corn but who was willing to part with a sheep, and thus effect a very laborious and difficult exchange. Since those days right down to the present moment the essential exchange basis of our trade and industry has never been touched, and in my judgment never will be touched. Things have become so complicated, the machinery of exchange has been so developed and made so wonderful, that it is very difficult for many of us to realise that we are actually engaged day by day and hour by hour in exchanging some service or some goods which we possess for the services and goods of others who are willing to accept our service in exchange for theirs. I am a journalist: I earn a living by scribbling for the Press. When I undertake a railway journey and a porter labels my luggage it is a little difficult for me or for him to realise that he is in effect exchanging that service for so many inches of something which I wrote for an American paper the week before. But the fact remains that actually that is what is happening. We have developed this business of exchange to such a point that we can any of us walk out to a shop at the street corner, without any previous argument or arrangement, and exchange our services for those of others spread in the farthest corners of the earth.

System dependent on the Consumer.

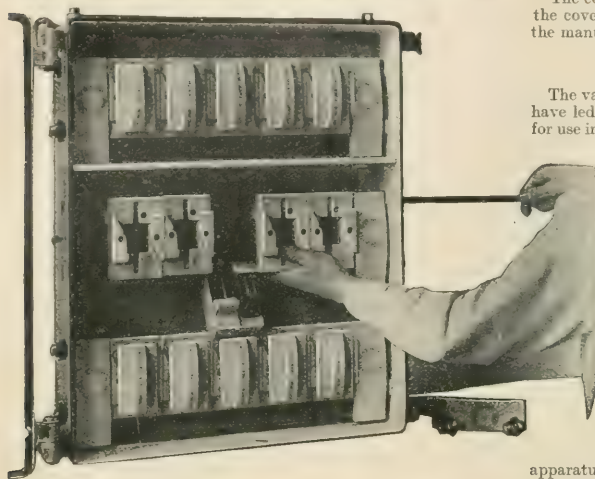
The next big feature of what is called the Capitalistic System—a most unfortunate designation, in my judgment—is that it is essentially a consumers' system. You will notice, if you come to think of it, that the business of exchange must always, in the nature of things, be slightly weighted in favour of the buyer. That is not a "system" invented by wicked persons for the purpose of acquiring riches; it is a characteristic of the human being which we have to admit and deal with as it is. Imagine me a maker of umbrellas. It is necessary for me every day and every hour to persuade somebody to accept my umbrellas in exchange for something which I want; but you, the user or consumer of an umbrella, have this advantage—that you may be a simple-lifer and prefer to do without an umbrella; you may think a mackintosh is better, or you may delay the purchase of the umbrella until to-morrow; and in that way, that very simple and very natural way, the process of exchange is always slightly weighted in favour of the consumer, against the producer. From that fact, as I see it, arises this talk of wage slavery. It is perfectly true—although the term is an exaggeration—that in the ordinary working of human affairs through the process of exchange the producer must be subordinate to the consumer, and, if you like, must be the slave of the consumer. But, after all, supposing if were possible to alter it—though I am one of those who deny that any radical alteration is even thinkable—but if in theory you can imagine a system whereby the balance was weighted in favour of the producer, you would merely have a system of slavery as consumers instead of slavery as producers.

The charm or the perfection of the system of exchange known as Capitalism is this, that every act we do, every thing we offer, every article we produce for the benefit of others, is subject always to the test of the appeal which we may make to others. In offering our service in a free market to the rest of our fellow-creatures we are subject at every moment of our service to this test—the willingness of others to pay for it—which is the only way in which they can express their appreciation of that service rendered. The Capitalistic System might be described as the perfect application of the democratic idea to the economic sphere. The failure of all the arrangements of the last six or seven years to do away with Capitalism or with private enterprise arises from the fact that all these arrangements obviously ignore the exchange consideration.

(To be continued next week.)

Heavy Power Fuses.

We regret that the wrong illustration was published in the short article with the above title that appeared on p. 457 of last week's *ELECTRICIAN*. The correct illustration is now appended, and our apologies are due to the makers of the apparatus, *PARMETER, HOPE & SUGDEN* for the error that was made. The "Fluvent"



VIEW OF "FLUVENT" FUSE BOARD PARTLY ASSEMBLED.

board is readily installed, and can be easily wired by the provision of top and bottom cable troughs. It thus permits of an easy arrangement of the cables and allows the use of alternative types of troughs interchangeable one with the other to suit all types and classes of cable from C.T.S. to the heaviest lead-covered steel-tape armoured cable.

Dolls' Eyes as Scientific Glass.

A week's administration of the Safeguarding of Industries Act has sufficed to show that trade and industry are to be affected in a manner not contemplated by its authors. The Customs Authorities have decided that glass Christmas tree ornaments come under the heading of "lampblown ware," and that pocket carbon batteries for flash-lamps are dutiable as are lamp carbons. Other strange decisions have been made by the Customs officers and the members of the Fancy Goods Trade and the British Chemical Trade Association have already made strong protests against the manner in which the first part of the Act is being administered by the Board of Trade.

When the Bill was before the House of Commons we pointed out the danger of leaving so much power in the hands of the bureaucrats, but owing to the limited time allowed for the discussion of the clauses the matter did not receive the attention it deserved. Anyhow the new riddle-making and puzzle-solving department of the Customs is bringing modern legislation and legislators into ridicule, and the sooner a sensible amending Act is passed the better for the trade of the country.

Explosion-Proof Mining Switchgear.

In a recent issue of *THE ELECTRICIAN* we gave a description of the relief bolts designed by the *ELECTRICIAN APPARATUS COMPANY*. It will be remembered that these bolts when used for the purpose of securing the cover of a suitably constructed switchgear enclosure, convert that cover into a large relief valve, and so effectively protect the apparatus from damage in the event of an internal explosion, and, what is more important, prevent the ignition of inflammable gases in the mine.

Some tests which have recently been made show how these claims have been borne out. One of the boxes was filled with a 9.5 per cent. methane air mixture, which is the mixture having the maximum explosive effect, and this was exploded inside the box by means of an electric spark. It was then found that the pressure due to the explosion did not rise above 12 lb. per sq. in., and did not last longer than about one-tenth second.

Another test was to repeat the previous experiment, but with an explosive atmosphere surrounding the enclosure in addition to the charge inside the enclosure. The object of this test was to determine whether an explosion inside the switch gear enclosure

would ignite the gas outside. For the outside atmosphere, an 8 per cent. methane mixture was adopted—this being the most readily ignited. On exploding the charge as before, the pressure developed did not exceed 12 lb. per sq. in., and its duration was less than 0.2 sec. No flame passed out at the flange, nor, of course, was the outside atmosphere ignited. There was no distortion of flanges or damage of any kind to the enclosure.

The cover was held on to the box by eight relief bolts set to allow the cover to lift $\frac{1}{32}$ in. on explosion. The results are regarded by the manufacturers as entirely satisfactory.

Air-break Colliery Switchgear.

The various Home Office regulations regarding electricity in mines have led to the development of lines of switchgear specially suited for use in fiery mines. Apart from the question of these regulations,

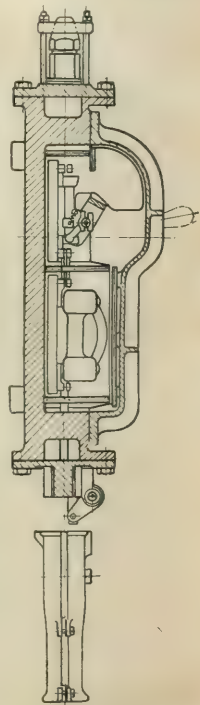
however, the extended use of large electrical plant in collieries has increased the demand for switchgear of a reliable and substantial character capable of giving the arduous service required.

In connection with this subject a pamphlet has recently been issued by the *GENERAL ELECTRIC COMPANY, LTD.*, giving brief particulars of the air-break switchgear which this firm has specially designed for colliery service.

Particular attention has been devoted to ensuring that this is a very robust apparatus, the flame-proof designs being fitted with wide machined flanges on the case and door so that heated gases generated within shall not be able to pass to the outside atmosphere until their temperature is reduced well within the safe limit.

A good example of this is the 50 A "gate end" box, consisting of a "Salford" switch, fuses and plug, which is made in both double and triple pole sizes. This is illustrated herewith. In this switch the break is long and rapid, the force necessary to operate the blade being transmitted by means of steel stampings which prevent any chance of straining the springs. The springs quicken the break only after the blade has left the jaws.

The poles of the switch are separated by means of a substantial fire-proof insulating barrier which effectually prevents arcing from one pole to the other. The usual mechanical interlock is provided to safeguard the attendant. The fuses are of the well-known "Handguard" type, in which the hand is effectively shielded. The plugs are interlocked with the switch in such a manner that the switch must always be in the "off" position before the plug can be inserted or removed. This is of great importance, as it prevents the circuits being made or broken on the plug. Earthing contacts are provided in accordance with the Home Office regulations, and special attention is given to the design of the glands and bifurcating and trifurcating boxes to ensure that the heated gases have no exit except through the wide machined flanges of the case.



"SALFORD" FLAME PROOF SWITCH AND FUSES WITH INTERLOCKED PLUG.

Deadly Gas Lighting.

The terrible French railway disaster in the Batignolles tunnel (just outside the Saint Lazare Station, Paris) on the 5th inst. is a fresh and forcible reminder of the folly of continuing the use of gas as an illuminant for trains. The accident appears to have been due to an error on the part of a signalman, who permitted two trains to enter the tunnel and one crashed into the other. The Batignolles tunnel is unlit and the trains, in which gas was used for lighting, at once burst into flame. It took many hours before the fire was subdued, and one of the most distressing features of the accident was that the bodies were so charred that great difficulty was experienced in identifying them. One of the morals to be drawn from the disaster is that electric lighting should be made compulsory in all trains.

Birmingham Engineers' Club.

The difficulties in the way of perfecting the plans for the establishment of an Engineers' Club in Birmingham were referred to at a luncheon held on Friday at the Midland Hotel. Mr. R. A. Chattock, city electrical engineer, took the chair in the absence of Sir Hallowell Rogers.

The LORD MAYOR (Ald. W. A. Cadbury), who gave the toast of the club, said, in view of the prominent position occupied by engineers in the city, and the large contribution made by Birmingham to the science of engineering, it was, perhaps, strange that no club had been established for engineers up to the present. The project for a club was a great step towards uniting the engineers of the city, and he wished it success.

MR. R. A. CHATTOCK, responding, said it was only possible at present to congratulate the members upon a half-formed club. That condition was unfortunate, but it was one imposed upon them owing to the difficulties of the times. The idea was first mooted during the war, and a committee was appointed. The committee had done a lot of hard work, and eventually it was decided to proceed with the formation of a club, coupled with the determination to have a minimum membership of 500. It was estimated that it would be necessary to raise £10,000 to get premises and equip them. Plenty of engineers were ready to come forward as members, and in the first six months they got 330. Unfortunately the money did not come in as quickly as the members, and they found that in the time available it was possible to raise only about £3,000. They now had £4,500, including subscriptions. They had reluctantly come to the conclusion that it would be courting disaster to go on without the necessary funds, and the idea had to be given up of forming the club at present. They must keep the idea alive until better times came. They hoped that the time would come when the cost of furnishing and other equipment would have fallen so that they could manage on a smaller capital than that originally anticipated. In any case, they would all make up their minds that the idea of the club must not be allowed to fall through.

Dr. Garrard proposed the toast of "The Visitors," which was responded to by Mr. E. Manville, M.P. (president of the London Engineers' Club), and Mr. J. S. Webb (president of the Manchester Engineers' Club).

Trouble at Belfast.

At the meeting of the BELFAST Corporation last week the adjourned debate on the position of the electricity supply undertaking was resumed, and in consequence of the attitude of the Council, the whole of the members of the Electricity Committee tendered their resignation.

COUNCILLOR ALEXANDER's motion was: "That in view of the very grave state of the city's electricity undertaking, the Corporation forthwith dispenses with the services of their consultants (Messrs. Preece, Cardew & Rider), and that the opinion of senior counsel be taken as to their responsibility and the responsibility of Sir John Snell in the matter."

COUNCILLOR CAMPBELL referred to Mr. Rider's refusal to give them the additional factors which induced him to alter his estimate of the loss from the shipyard contracts from £22,000 to £18,000. He considered the revised schedule submitted by him was designed to side-track the principal issue, and his mind, therefore, was made up, and he should vote for the resolution at all risks.

COUNCILLOR OSWALD JAMISON said no one had been more surprised than himself when Mr. Rider refused to answer the question. The questions of coal consumption per unit, of the allocation of standing and running charges, and also of the "divers factor" had been brought to the notice of the consultants by the City Accountant, Mr. Geale. The original report showed an estimated loss of £52,000 a year for ten years from the shipyard contracts. The Electricity Committee considered that if that statement were not accurate it would be for the good of the city that it should be corrected.

ALD. DUFF appealed to Councillor Alexander not to press his motion at present. He held no brief for the consultants, but he felt convinced that to pass the motion that day would be very unwise and would only throw the whole position into deeper chaos. He denied that they had been given any figures to show that they had a loss of even £18,000 a year from the shipyard contracts. The Council were going to pass that day a recommendation from the Electricity Committee to raise the charges for the current up to 8d. per unit. The report of the consultants showed that after providing for the supposed loss of £18,000 the consumer was going to get from the new station his current at 4d. per unit. That was a startling statement. Moreover, what was going to be done after scrapping the whole of their existing power plant? That had not been made clear by the City Accountant. Their estimate had been made on the assumption that their machines in East Bridge-street station were not capable of doing anything at all. They were basing their forecast of an enormous loss on the new station on the assumption that 13,000 kW of plant in the existing station was incapable of turning out a pennyworth of electricity. He considered they would not have a leg to stand upon if they took their consultants into a law court. The shipyard prices were fixed by Sir John Snell. Was the indictment against Sir John Snell for making a bad bargain with Messrs. Harland & Wolff, or did they impeach his professional skill in choosing proper machinery for the station? Mr. Rider had still to supply the information asked for by the Council, and it would only complicate matters to dispense with the consultants.

City Accountant's Statement.

The City Accountant (Mr. R. G. GEALE) made a statement upon the differences between Mr. Rider's withdrawn report and the later one; he entered upon a long analysis of the position and explained what occurred at his interview with Mr. Rider on July 11th.

Mr. Geale was examined at some length by Councillor Alexander, who observed that in the first report of the consultants the cost of current for general supply was put at 2.58d. per unit, while in the substituted report it was amended to 3.57d. That apparently explained the difference between a loss of £52,000 and £18,000. He charged Sir John Snell with negligence, which had landed the Corporation in financial chaos. As for their present consultants' responsibility, he held that the firm were interested in the agreement from the very first.

Councillor Alexander's motion was then put and carried by 22 votes to 19.

Increase of Charges.

The chairman of the Electricity Committee (Councillor Sir James Johnston) then moved the adoption of the Committee's minutes, which recommended increases in the charges for current for lighting from 6.987d. to 8d. per unit, or on maximum demand from 8.937d. for the first hour with 4.387d. afterwards, to 8d. for the first hour and 7½d. afterwards; residential rates from 6.337d. to 8d., and for power on maximum demand from 4.55d. for the first hour to 6d., and the subsequent price from 2.925d. to 4d. For combined lighting and power the charges were also increased. He said it was very regrettable that the present position of the station was such that the committee were obliged to recommend an increase in the rates, but there was no alternative. The figures showed that the revenue would scarcely do more than cover the loss and bring them into a position which would enable them to meet their financial obligations.

The next question dealt with the report of the consultants, and the Council were asked to approve of the expenditure of a further sum of £519,000. When that sum was expended they would have a completely new station.

After discussion the minutes were passed, with the exception of an item as to a payment to the consultants.

At a later stage Councillor Sir James Johnston said since the vote of the Corporation had been taken on the minutes of the Electricity Committee he had had an opportunity of consulting the members of the Committee, and they were unanimously of opinion that they ought to tender their resignation.

There was a further special meeting of the Corporation on Monday, when the above resolution was rescinded by twenty-three votes to nineteen, and consequently the members of the Committee will remain in office.

Legal Intelligence.

MINIMUM CHARGES FOR ELECTRICITY.

At Newbury Police Court last week Wm. J. Lewendon disputed the payment of a minimum charge of 8s. 4d. for electricity, on the ground that he had not consumed any current. For the defence, Mr. A. F. Clark argued that as there was no current used during the period there was no liability, and also that there was no consideration for the demand.

Mr. A. Marshall, for the supply company, replied that there had been adequate consideration, because during the whole time there was the liability to supply current whenever called upon. Therefore the defendant was liable to pay for any amount up to ten units whether any had been used or not.

The Bench ordered defendant to pay the claim and costs, but they agreed to consider any application to state a case for appeal.

A FUSE-BOX CONTRACT.

A dispute over a fuse-box contract came before Judge Sir Walworth H. Roberts at Marylebone County Court last week, when Messrs. Chas. Peacock & Company, Ltd., sued Mr. Joseph R. West, of Brondesbury, for the recovery of £70 14s. 2d. for goods sold.

A witness gave evidence that in January, 1920, Mr. West gave an order for a number of fuse-boxes, which were to be made of Cyprus stained oak wood, at the same time supplying a box as a sample of what he required. Plaintiffs duly delivered a number of boxes required, but they had not been paid for, except so far as the delivery up till February was concerned. Defendant had contended the boxes were not equal to sample, and when witness attended with him at the Electrical Supplies Company's premises in Tottenham Court-road, he (witness) was shown a piece of stained wood, a material witness denied was similar to the material of the sample box originally given by defendant. Witness had known that defendant had some connection with the Electrical Supplies Company. The piece of wood was stained walnut.

MR. HARTLY (for defendant): So far as the sample box originally given is concerned, do you suggest that any of the boxes you supplied to the defendant are in any way equal to the workmanship or anything else of that sample?

WITNESS: They are not only equal, but much superior. Replying to further questions, witness said he was told by Mr. West that if he did not make the fuse-boxes to suit his customers, he need not deliver any more.

Mr. Albert Farr, merchant and electrical supplies manufacturer, said he was asked to attend at defendant's works to examine some of the boxes in question. There were about 500 boxes, but he examined only about fifty or sixty. He should say they were fairly up to sample, but one of them produced he would not pass. He added that before the war fire insurance companies might have

pressed boxes made of soft wood: they might also have done so during part of the war, but after 1920, owing to the attitude of fire insurance companies, he was unable to sell fuse-boxes unless they were made of very hard wood.

His Honour said the whole subject in dispute was more fit for the determination of an expert, and ultimately it was agreed to appoint an expert referee to inquire into the material from which the boxes were made, &c., and report to the court.

A BOSCH MAGNETO CONTRACT.

On Friday Mr. Justice Greer had before him an action in which Mr. Robert Mate claimed damages against Mr. Morgan, an agent, for failure to supply under a contract 2,000 Bosch magnetos.

Mr. Doughty (for plaintiff) said that the only point was failure to deliver according to contract, and the only defence put forward was a statement that the magnetos were coming from Germany, and as defendant was unable to get them from Germany he was excused from his contract. The contract was made on Aug. 11, 1920, for the delivery of the magnetos (Z U 4 and Z R 4) at the rate of 100 a week, at £9 2s. 6d. each, free of all charges. The sum of £1,800 was to be paid as soon as the offer was accepted, and payment of that amount was made on Aug. 14. Mr. Morgan was unable to obtain the magnetos in Germany, and on Sept. 23 he informed plaintiff of the fact.

His Lordship.—And there were none delivered at all?

Mr. Doughty.—Only one, and that was sent as a sample. At the end of last year there was a great demand for those magnetos, and there was still a demand for them.

His Lordship.—Notwithstanding the name?

Mr. Doughty.—Yes, my Lord, notwithstanding the name. Continuing, counsel said that they were made of a peculiar kind of steel, which would take a higher magnetisation than any other metal.

Mr. Robert Mate, the plaintiff, said that in the summer of last year he was introduced to Mr. Morgan, who entered into the contract for the purchase of the magnetos, and he (plaintiff) paid £1,800. On Sept. 22 Mr. Morgan told him that he was unable to get the goods; he returned the cheque for £1,800 and offered £100 in addition. He (plaintiff) was unable to say what his loss was from the failure on the part of defendant to carry out his contract.

In cross-examination, plaintiff said that the goods were to be delivered free on rail at Grimsby, but at the time he had no warehouse or place in which to store them. He had entered into other contracts to buy magnetos. One was with the Vulco Company for two parcels of 250 each. The 2,000 from Morgan and the 500 from the Vulco Company were the only contracts made. He had brought an action against the Vulco Company for failure to deliver, and that was the only action which he had previously brought.

Witness was further cross-examined as to the prices of magnetos at the time of the contract, and the persons with whom he had dealings with a view to showing the losses which he might have sustained, and trade witnesses were called in support of his statements that the prevailing price for magnetos was then from £11 6s. wholesale to £18 retail.

At the close of plaintiff's case a consultation took place between the parties, with the result that the record was withdrawn upon terms endorsed upon counsels' briefs—terms which did not transpire, except that the £250 paid into court should be paid out to plaintiff.

Electric Heating in Fire Stations.

Mr. J. W. Beauchamp, the director and secretary of the British Electrical Development Association, 84, Kingsway, W.C. 2, would be glad to hear from anyone who has employed electric heaters, immersion or otherwise, for maintaining at a moderate temperature the water in boilers of steam fire engines. This is to enable steam at working pressure to be obtained without delay. In some places it has been the practice to use a movable gas ring in the furnace of the fire engine, so keeping the water always at a fair temperature. There seems to be room here for the employment of a substantial form of immersion heater, which could be readily plugged up to a local electric circuit and disconnected instantly when the engine is required.

Electric Cookers in Glasgow.

Apparently there is a boom in electric cooking in Glasgow at present. The Electricity Sub-Committee on Propaganda recommend the Electricity Committee to make application to the Corporation for permission to supply a further 100 electric cookers on hire to householders in the city area. It will be remembered that sanction was recently given to hire out 100 cookers, but we learn that these have already been taken up, and applications for others are being received daily.

Electricians' Wages.

Under the national wages agreements between the National Federated Electrical Association and the E.T.U., it has been agreed that the variation in the cost of living justifies a 10 per cent. variation in wages, and that the net hourly rates of pay applicable to the respective grades, from the end of the first pay period in October to the end of the first pay period in February, 1922, inclusive, are as follows:—Grade A, 2s. 3d. (this rate includes a travelling allowance, but no further allowances to be paid except as provided by Rule 9 of the London rules); Grade B, 2s. 0½d.; Grade C, 1s. 10½d.; Grade D, 1s. 8½d.

Electric Traction.

The BLACKBURN tramway receipts to date show a reduction of £9,000, compared with the corresponding period last year.

A sub-committee of the CARDIFF Tramways Committee is to report upon a proposal to extend the tramways system and the inauguration of new omnibus services.

The receipts of the READING Corporation Electric Tramways from April 1 to Sept. 1 amounted to £35,051, compared with £13,609 for the corresponding period last year.

The tramway employees at PORTSMOUTH threaten to strike because the Tramways Committee refuse to meet the representatives of the Electrical Trades Union to discuss wages and conditions.

In consequence of an empty train running off the line outside the Hammersmith Station of the PICCADILLY RAILWAY at 6.50 p.m. on Monday evening, traffic was suspended for the rest of the evening.

STOKE-ON-TRENT Council had before them last week an application by the Potteries Electric Traction Company for a reconsideration of the terms of their lease, with a view to its extension, but the proposal was not entertained.

EDINBURGH Corporation have referred back a scheme of the Tramways Committee for revising the tramway fares and lengthening the stages in order that the southern parts of the city may be included in the scheme.

In view of the deficit of £4,000 on the past year's working of the parcels department of the BRADFORD Corporation tramways department, the Tramways Committee has decided to effect certain economies in working and to reduce the wages of the staff. A proposal to establish depots for the receipt and delivery of parcels where consignors and consignees might deliver and collect them is also to be considered.

Like other tramway undertakings, the L.C.C. SYSTEM seems to have been badly affected by the prevailing conditions. At Tuesday's meeting of the County Council, Dr. Scott Lidgett asked for an explanation of the decrease of over 11,000,000 in the number of passengers carried in the period July 13-Sept. 28, compared with the corresponding period of last year.

In reply, Mr. SQUIRES, Chairman of the Highways Committee, pointed out that during the same period the receipts increased £129,141. He doubted whether cheap mid-day fares would make up the loss, and particularly penny tickets. The question would be considered by the Committee.

AVONMOUTH Low Level Road Committee recommend the Council to introduce railless traction cars instead of trams along the new Avonmouth Road. If the Council approve the proposal it will be necessary to lay concrete omnibus tracks 15 ft. wide on each side of the new road, at an estimated cost of £38,000, while the cost of converting the space originally left for the tramroad into carriage-way is estimated at £55,000; but these amounts must be set against the £176,000 which appears in the original estimate as the cost of constructing the tramroad track, while the alteration will give an additional 24 ft. width of carriage-way in the new road for the general traffic. These figures have reference only to work upon the site of the new road. Estimates are being prepared of the cost of extending the railless traction to the docks.

The later train service on the LONDON UNDERGROUND SYSTEM is much appreciated. With the exception of the City and South London Railway, the stations remain open about half an hour later than hitherto, last trains leaving central points at 12.30 a.m. Thus the last trains for Ealing, Wimbledon, and Heston Hounslow leave the Mansion House Station at 12.30 a.m. instead of midnight, and the last train eastward for Barking leaves at 12.30 a.m. instead of 12.4 a.m. Cannon-street Station will close at midnight on week-days. An additional District train for Richmond leaves Hammersmith at 11.39 p.m., affording a useful connection with the Piccadilly line for theatre-goers. The theatre non-stop trains have been restored on the Hampstead and Highgate lines. On the City and South London Railway the last train for Clapham Common leaves Euston at 11.35 p.m.

An extraordinary dispute over a tramway timekeeper caused a two-day STRIKE of about 280 BEXLEY TRAMWAY, ELECTRICITY and other EMPLOYEES last week. The trouble commenced at the meeting of the council on the 4th inst., when objection was taken to a committee report on the ground that no reference was made to a recommendation for dispensing with the services of the timekeeper. It was then explained that the matter had to go before the Electricity Committee before being discussed in council, but the public present intimated that the council would not be allowed to leave until they agreed to discuss the matter. The sitting then ended abruptly. Councillor Kirk was voted to the chair for the public meeting which followed. Councillors and critics took part in debate, pickets meanwhile doing duty at the doors to see that none tried to quit. A visit was paid by the police, but they retired on an assurance from the men's leaders that there would not be any trouble. Failing a settlement, the electric supply was at midnight cut off for five minutes to announce the commencement of a protest strike, and half an hour later the doors were thrown open and councillors were free to leave the offices. None had attempted to do so earlier. Owing to the stoppage of the tramways many people had to walk to their work. Several local factories were at a standstill owing to the curtailment of electric current.

Electricity Supply.

ALDERLEY ELDON Urban Council have decided to wire the new houses that are being erected in the district.

PETERBOROUGH Corporation has received authority to borrow £74 187 for electricity extensions.

OSWESTRY Council has been asked by the Oswestry Electric Light Company to make an offer for the purchase of its undertaking.

A public inquiry has been held at COOKHAM into the rival applications for a Special Order to supply electricity in the village.

KIRKSTONBRIGHT TOWN Council has appointed a committee to consider the question of securing a supply of electricity for the town.

The Duke of York has been obliged to cancel his engagements at SHEFFIELD on the 27th and 28th inst. On the latter day he was to have opened the new power station of Sheffield Corporation.

The Minister of Transport has revoked, as from Aug. 1 last, the BRADFORD-ON-AVON ELECTRICAL LIGHTING ORDER, 1914.

The WANTAGE Urban Council are considering the possibility of introducing electric supply in the town, mainly with a view to finding work for the unemployed.

MIRFIELD (YORKS.) Urban Council have increased the price of electricity for power and heating by 25 per cent., and reduced the discounts previously paid by 50 per cent.

There were two failures of the electric supply in BINGLEY last week owing to faults in the overhead transmission cable from Keighley, which supplies electricity in bulk. A public inquiry into the failures was held on Saturday last.

DONCASTER Corporation has applied for a loan of £1 712 to meet the cost of supplying electricity to 113 houses, to be erected on the Wheatley Hill Estate by private enterprise.

Pending the extension of cables, the LYTHAM Parish Church, Vicarage, and Victory Hall are to have a supply of current from the tramway cables. The wiring and fittings are the gift of Mr. E. W. Mellor, J.P.

The application of WORCESTER City Council for sanction to borrow £62 000 for extensions of the electricity undertaking has been adjourned until the position of the South-West Midlands Electricity District is clearer.

The formal inauguration of public electric lighting in STEYNING, BRAMBER, and UPPER BREEDING took place on the 30th ult., when Mr. G. A. Flowers, chairman of the STEYNING Electric Light Company, switched on the current.

WECBLEY Council have approved a scheme for the provision of electric light in the district, which has been prepared by Mr. Harrison, the rural supply engineer of Hereford.

The ASCOT District Gas and Electricity Company has applied for an order to authorise a charge of 1s. 1d. per unit for electric current, with a minimum of 16s. 3d. for each winter quarter, and 10s. 10d. for each summer quarter.

The application of ACCRINGTON Town Council for sanction to a loan for the proposed extensions to the electricity works has been refused, and they have been directed to ascertain whether a bulk supply cannot be obtained from Blackburn.

BLACKBURN Corporation has decided to purchase a powerful electric vacuum cleaner for the Sessions House and Law Courts. The Electricity Committee proposes to erect an electricity sub-station at Mill Hill for the supply of current to the district.

The employees of the BLACKPOOL Electricity and Tramways Departments made the Lake district the venue for their annual picnic last week. The party of seventy was conveyed in motor char-à-bancs, lunch being served at Grange-over-Sands; and tea at Lancaster.

A proposal is under consideration for the linking up of the electricity supply systems of RATHMINES and PEMBROKE (DUBLIN), and it is also probable that a bulk supply, either from the Dublin United Tramways or some other source, will be obtained.

Negotiations are still proceeding between the GOURCOCK and GREENOCK Corporations in regard to the supply of electricity. Gourcock objects to the terms submitted by Greenock for laying the necessary cables, and efforts are being made to get Greenock to share the cost.

SOUTHWICK (SUSSEX) Urban Council have decided to approach the promoter of the Shoreham electric lighting scheme with a view to giving a supply to the town, the Council having found it impossible to arrange satisfactory terms with the gas company for laying services to the Council houses.

The Irish Overseas Direct Trade and Engineering Association proposes building a factory at BLACKROCK for the manufacture of electrical fittings and appliances. An electric generating station will also be erected. The local Council has granted the Association a site at £5 per year for fifteen years.

ST. ANNES-ON-THA-SEA Urban Council has applied to the Electricity Commissioners for a loan of £9 740, for supplying electricity to Lytham, including £5 400 for the supply and laying of cables, £390 for disconnecting pillars and section-boxes, £1 250 for services, £320 for 100 meters and £1 320 for footpath.

The BELPER AND DISTRICT ELECTRICITY SPECIAL ORDER, 1921, authorising the Derbyshire and Nottinghamshire Electric Power Company to supply electricity in Belper and Heage urban dis-

tricts, and the parish of Milford, has been submitted to the Minister of Transport for confirmation. Objections by Oct. 29.

EDINBURGH Corporation have agreed to give a bulk supply of electricity from the Portobello power station to the MUSSELBURGH and District Electric Light and Traction Company. On the recommendation of the Plans and Works Committee, the collector's premises in Waterloo-place are to be lighted electrically.

A Special Order for the amendment of the HOYLAND NETHER ELECTRIC LIGHTING ORDER, 1912, granted to Hoyland Nether Urban Council, has been submitted to the Minister of Transport for confirmation. Objections to the Minister of Transport by Oct. 31. The amendment has reference to increased charges.

Arrangements have been made for the laying of a cable by ACCRINGTON Corporation to supply Messrs. Steiner & Company, Ltd., print manufacturers, with electric current for a night load only. The Electricity Commissioners have been asked for power to borrow the amount necessary for carrying out the work.

At a recent conference of representatives of local authorities in the NORTH-EAST MIDLANDS ELECTRICITY DISTRICT a resolution was passed in favour of postponing the draft scheme recently prepared by SHEFFIELD Corporation for the reorganisation of electricity in the district until the promised Electricity Supply Bill has been passed.

BURY Electricity Committee have approved the draft scheme for the establishment of the SOUTH-EAST LANCASHIRE ELECTRICITY BOARD. This scheme has so far been received with much more favour than has the one for Mid-Lancashire. Littleborough Urban Council are supporting the South-East scheme, but Crompton, Irlam, and other districts are awaiting further information before making a decision.

MAIDSTONE Council has applied to the Electricity Commissioners and to the Kent Electric Power Company for permission to supply electricity to the mill of Messrs. A. E. Reed & Company, New Hythe, which is outside the council's area of supply. Application has also been made for a further loan of £500 for the purchase of apparatus in connection with the hiring out of electric fires, irons and cooking stoves.

There is a reasonable prospect of a public supply of electricity in TEIGNMOUTH in the near future, as the Electricity Commissioners are now prepared to fix the date for the commencement of the Provisional Order, which was obtained in 1915 by Messrs. J. & W. Purves, of Exeter. It is probable that the Order will now be transferred to the Channel Shipbreaking Company, who already have a private generating station, or a new company may be formed for undertaking the work.

The agreement with Dr. Purves in regard to the provision of electricity supply in TEIGNMOUTH was sealed by the Urban Council at the meeting last week.

Important proposals for the development of the BLACKPOOL Electricity Works have been approved by the committee. In a report dealing with prospective extensions, Mr. C. Furness, borough electrical engineer, estimates the cost of the plant extensions necessary to meet the increasing demands at £150 000. The output for August was 849 878 units, a decrease of 9 480 on the corresponding month last year, the biggest decrease being in power for tramways. The number of new consumers connected this year is 208.

In future, electricity consumers in TORQUAY must pay a minimum charge of £2 1s. 8d. per annum, or 12s. 6d. per quarter for each of the two winter quarters, and 8s. 4d. per quarter for each of the summer quarters. The chairman of the Electricity Committee, Ald. J. Taylor, hopes that these revised charges will encourage people to use current by day, instead of in the evening only. People were using less current; with the gas-filled lamp they were getting double the light for half the energy. During the six months 500 new consumers had been put on, and at that rate income would not meet expenditure.

At the meeting of DERBY Corporation last week, Ald. Wilkins, chairman of the Electricity Committee, said that though the electricity undertaking made a profit of £8 000 during the past year, and had about £16 000 in hand, the present year would be a very difficult one, as there had been a very severe loss owing to the coal crisis, and there would be increased standing charges. As to the scheme for the establishment of a joint authority for the East Midland electricity district, the committee were not asking the council to commit itself to any expenditure beyond a merely trifling amount for the expenses of the joint authority in its initial stage. The electrical station and the distribution system would remain under the complete control of the committee.

Attempts are once more being made to prepare a suitable scheme for the provision of ELECTRICITY SUPPLY for TORQUAY, NEWTON ABBOT, and adjoining areas. The Torquay Electricity Committee has approached Newton Council with a suggestion that Torquay should take responsibility for the erection of a new generating station at Newton, and thus relieve the mid-Devon town of any capital expenditure, whilst the consumers would be supplied with electric current at about the same price as those at Torquay. Newton Abbot are not quite satisfied with these terms, but Torquay has been asked to place the full scheme before them, whilst Newton has requested the Electricity Commissioners to exercise their authority for the extension of the period for the option of purchasing the present undertaking of the Urban Electric Supply Company.

Imperial Notes.

Though the past year's receipts of the TORONTO STREET RAILWAY created a record, there was a net loss of over \$400 000 on the year.

A sum of £900 000 has been expended on the TASMANIAN GOVERNMENT HYDRO-ELECTRIC WORKS this year, making the total expenditure to date nearly £200 000.

The first unit for the COMMERCIAL PRODUCTION OF SPECTER in Tasmania will be put into operation before the end of the year by the Electrolytic Zinc Company. About 50 tons per day will be produced.

Buying agents for Europe, with headquarters in London, are required by the EAST LONDON (S. AFRICA) MUNICIPAL COUNCIL for a period of three years from January next. Tenders must reach the Town Clerk not later than December 1.

Progress is being made with the survey work for the ABERDEEN-LANARK HYDRO-ELECTRIC PROJECT on behalf of the Cingalese Government. The scheme, which is estimated to cost about Rs. 36 000 000, will be carried out in three stages, and the first to be undertaken will probably be the Kehelgomu-oya.

An order has been placed by the STATE OF VICTORIA in Germany (with the Zeitz Iron Foundry and Engineering Company) for the supply of complete BRIQUETTING PLANT for dealing with lignite deposits. The value of the contract is said to be 30 000 000 marks, and part of the plant will be erected at Morewell, where there is an abundance of brown coal.

Work was recently started on a scheme for developing water power at the GREAT FALLS on the WINNIPEG RIVER, Manitoba, Canada. It is estimated that about 168 000 H.P. will be available ultimately, and the total cost is put at \$10 000 000. The owners of the undertaking are the Manitoba Power Company, Ltd., of which Sir A.G. Nantán is president.

As already announced, the Municipal Council of SAN FERNANDO (TRINIDAD) is considering the question of erecting electric supply works, and it is to be hoped that British electrical firms will consider the advisability of tendering. American trade representatives in the colony are already devoting attention to the matter, and one firm in the United States is sending one of their representatives to discuss the matter with the Council.

Mr. Bernard Price, the chief engineer of the VICTORIA FALLS AND TRANSVAAL POWER COMPANY, reports that by alterations of the routes of the existing cables and rearranging the transformers, an additional supply of electricity could be made available in JOHANNESBURG in five months and more cheaply than by any other alternative. Councillor Clark recently contended that it would take eighteen months to obtain an extraneous supply to supplement the electricity generated by the municipal power station, and that it would cost £60 000 for cables, besides transformers.

Foreign Notes.

It is announced that M. R. BLAKSTAD, managing director of the TISSE FALLS SHARE COMPANY, which owns a large power-station at Odda, Hardanger (Norway), has transferred his interest in the company to an English syndicate.

The Italian Government have undertaken to introduce a Bill for allotting funds towards the establishment of new HYDRO-ELECTRIC WORKS in SARDINIA in order to relieve unemployment.

A considerable improvement is reported in the RUMANIAN oil situation, and as the supply of electric current is now nearly normal the work of extraction and development is carried on uninterrupted. The present production amounts to about 3 000 tons daily, and a considerable reduction in the cost of transport, in some cases amounting to 45 per cent., should further stimulate production.

The CHILEAN Government have accepted a proposal made by New York bankers for a loan of 25 000 000 pesos gold (£1 875 000 at 18d. per peso), which will be principally used for the ELECTRIFICATION OF THE RAILWAYS. The Government have entered into a contract with the Westinghouse Electric and Manufacturing Company for the electrification of the railway from Santiago to Valparaíso at a cost of U.S. \$10 000 000.

Occasionally we hear of electrical progress in RUSSIA, of projects for utilising water power, &c., but we are afraid it is only part of the Soviet propaganda. At all events, according to Reuter, an Electrotechnical Congress was opened in Moscow on the 1st inst., the object being "to extend greatly the use of electric power in Russia." A worthy object, no doubt, but in the absence of details we remain unimpressed.

It is announced that the CHINESE MINISTRY OF COMMUNICATIONS has invited a number of electrical experts, both Chinese and foreign, to a conference on the question of the promotion of the electrical industry. The following electricity companies have been formed:—The Kweisui Electric Light Company, at Kweisui, Shansi, by Yung Yau-tsen; and the Ming Ming Electric Light Company (of Tienning-chang, Kiangsi), organised by Chiao Shen-ching and others with a capital of \$1 600.

At the AUTUMN LYONS FAIR there are very good exhibits of electric supplies on 126 stands (out of a total of 792), though general engineering, tool steel, agricultural machinery, motor cars, &c., form the principal goods on show. On this occasion there are forty British exhibitors of telephone apparatus, high-speed steel, central-

heating installations, forges, &c., but the Federation of British Industries had a stand on which were exhibited a number of catalogues of engineering firms.

Arrangements have been made by the Municipal Council of Vienna with a syndicate of local banks to provide money for developing HYDRO-ELECTRIC POWER on the DANUBE, in order to supply the city with electricity for lighting and power. The Wasserkraftwerk A.G. has been formed for carrying out the project, and half of its capital of 500 000 000 kronen will be subscribed by the banks, the remainder being supplied by the Council. Work will be started next month, but the scheme, which will ultimately be capable of supplying 500 000 H.P., will take four years to complete.

An international electrical exhibition organised by the Amsterdam department of the Netherlands Society of Electrotechnical Employers is to be held at AMSTERDAM from Nov. 25 to Dec. 26 next. The exhibition will be divided into a number of sections, and energetic attempts are being made to give it an international character. We understand that already a number of German firms have taken space, and this, combined with the accessibility of Amsterdam to this country, and its well-known place owing to scale of electrical development, are reasons why British firms should be well represented. Full particulars as to floor space, &c., may be obtained from Mr. C. T. O'Callaghan, 30, Great James-street, London, W.C. 1.

In regard to the contract recently entered into by the CZECHO-SLOVAK GOVERNMENT, as owners of the RADIIUM STATE MINES in Joachimsthal and the Imperial and Foreign Corporation of London, it is announced that the Radium Corporation of Czecho-Slovakia, a private limited company, has been formed, the Czecho-Slovak State and the Imperial Foreign Corporation holding equal interests. The Radium Corporation will obtain the loan for fifteen years of the radium production of the State mines, less a certain portion to be reserved for public use, especially for scientific purposes. The radium so lent to the Corporation will remain the property of the Czecho-Slovak State. The contract does not contain anything relative to the working of the radium mines, which will continue to be exploited by the Czecho-Slovak State.

The Commercial Counsellor at Shanghai (Mr. H. H. Fox, C.M.G.) has notified the Department of Overseas Trade that the majority of United Kingdom manufacturers who communicate with him direct asking for the names of suitable firms to act as AGENTS IN CHINA, do not accompany their inquiries by catalogues, price lists, or illustration of their goods, and even when these are sent the number is usually limited to one, or at the most two copies. Mr. Fox points out that considerable delay is frequently incurred on this account, as he has to send a copy of the inquiry with catalogue round to one firm at a time, with a request that, if the business does not interest them, they will return the catalogue. It may also occur that a catalogue gets mislaid when going the rounds in this way. He therefore suggests that manufacturers, when making inquiries for agencies, more particularly in the case of engineering specialities, should send at least six copies of their catalogue or illustrations for distribution amongst local firms. Attention has recently been drawn by the Commercial Counsellor to the desirability of quoting prices, even if they are only approximate.

At the recent annual meeting of the German Metallurgical Society Dr. R. Sterner-Gainer gave an account of the development of the GERMAN ALUMINIUM INDUSTRY. The only factory in Germany prior to 1914 was the Rheinfelden works, in Baden, with an annual output of 800 tons, but the war was responsible for the establishment of additional works at Rummelsburg (Berlin), Horrem (Cologne), Bitterfeld, Grevenbroich, Hoyerswerda (Lower Lusatia), and Goisern. The Inn works, at Muhlendorf, are in course of construction, and production will commence in a couple of years hence. The Rummelsburg and Horrem works, being war emergency works, have been closed down, and production is restricted to Bitterfeld, Grevenbroich, and Lusatia plants, the former producing 4 000 tons annually, while the capacity of the latter two works is 14 000 tons each. The factories established during the war take electric current from lignite-fired power-stations, but for the Inn works a hydro-electric scheme is projected. The outlook for the German aluminium industry is said to be rather obscure, and the need for an improvement in methods of production is urged.

Telegraph and Telephone Notes.

The Belgian Government have decided to erect a BIG WIRELESS STATION near Elizabethville, Katanga (Congo), in order to give direct communication with Belgium. The station will be finished in 1923.

According to a correspondent of the "Daily Telegraph" the LEAFIELD WIRELESS STATION, which was described in our issue of Aug. 26, is already proving that it is not up-to-date. The experimental work has not been very satisfactory. The Cairo station—the next stage of the Imperial chain—will not be finished before the end of the year, if then. The specification for new stations at Poona, Nairobi, and Singapore will be ready in November, but at present the Post Office has not funds for the erection of more than one. It is further asserted that the entry of the Post Office into foreign wireless means an inefficient service subsidised by the British taxpayer.

Tenders Invited and Accepted.

UNITED KINGDOM.

LOUGHBOROUGH CORPORATION. (a) OCTOBER 31, (b) OCTOBER 17.—(a) Steam-raising plant; (b) high and low pressure mains networks. Particulars from Mr. C. H. Wordingham, at 7, Victoria-street, Westminster, S.W. 1; or 11, Moseley-street, Manchester.

NOTTINGHAM CORPORATION. OCTOBER 21.—For North Wilford Power Station: (a) Three 10,000 kW turbo-alternators (for 1500 r.p.m.), with exciters, condensers, auxiliary plant, &c., and one 1,000 kW turbo-generator alternator, with condenser, auxiliary plant, &c.; and (b) six water-tube boilers, with mechanical superheaters, forced-draught fans, &c. Specifications from Messrs. Preece, Cardew & Rider, 8, Queen Anne's-gate, Westminster, S.W. 1.

GLASGOW PARISH COUNCIL invite tenders by Oct. 24 for the supply of electric lamps and fittings, ironmongery, &c., for twelve months. Tender forms from Mr. M. A. Reynard, 266, George-street.

CANNOCK URBAN COUNCIL. OCTOBER 18.—Transformers, switch-gest, and cables. Specifications from the consulting engineers, Messrs. Arthur Ellis & Partners, 9, Park-street, Cardiff. Tenders to the Clerk of the Council.

EDINBURGH DISTRICT BOARD OF CONTROL. OCTOBER 21.—Wiring and fitting of the Bangour Village Asylum. Specification from Mr. J. D. Giffon, 60, Frederick-street, Edinburgh.

DARWEN CORPORATION.—Supply of 100 tons of tram rails.

MARTON, BLACKPOOL.—Wiring and fitting two bungalows. Particulars from Messrs. Heap & Willett, Straits-road, Preston Old-road, Marton.

EDINBURGH CORPORATION. OCTOBER 18.—Four 10-15-ton hand-operated overhead travelling cranes (specification 38), and electric and steam driven feed pumps (specification 39). Specifications from Sir Alexander Kennedy, 17, Victoria-street, Westminster, S.W.

HEITON DOWNS PRIMITIVE METHODIST CHURCH. OCTOBER 20.—Wiring and fitting. Particulars from Mr. W. Vasey, 42, South Market-street, Heiton, Co. Durham.

LONDON COUNTY COUNCIL. OCTOBER 24.—Electric goods lift (50 cwt.) for Stamford Hill Stores Depot. Specification, &c., from the Chief Engineer, Spring-gardens, S.W.

AUSTRALIA.

VICTORIA RAILWAY COMMISSIONERS. NOVEMBER 2.—* Storage battery, with accessories and spares (contract No. 34 229).

VICTORIAN GOVERNMENT RAILWAYS. NOVEMBER 9 (extension of time). The date for receiving tenders for miniature banding machinery, with motor and starting gear (contract 34 378) is extended from Oct. 25 to Nov. 9.

NEW ZEALAND.

WELLINGTON, PUBLIC WORKS TENDER BOARD. NOVEMBER 1.—* New or second-hand auxiliary plant for the Rotorua electric supply as follows:—One oil engine (200 to 250 h.p.) and one three-phase 50 cycle alternator of 150 kw (power factor of 0.8), with exciter, &c. Also for steel pipe lines and fittings in connection with the Mangahau power plant.

WELLINGTON, CONTROLLER OF STORES, POST AND TELEGRAPH DEPARTMENT. NOVEMBER 21.—* 750 red and 750 white switchboard cords (three conductor, to specification No. 87).

INDIA.

CALCUTTA ELECTRIC SUPPLY CORPORATION, LTD. NOVEMBER 9.—One 15,000 kW turbo-alternator and condensing plant, and water-tube boilers, each of 60,000 lb. evaporative capacity. Specifications from the consulting engineers, Messrs. Kennedy & Donkin, 17, Victoria-street, S.W. 1.

EAST INDIAN RAILWAY COMPANY. OCTOBER 19.—Insulated cables, &c. Specification can be seen at the Company's Offices, Nicholas-lane, London, E.C. 4.

SOUTH AFRICA.

MUNICIPAL CORPORATION OF HUMANSBORP, CAPE PROVINCE. NOVEMBER 30.—Machinery and plant. Section A: one water turbine and dynamo, switchboard with connections, battery of accumulators, and accessories for same; Section B: electricity supply main and public lighting; aerial distributing lines, street lamps, fittings and accessories, section boxes, service cut-outs, meters, &c.; Section C: ferro-concrete pipe line; Section D: reinforced-concrete tank; Section E: buildings and foundations. Further particulars from the Town Clerk, Humansdorp.

DURBAN CORPORATION.—* Contract S. 360.—(a) 250 single-pole or 125 double-pole iron-clad fuses, 25 A, 200 V; (b) 500 combined double-pole enclosed switches and fuses, 25 A, 200 V; (c) 144 single-pole switch-fuses, unmounted, 100 A, 200 V; (d) 50 single-pole switch-fuses of "Brush" or similar type, 50 A, 2,750 V. Contract S. 355.—Three-phase transformer, 25 kVA, capacity 50 cycles.

SOUTH AMERICA.

ARGENTINE STATE RAILWAYS. NOVEMBER.—* One year's supply of railway signal material, telephone and telegraph materials.

ARGENTINE DEPARTMENT OF NAVIGATION AND PORTS. NOV. 5. Electrical anemometers and anemographs, thermographs, barographs, tide gauges, and rain gauges. Specification, &c., can be seen until Oct. 15 and obtained on loan after that date at the Department of Overseas Trade, 35, Old Queen-street, S.W.

* Particulars from the Department of Overseas Trade.

GREECE.

ATHENS.—Nov. 14.—* New telephone installation of central battery type and of an approximate capacity of 5,000 local lines, forty inter-urban lines, and at least fifty special lines connecting Athens with the Piræus.

HACKNEY (London) Council has accepted the offer of the Hayward Company to supply an electrically driven addressing machine, with d.c. motor, at £172 10s.

SUNDERLAND Corporation has placed a further order with the General Electric Company, Ltd., for a twelve-panel 250 V d.c. switchboard.

BARKING Council have accepted the tender of Graham, Denny & Company (lowest tender received) for electric lighting work at the special school at £254. Thirteen tenders were received, the highest being £518 13s.

For the purpose of testing the best method of dealing with breeze from house refuse, ST. MARTYLBONE Borough Council has accepted the tender of the Liner Concrete Machinery Company for a "Harrison" washing machine and screen at £650.

WORCESTER Corporation have accepted the tender of Heenan & Froude for providing and fixing a telfer coal and ash handling plant at £3,945, and an automatic weigher and totaliser at £803. Messrs. Heenan & Froude have agreed to manufacture the whole of the steel work at Worcester.

MANSFIELD Corporation has accepted the tender of the Mansfield Engineering Company at £13,695 for the provision of refuse screening and sorting plant. It is estimated that when the plant is in operation there will be about 7,000 tons of cinders available for the electricity department.

SHEFFIELD Tramways Committee has accepted a local tender for 400 tramcar tyres. The continental quotations ranged from £2 8s. 3d. to £2 15s. 6d. per tyre, and Sheffield quotations varied between £3 12s. and £5 1s. Although the placing of the contract at home means a loss of £475 on the 400 tyres required, the Tramways Committee decided to accept the lowest Sheffield tender.

Catalogues, Price Lists, &c.

The October price list of C.I. PIPES available for immediate delivery is being circulated by the Stanton Ironworks Company.

From Messrs. ARTHUR CORT & COMPANY, 303, Camberwell-road, S.E. 5, we have received a 4-in. pocket rule, made of fibre, and also marked on the decimal scale. It should prove useful to engineers and others. The firm will send one on receipt of 2d. for postage.

The General Electric Company's revised catalogue prices of MAGNET ELECTRIC COOKING AND HEATING APPARATUS are available in good time. With the approach of the heating season there should be a brisk demand for these domestic appliances, particularly as reduced prices now apply to them.

We have received from the METROPOLITAN-VICKERS ELECTRICAL COMPANY a large hanging card calendar for 1921-1922, artistically printed in eleven colours, and having weekly tear-off sheets. The picture is reproduced from one of the company's latest posters and forms an effective advertisement of "Cosmos" lamps.

Particulars of the design and construction of two new types of single-phase, two and three wire house service type of watt-hour meters of MEASUREMENT, LTD., are set out in List A, which has been recently issued by the company. The meters are of the induction motor type, and prices, dimensions, and diagrams of connections are included.

The second edition of Section J. of MESSRS. SMITH & COVENTRY'S catalogue, dealing with the firm's spiral bevel gear planer and true spiral bevel gears, has been issued. The production data and the general advantages of the firm's system of spiral bevel gears are briefly set out, and there is also an illustrated description of the patent spiral bevel gear planer, together with a specification of the machine which was one of the outstanding features in the Machine Tool Trade Exhibition of 1920.

A well-illustrated catalogue and price list of "G. F." MALLEABLE TUBE FITTINGS for gas, steam, and water has been issued by Messrs. Edward Le Bas & Company, Dock House, Billiter-street, E.C. 3. These fittings are manufactured from the best English iron, and are stated to be far superior to wrought fittings. About 7,500 varieties of bends, elbows, tees, crosses, flanges, and other fittings are listed and priced in the present catalogue, which runs to 361 pages. All fittings are examined and tested to 300 lb. pressure, found true to size, geometrically correct, and with perfect threads. The firm hold large stocks of these fittings, but the main stock is kept in London.

In a nicely-printed and well-illustrated pamphlet of thirty-two pages MESSRS. HIGGS BROS., Birmingham, give full particulars of their electric motors and dynamos. In the first portion there is a specification of induction motors, and the remainder gives similar information concerning d.c. motors and dynamos. There are a number of excellent illustrations and sectional views, with dimensions and other particulars. The firm's standard machines are suitably wound for use in tropical climates and humid atmospheres; all d.c. machines are reversible under full load, with rocker in neutral position, and with rocker adjustment can be used as variable speed motors up to a maximum of one to two. The squirrel cage machines are fitted with their patent rotor, and all machines are made to the British Standard Rules for electrical machinery.

Miscellaneous.

THE LAST MEETING of the COMMITTEE to INQUIRE INTO THE WORKING of the LEAD-BOARDING ACTS took place on Wednesday. The chairman (Viscount Cave) presided, and methods of procedure, &c., were considered.

The Disposal and Liquidation Commission states that Sir Howard Frank has entered into a contract for the sale to the British Metal Corporation of the LEAD-BOARDING ACTS in GREAT BRITAIN belonging to the Government. The purchase price is expected to work out at approximately £4,000,000.

In connection with Sir Ernest Shackleton's fresh Antarctic expedition, it is interesting to note that the "Quest" carries on board a complete equipment of "Ceag" lamps of the standard "Ceag" pattern. These lamps, of 100 and 250 wattage, and all accessories, also a charging stand of the "Ceag" Company's bulk head type specially adapted for the "Quest".

AN INDUSTRIAL EXHIBITION is being held at the City Hall, Manchester, and will remain open until the 22nd inst. The exhibits are of a varied character, and are divided into four classes, including labour-saving devices, office furniture, and efficiency apparatus, electric motors, power and lighting fittings and accessories, motor-cars, &c.

A conference, organised by the INDUSTRIAL LEAGUE AND COUNCIL, and presided over by the Lord Mayor of London, was held at the Mansion House, London, yesterday (Thursday), to consider the best means of promoting whole-hearted co-operation among employers and employed, and also methods of efficient and increased production. A report of the proceedings will be given in our next issue.

We have received a copy of the first issue of "LA FRANCE," a weekly review of the French Press, compiled by teachers of French with a view to presenting to young students of French aspect of contemporary life, customs, and institutions in France. It is published at Montague House, Russell-square, London, W.C. 1, at 2d. per copy, but can be supplied in quantities to schools at lower rates.

In consequence of an alteration in the times of departure of the P. and O. packets from Marseilles and Toulon respectively, it will no longer be possible to post LETTERS FOR INDIA, EGYPT, &c., and, in some weeks, Australia, by Air Mail to Paris on Friday with a view to overtaking the ordinary mail for those countries, which is closed in London on the previous evening. Since May 1 last this connection has been missed on only one occasion.

It is announced that over 900 LABOUR DISPUTES were dealt with by the Industrial Relations Department of the Ministry of Labour in 1920. Statistics indicated in the aggregate an unprecedented advance in wages during 1920. The number of strikes and lock-outs recorded was the highest since statistics have been kept. The policy of non-intervention by the Government in disputes and the establishment of new conciliation machinery had the effect of reducing the number of cases.

The death is announced of MR. GEO. W. WALKER, F.R.S. A native of Aberdeen, he obtained a national scholarship, and subsequently went to the University of Cambridge, where he was Smith's Prizeman and Isaac Newton student in 1899. After studying at Göttingen, he became Lecturer in Physics at Glasgow University in 1908. From 1912 to 1915 he was employed on the new magnetic survey of the British Isles, and in 1913 he was elected a Fellow of the Royal Society. From May, 1918, to November, 1920, he was engaged on scientific work at the Royal Naval Mining School, Portsmouth.

The members of the ROYAL COMMISSION on the LOCAL GOVERNMENT of GREATER LONDON are as follows:

Viscount Ullswater, G.C.B. (chairman), Sir Richard Vassar-Smith, Bt., Sir Albert Gray, K.C., K.C.B., Sir Horace Cecil Monro, K.C.B., Mr. Geo. J. Talbot, K.C., Mr. Neville Chamberlain, M.P., Mr. Robert Donald, LL.D., Mr. Ernest H. Hiley, C.B.E., and Mr. E. R. Turtton, M.P. There will also be a representative of Labour. The Secretary of the Commission is Mr. Michael Heseltine, C.B., of the Ministry of Health, Whitehall, S.W. 1, to whom all communications should be addressed.

Mr. E. W. Petter, managing director of Messrs. Vickers, Petters, Ltd., and chairman of the British Engineers' Association, is to lecture on Wednesday, the 19th inst., at Caxton Hall, at 7.30 p.m., on "Economic Axioms of Industry." The lecture is the third of the series arranged by the INDUSTRIAL LEAGUE AND COUNCIL, and should be extremely interesting, because Mr. Petter, while being a large employer, is very sympathetic to the interests of labour. The lecture is to be presided over by Mr. A. G. Walkden, general secretary of the Railway Clerks' Association.

In order to stimulate interest in the excellent work done by the MIDDLESEX HOSPITAL, the employees of business firms whose premises are in the neighbourhood are being invited to attend a series of conversaciones. The first of the gatherings took place on the 6th inst., when between 200 and 300 employees attended, all the important firms being represented. An excellent programme was arranged, including a lecture on radium by Prof. Lazarus-Barlow, and an X-ray demonstration by Dr. J. H. D. Webster. It is calculated that the new method will bring the hospital into direct touch with its immediate neighbourhood, and so awaken the community to a sense of the importance of medical research.

Personal and Appointments.

MR. J. W. THORPE, of Oldham, has been appointed works superintendent of the Liverpool Tramways Department.

SIR JOSEPH COOK, the Australian Commonwealth Treasurer, has been appointed Commonwealth High Commissioner in London.

MR. EDWARD W. BEATTY, president of the Canadian Pacific Railway Company, has been appointed Chancellor of McGill University.

Major E. G. Cheesman, R.M.L.I., has been appointed to the "President," additional, and for charge of Cleethorpes Wireless Telegraph Station, from Nov. 12.

In a note under this heading in our last issue we referred to MR. DUNDAS HEENAN, A.M.I.C.E., "of the Power Specialty Company, Ltd." This should be "the Power Specialty Company."

MR. A. C. CHAPMAN, F.R.S., President of the Institute of Chemistry of Great Britain and Ireland, has been appointed a member of the Royal Commission on Awards to Inventors, in place of Sir Jas. Dobbie, resigned.

At the first Congress of Applied Chemistry in Paris on Monday, M. Dior, French Minister of Commerce, handed to PROF. SIR WILLIAM POPE, president of the Society of Chemical Industry, the GOLD MEDAL of the Society of Industrial Chemistry.

The recent accident at HEYWOOD ELECTRICITY WORKS was fortunately not so serious as was at first feared, and MR. D. H. DAVIES, the borough electrical engineer, has returned home; but Mr. Hadfield, the assistant, who was also burned whilst meter testing, is expected to leave the infirmary this week.

MR. EDGAR MOXON, borough electrical engineer of South Shields, has been appointed borough electrical engineer of SOUTHPORT at a salary of £800 a year. There were over 140 applicants for the position, which was rendered vacant by the appointment of Mr. A. S. Black as electrical engineer and tramways manager at Ipswich.

MR. HAROLD DOWSON, electrical engineer and superintendent of telegraphs of the Western Australian Government Railways, has retired, as has MR. T. F. DUNCAN, superintendent of signals and interlocking at Perth. The two branches have now been amalgamated, and MR. C. A. McCALL has been placed in charge, under the control of the chief engineer.

Business Items, &c.

Messrs. Parker & Turnbull, electrical engineers, have opened premises at 81, Shakespeare-street, Dumfries.

MESSRS. HAYNES BROS., LTD., have removed their electrical business from 18, Gabriel's-hill, to more central premises in King-street, Maidstone.

The new address of the CANADIAN CHAMBER OF COMMERCE in London is 55, Holborn Viaduct, London, E.C. 1. Telephone: City 5441.

The Director of Public Works, Bagdad, would be glad to receive PRICE LISTS of BRITISH FIRMS exporting engineering materials and machinery.

THE NEW INVERTED INCANDESCENT GAS LAMP COMPANY, LTD., 19-21, Farringdon-avenue, E.C. 4, now supply electric light fittings, switches, lampholders, &c.

The monthly magazine of MESSRS. HIGGS BROTHERS contains the prices and other particulars of their a.c. and d.c. motors in stock. The prices have been again reduced.

Mr. L. Wilde, for fifteen years commercial assistant in the Ilford Urban Council's electricity department, has joined the Ajax Electrical Company, High-road, Ilford.

MESSRS. FRANCIS POLDEN & COMPANY, LTD., electrical and mechanical engineers, have opened a showroom and West-End branch at 17, Wells-street, Oxford-street, W.

In a neat descriptive folder, just issued by Messrs. L. G. HAWKINS & Co., the advantages of the Universal vacuum cleaner and of the Universal electric apparatus are set out clearly and concisely, while a striking showcard relating to the Universal electric radiator for drying clothes in the laundry is also available.

Messrs. Johnson & Phillips, Ltd., Charlton, S.E. 7, have appointed Mr. W. A. BOOTH as assistant engineer at their City office, 12, Union-court, Old Broad-street, E.C. 2. Mr. Booth was for several years assistant engineer at the works in their switchgear, transformer and junction box departments, and will specialise in these branches in connection with his new duties.

MR. T. K. EVANS, B.Sc., A.M.I.E.E., district manager in charge of the Manchester branch of the ELECTRICAL APPARATUS COMPANY, has been transferred to London to take charge of the London district sales organisation. Mr. H. H. Pollard, until recently Glasgow branch manager to the Harland Engineering Company, has been appointed district manager at the Manchester office of the company.

MESSRS. HALL AND HALL, manufacturers of "Hallite" high-pressure asbestos jointings, &c., have transferred their works from Limehouse, to Oldfield Works, Hampton, Middlesex, where, with enlarged and up-to-date plant, they are now in a position to cope with their increasing business and to give quick delivery of orders. The firm's head office remains at 47, Leadenhall-street, London, E.C. 3, to which all communications and orders should be addressed.

Institution Notes.

On Wednesday, Capt. H. Riall Sankey, C.B., C.B.E., delivered his presidential address to the ASSOCIATION OF ENGINEERS-IN-CHARGE, at St. Bride's Institute, London, the subject being "Some Recent Advances in Wireless Telegraphy."

The ELECTRICITY SUPPLY COMMERCIAL ASSOCIATION (London Division) will hold a Bohemian concert, on Oct. 21, at Anderton's Hotel, Fleet-street, E.C. 4, beginning at 7.45 p.m. The association is the only trade union catering exclusively for the commercial and clerical staffs.

At the annual meeting of the INSTITUTE OF GAS ENGINEERS on Tuesday Mr. Thomas Goulden said that, apart from the clear duty to the community to supply gas at the lowest possible price per unit, they must not forget they had a powerful rival in electricity, the cheapening of the supply of which, manufactured in super-stations to be built, was one of the panaceas put forward as a remedy for existing unemployment. The gas industry would have to struggle hard to maintain its position. Yet there was room for both gas and electricity.

Before the OLDHAM TECHNICAL AND OLD STUDENTS' UNION on Saturday evening an interesting lecture was given to a large attendance by Mr. F. Clegg, A.M.I.E.E., A.M.I.M.E. (Messrs. Ferguson, Pailin, Ltd.), on the subject of "Distribution of Electrical Energy—Switchgear Control." The lecturer gave brief historical notes and dealt with three-phase transmission and distribution systems. Descriptions of various types of switchgear were given, and the protection of machines and mains and motor control gear was also dealt with.

The third session of the PAISLEY ASSOCIATION OF ELECTRICAL ENGINEERS was inaugurated on the 15th inst., when the new president, Mr. W. R. Scott, delivered his presidential address. Mr. Scott spoke on "Engineering and Imagination," and said an engineer should have the power of imagining a thing and then achieving it. The engineer should first of all be a craftsman skilled in the use of tools and with a trained knowledge of accurate measurement. He should, secondly, be conversant with the existing and ever-growing records of scientific research. After these fundamentals had been attained, the principal factor in producing efficiency was imagination.

A local section of the JUNIOR INSTITUTION OF ENGINEERS was successfully inaugurated at Loughborough on the 5th inst. The president (Lord Weir of Eastwood, P.C.) took the chair at the inaugural meeting, the chairman of the institution (Mr. B. E. Dunbar Kilburn, M.A.) and other officers from headquarters being present. There was a large attendance of engineers. Mr. H. Schofield, M.B.E., principal of Loughborough Technical College, is the first chairman, and the new section will have its headquarters at the college. Persons resident in the district (including Leicester, Derby and Nottingham) who desire information should apply to the local hon. secretary, Mr. G. Mavor, The College, Loughborough.

At the BIRMINGHAM AND DISTRICT ELECTRIC CLUB on Saturday last a lecture was given by Mr. G. C. Findlay (a member) upon the commercial efficiency of the telephone. Mr. Findlay commenced with a short reference to the historic development of telephony, and then gave a lucid, and, so far as time allowed, a detailed description of the technical equipment of the modern telephone exchange, giving some account of the many devices at present being developed to increase the load capacity of cables. The lecturer agreed that the automatic exchange was in process of successful development, but he feared economic reasons would delay universal adoption. The paper further dealt with the administrative side of the development, and concluded by pointing out that the commercial efficiency of the telephone depended to quite an unrealised extent upon the subscriber and his staff. The lecture was fully illustrated by lantern slides.

The British standard SPECIFICATION FOR METALLIC RESISTANCE MATERIALS FOR ELECTRICAL PURPOSES (No. 115—1921) has just been issued, and divides metallic resistance materials into the following five classes:—Class A, for use when a low temperature coefficient is required at temperatures not exceeding 60° C. (such as in standard resistances and in sub-standard instruments); B, when the temperature coefficient may vary more than that permitted for Class A, and at temperatures not exceeding 200° C. (such as in instruments other than sub-standard); C, when the temperature coefficient may vary over a wide range and at temperatures not exceeding 300° C.; D, for use at high temperatures not exceeding 700° C. (as in heating apparatus); and Class E, for use at high temperatures not exceeding 1000° C. (as in heating apparatus). It has not been possible to specify definitely a value of the resistivity of any type of material, as there are such a large number of different makes of material, but it is specified, however, that the value shall not differ from the value declared by the makers by more than 5 per cent. As uniformity of resistance and dimension is a matter of considerable importance, the specification fixes limits for these. A comprehensive list of standard sizes of wires, tapes, and sheets is included, and considerable advantage will result if all designers of apparatus in which resistance wire is used would employ one or other of the standard sizes wherever possible. Copies of the specification may be obtained from the Secretary, British Engineering Standards Association, 28, Victoria-street, S.W. 1. Post free 1s. 2d.

The Council of the INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS announce that the Postmaster-General has awarded Lieut.-Colonel A. C. Booth, M.I.E.E., the sum of £100 in recog-

nition of his invention and services in connection with improvement in telegraph working. This applies more particularly to the development of the Booth-Baudot duplex, giving six-eight, ten, or twelve channels per circuit in place of the three, four, five and six channels of the ordinary Baudot, as used in France for some forty years. Lieut.-Colonel Booth has handed over this sum (£100) to be utilised, at the discretion of the Council, in annual awards for the best improvement in telegraph land-line apparatus or systems. An annual award of £5 (to be known as "The Booth-Baudot duplex award") is therefore offered for the best improvement in telegraph land-line apparatus or systems, to be governed by the following conditions:—(1) British subjects only, employed by public telegraph administrations throughout the world, will be eligible to compete. (2) Applications for the award to be received between Jan. 1 and March 31 of any year, such applications referring to improvements made or suggested during the twelve months prior to January. (3) At the discretion of the Council an award may be withheld in any year, if, in the opinion of the adjudicators appointed by the Council, after full consideration of the application received, panied by full details of the improvement, should be addressed to The Secretary, Institution of Post Office Electrical Engineers.

A SOCIETY has been formed among telephonists in the LONDON POST OFFICE TELEPHONE system for the purpose of discussing day-to-day problems connected with their work. Already the membership exceeds 1000. The first meeting of the new session was held on the 5th inst. at the Museum Exchange (Chesham-street), and an address was given by the president, Mr. M. C. Pink (superintendent of traffic). Dealing with telephony of the future, he prophesied that the present number of exchange lines in London would be nearly trebled in fifteen years, and that it would be necessary to build a very large number of new exchanges, in addition to rebuilding some of the existing ones. The new "toll" exchange had fully justified itself, and about 95 per cent. of the calls passed to the exchange could now be connected immediately upon demand. Referring to the trunk lines, Mr. Pink emphasised the importance of the development of telephone "repeaters" in securing satisfactory transmission over long distances. A wonderful improvement in the telephone conversations between England and such distant French towns as Bordeaux and Marseilles had been secured by "repeaters." There was a great future for international telephony, as it would be an important factor in the maintenance of a proper understanding between European countries. He urged the setting up of a body of experts to co-ordinate work by different Governments towards securing a European system. There was also the possibility of applying wireless methods to ordinary telephone service for increasing the number of simultaneous conversations carried by one pair of wires. He said the experiment had been successfully made.

At the second annual dinner of the INSTITUTE OF TRANSPORT on Monday, Lord Ashfield, president of the institute, in responding to the toast of the institute, said transport as an industry differed from almost any other industry, in that service must be rendered whether there was a fair return or not. In 1913 the gross receipts of the railways in Great Britain were roughly £135 000 000, and for the twelve months ended July last the gross receipts were £254 000 000, an increase of £119 000 000. He believed that for this year the total operating cost would be £240 000 000, and he thought he was well within the estimate in saying that the gross receipts would not be sufficient to pay the working expenses, without any provision for a return on the £1 300 000 000 invested in railways. In every direction economy must be exercised, but whether this would be sufficient to bring an adequate degree of prosperity to the railways only the future could tell. In the United States there was a motor-car for every eleven persons, while in Great Britain there was only one for every forty-three persons. If we were to do as well as America—and there was no reason why we should not—our motor vehicles must increase from 870 000 to 3 500 000. The roads were quite inadequate to meet that traffic; they must be widened, and he suggested that roads for motor traffic should be constructed parallel with the railways. There should be between railways and road transport the closest co-operation, and it was only through the co-ordination of those services that the very best results could be obtained. Again, more underground railways would have to be built, and he suggested that at the same time underground roads should be constructed for motor traffic.

Educational.

A University Research Committee of fifteen members has been established at BIRMINGHAM UNIVERSITY, and include the following as representatives of the faculty of science:—Profs. F. W. Burstell, F. W. Gamble, and S. W. J. Smith. The Registrar will act as secretary.

In the Faculty of Engineering of the UNIVERSITY OF BRISTOL, Merchant Venturers' Scholarships have been awarded to the following:—H. A. C. Riddale (Crypt Grammar School), R. Robertson (Bristol Grammar School), A. E. Russell (Fairfield Secondary School), and R. H. Wilmot (Malmesbury Secondary School).

During the vacation various alterations and improvements have been carried out at the EAST LONDON COLLEGE. Extensive library accommodation has been provided, and improved equipment in the mechanical and electrical engineering departments has been installed. Already 250 new students have joined for the 1921-22 session.

Companies' Reports, &c.

VICTORIA FALLS AND TRANSVAAL POWER COMPANY, LTD.

The Managers of Winchester, who presided over the ordinary general meeting of this company on Friday, said the report was a record of satisfactory progress, the year's trading having enabled the company to maintain the same dividends as formerly. The share capital still remained at £3 000 000; the first mortgage debentures stood at £2 330 928, the actual amount outstanding being £2 071 790; and the second mortgage debentures stood at £1 280 286, a sum of £92 199 having been paid off during the year. No addition had been made to the reserve fund (£250 000). The assets, leases and concessions, and the power station, buildings, equipment and land stood at £1 395 970 and £1 798 812 respectively, and a reduction of £99 961 compared with last year, and mainly accounted for by depreciation written off. The company's loan to the Rand Mines Power Supply Company and the 500 000 shares in that company stood together at £2 739 912, the advances being amply secured by a first charge over the Rand Mines Company's whole undertaking.

The Year's Revenue and Taxation.

The revenue amounted to £808 419, compared with £829 470 last year. The amount paid for the service of debentures in the shape of interest and premium amounted to £183 892, or £35 268 less than last year. Depreciation and amounts written off and provision for British taxation amounted to £409 940. The amount written off for plant and machinery was in accordance with their adopted scale, calculated to reduce the value of plant and machinery to a reasonable residual value during its useful life. The net result, after making provision for all taxation, was a profit of £173 161. With the amount brought forward the total balance was £267 482. The preference shareholders received three dividends, two each of 3 per cent. and one of 4 per cent., and the ordinary shareholders had received a dividend of 5 per cent. (all less tax) in respect of the year, leaving a balance of £92 482, which has been carried forward. With regard to the relief from British Income Tax in respect of colonial taxation, they had received the amount of their claim in respect of relief from British income tax for the two years ended April, 1917, and April, 1918, but in regard to the two subsequent years they had not yet reached a settlement. All of their contracts for power had been renewed for a further period of five years.

Low-grade Mines and Legislation.

The chairman reminded them that at past meetings he had referred to the position of the low-grade mines, which took their share of their power supply, and emphasised the importance of the continuance of mining operations by those consumers. It was a matter of satisfaction that for the most part those mines were still at work, and where mines had closed they had found an increase in demand by other consumers, who had been able to absorb the displaced native labour. With regard to the present year, the results, apart from the dislocation of business caused by the strike on the mines in the early months, showed that the business was well maintained; in fact, the power demanded had in some months exceeded the corresponding demands of last year. The second quarter showed a recovery from the effects of the strike in February to their old position, with a tendency to improve, which improvement was still being maintained, and he was hopeful that the results of the latter part of the year might make up for the dislocation caused by the strike.

During the year the South African Government appointed a Drafting Committee to frame a new Electric Power Bill for the Union. At present the Act under which their licences were granted applied only to the Transvaal, while less concise and older legislation held in other parts of the Union. Their company and other interested parties were heard by the Committee, and the Draft Bill would leave the company generally in the same position as at present. New enterprises would, however, be brought under similar regulations, and the Bill would enable the South African Government to vote money for the establishment of Government-owned stations for supplying Government Departments and the public. The Bill has not yet been dealt with by the South African Parliament.

The ARKLAND ELECTRIC SUPPLY COMPANY, LTD., will be shortly in the market for fresh capital to provide for extensions of plant and mains.

A quarterly dividend of $\frac{1}{4}$ per cent. has been declared on the common stock of the PACIFIC GAS AND ELECTRIC COMPANY, payable on the 15th inst.

The tramway and electricity receipts of the ELECTRIC SUPPLY COMPANY OF VICTORIA, LTD., for the quarter ended June 30 were £34 003, and the expenses £23 904.

Letters of allotment have been posted in respect of the CLYDE VALLEY ELECTRICAL POWER COMPANY's issue of 50 000 8 per cent. cumulative second preference shares of £10 each.

Like other recent electrical issues, the offer made last week of £300 000 $\frac{7}{8}$ per cent. mortgage debenture stock of the MERSEY POWER COMPANY was largely over-subscribed in a single day.

The directors of the RANGOON ELECTRIC TRAMWAY AND SUPPLY COMPANY, LTD., have declared an interim dividend of 8 annas per ordinary share, payable in Rangoon on the 31st inst., against nil a year ago.

The directors of the DIRECT UNITED STATES CABLE COMPANY, LTD., have declared an interim dividend of 4s. per share, less tax, being at the rate of 4 per cent. per annum for the six months ended Sept. 30, payable on the 31st inst.

The SUBMARINE CABLES' TRUST gives notice that the coupons due on the 15th inst. will be paid on that day by Messrs. Glynn, Mills & Company, 67, Lombard-street, E.C. 3. Coupons should be left four clear days before payment.

The directors of the KAMINISTOGUIA POWER COMPANY have declared the regular quarterly dividend of 2 per cent. (or at the rate of 8 per cent. per annum) on the common stock for the quarter ending October 30, payable November 15.

The EASTERN TELEGRAPH COMPANY, LTD., announce that the payment by warrants on Nov. 1 of interest for the half-year ending Oct. 31 on their 4 per cent. mortgage debenture stock. The transfer books of the debenture stock will be closed from the 26th to 31st inst., inclusive.

The directors of the ORIENTAL TELEPHONE & ELECTRIC COMPANY, LTD., have declared the following interim dividends: 3 per cent. on the 6 per cent. cumulative preference shares for the current year (less tax), and 4 per cent. on the ordinary shares (tax free). The warrants will be posted on the 31st inst., and the share transfer books of the company will be closed from the 11th to the 24th inst., inclusive.

The following STOCK EXCHANGE NOTICES have been issued during the past week: Dealings in the following securities have been specially allowed by the Committee: £50 000 6 per cent. registered redeemable mortgages, and £91 650 $\frac{7}{8}$ per cent. registered redeemable mortgages of the Tottenham and District Light, Heat and Power Company, and £300 000 $\frac{7}{8}$ per cent. mortgage debenture stock, £25 and fully paid (after issue of letters of acceptance) of the Mersey Power Company's Scrip, fully paid, for £750 000 6 per cent. debentures. The County of Southland Electric Power Board has been ordered to be quoted in the Official List.

The directors of the SINGAPORE ELECTRIC TRAMWAYS, LTD., state that owing to heavy expenditure on relaying the track, renewing cables, and the loss incurred in supplying electricity to the Municipality of Singapore under the 1913 contract, they are not in a position to pay the debenture interest due on Sept. 30 or to redeem the debentures due for redemption on the same date. The trustees for the debenture-holders have refused to agree to a postponement of the payment of interest and of the redemption of the debentures. The board thinks the best interests of the debenture holders would be met by assenting to the non-payment of the interest due for at least three months, in order that the board may continue the negotiations by which it is endeavouring to obtain an offer for the purchase of the undertaking.

New Companies.

The following list is compiled from information supplied by Messrs. Jordan & Sons, Ltd., company registration agents, 116 and 117, Chancery-lane, London, W.C. 2.

B.E.E. ASSETS COMPANY, LTD. (177 084). Registered October 3. To promote and carry on exhibitions of all kinds, and in particular to acquire, develop, and undertake all or any of the assets and liabilities or obligations of the British Empire Exhibition (1923), Incorporated. Nominal capital, £1 000, in £1 shares. Subscribers: The Right Hon. Lord Morris, Sir R. V. Vassar-Smith, and Sir W. B. Peat.

LLOYD & RAMSDEN, LTD. (177 109). Registered October 4. To acquire the business of manufacturers of cinematograph projectors and general electricians, now carried on at 17 and 19, St. Michael's-street, Nottingham. Nominal capital, £3 000, in £1 shares. Directors: E. G. Lloyd, O. W. Redgate, and C. E. Ramsden.

Forty Years Ago.

(THE ELECTRICIAN, OCTOBER 15, 1881.)

'THE TELEPHONE.' A new 'Telephone' is announced as the 'smartest thing going,' and as being able to 'transmit the future voice of the nation.' On closer inquiry we find that all this refers to a new evening paper of that name, not to a new telephone.

PRESIDENT GARFIELD.—It is stated that during the time the President of the United States lay ill at Longbranch, an average of 100 000 words of Press matter were transmitted per day by the Western Union Telegraph Company, and that on the day of his death the number of words transmitted for the Press amounted to 225 000.

LONDON INSTITUTION.—Among the papers on subjects connected with electricity and magnetism which are down for reading at the Institution during the coming session, we notice the following, viz.: 'Electricity versus Smoke,' by Dr. Lodge, on Dec. 15; 'The Storage of Power,' by Professor Ayrton, on March 2.

LIGHTING OF THE SAVOY THEATRE.—This new theatre close to the Thames Embankment was opened on Monday night last, when some parts of the structure were illuminated by means of electric light. The arrangements were necessarily tentative, and improvements will doubtless be introduced; but on the whole they are spoken of approvingly by the daily Press.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Partnerships Dissolved.

BEITH, John Russell, BEITH, George Royal Millward, and BEITH, Robert Douglas, electrical engineers, at Fair-lawn, Pontypool, co. Glamorgan, under the style of George Beith & Sons, by mutual consent as from Sept. 14, 1921. Debts received and paid by the said partners, who have appointed Mr. Alfred Mart, F.S.A.A., of 8, Park-place, Cardiff, to act on their behalf for the purpose of winding-up the business.

BRACKENBURY, Edgar William, and AYRES, Noel Aston, electrical and mechanical engineers, at Church End, Arlesley, Bedford, under the style of Aston Ayres & Company, by mutual consent as from June 22, 1921.

Bankruptcy Information.

MATHERS, Ernest Edward, 10c, High-street, Doncaster, electrical engineer. First meeting, Oct. 14, 12 noon, Official Receiver's Offices, Figgie-lane, Sheffield. Public examination, Oct. 20, 2.30 p.m., County Court Hall, Bank-street, Sheffield.

WORTHINGTON, Vincent Broughton, carrying on business at Ellesmere-yard, Walkden, co. Lancaster, electrical and mechanical engineer. Date of receiving order, Oct. 4, debtor's petition.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors, we do not report subsequent county court judgments against him.]

BARNETT, Bernard, 104, Whitechapel-road, E., electrical engineer. £21 1s. 1d. Aug. 31.

DRUMMOND, F. V. J., & Co., Hamilton-street, Grimsby, electricians. £11 19s. 10d. Aug. 25.

ELECTRIC INSTALLATION COMPANY, Central-arcade, Dudley-street, Wolverhampton, engineers. £13 7s. 11d. Sept. 7.

ENDALL, George Williams (trading as Endall & Company), Canal Motor Works, Canal Bridge, Church-street, St. Helens, electrical engineer. First meeting, Oct. 18, 11.30 a.m., Offices of the Official Receiver, 11, Dale-street, Liverpool. Public examination, Nov. 7, 11 a.m., Court House, Government-buildings, Victoria-street, Liverpool.

GREENFIELD, Frederick Chas., 47, Goldhawk-road, Shepherd's Bush, electrician. £47 2s. Aug. 29.

HEATH, Mr. F. (trading as Fuller, Heath & Company), 26, Buckingham-gate, S.W., electrical engineer. £26 10s. 6d. Sept. 2.

HOGG, W., 4, Pollen-street, W., electrician. £13 7s. 2d. Aug. 30.

HORCOCK, William Richard, 10, College-street, Worcester, electrician. £32 8s. 1d. Aug. 17.

KERFOOT, Edwin, 103, Cobden-street, Moston-lane, Blackley, Manchester, electrical engineer. First meeting, Oct. 18, 3.30 p.m., Official Receiver's Offices, Byrom-street, Manchester. Public examination, Oct. 28, 10 a.m., Court House, Quay-street, Manchester.

MARTYN, E. A., & JOHNS, 43, Kentish Town-road, N.W., electrical engineers. £12 19s. 10d. Sept. 5.

VENNER'S SIGNS, LTD., 6, Old Queen-street, Westminster, electrical engineers. £10 12s. Aug. 31.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

GENERAL ELECTRIC COMPANY, LTD., London, W.C.—Registered Sept. 26, charge, under Land Transfer Acts for securing £3,500,000 debenture stock, secured by trust deed registered July 26, 1921; charged on Magnet House, Kingsway, W.C. *£3,500,000. Aug. 4, 1921.

Bankruptcy Proceedings.

NICHOLS, Frederick Charles, motor and electrical engineer, 19, South-street, Scarborough, Yorkshire, trading in co-partnership with another under the style of The Scarborough Motor and

Accessories Supply Company. The receiving order in the above matter was made on Sept. 24 on debtor's own petition. The statement of affairs shows liabilities £371 and assets £39, from which has to be deducted £12 10s. for preferential claims, leaving a deficiency of £345 3s. Debtor attributes his position to bad trade, lack of working capital, and neglect of his pupil in attending to business. In May, 1914, he came to Scarborough, and started business at 24, Park-street, Scarborough, as an electrical engineer, with a cash capital of £120, which represented his savings while working at Bradford. He carried on the business until May, 1916, when he joined the army, but after being demobilised in January, 1918, he again opened out business at the same address, and also at Whipp's-yard and Falsgrave, all in Scarborough, when his capital, he states, was £150. About two years ago, whilst at Whipp's-yard, the debtor was financed by another, and in July last the business was transferred to South-street, Scarborough. At the same time an agreement was entered into that in consideration of the £500 contributed to the business by this other person the debtor would teach her son the business of a motor engineer until he was twenty-one years of age, and then take him into partnership. It appears that after business hours the debtor did some spare-time employment, and thereby earned £200 during the last year. The only book of account kept was one of receipts and expenses, and he states that this was recently destroyed by his pupil, together with other papers. He alleges he first became aware of his failure in November last, when trade was very bad, but it was not until last August that he realised his true position.

PRIVATE MEETING.

[Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.]

PERRY, John Victor, trading as J. V. Perry & Company, Conway-street, Birkenhead, electrical engineer. At a meeting of creditors held recently, debtor made an offer to pay his creditors in full, it being proposed that he should set aside a sum of £40 per month. It was decided, however, that the deed of assignment already executed to Mr. J. F. Warburton, accountant, of Manchester, should be confirmed, and a committee of inspection was appointed, consisting of the representative of the General Electric Company, Ltd., Mr. J. Airey, and Mr. Parkin S. Booth. A statement of affairs was presented, which disclosed liabilities of £850, all due to the trade. Net assets were estimated to realise £922, or a surplus of £72. It was stated that debtor commenced trading on his own account at Broad-street, Pendleton, Manchester, in September, 1919, with a capital of £100. He was later joined by a partner, who brought in £20, but in July last he gave up the Manchester business and started at his present address, when the partner retired. The latter received nothing on going out. The total purchases at Birkenhead up to Sept. 3 last were £1,492, but since that date the books had not been written up. In the same period the sales were £256, and it was estimated that a gross profit of 33 per cent. was made. During the period the debtor had employed four men, two boys, and a girl, at total wages of 18 guineas per week, while his personal drawings were £3 weekly, and he had expended £150 on advertising, and £80 on office equipment and printing. The present position was attributed to the slump in trade. Creditors include: Metropolitan-Vickers Electrical Company, Ltd., Manchester, £239; Cable Accessories Company, Ltd., Tipton, £127; Downes & Davies, Ltd., Liverpool, £19; Electrical Specialties Company, Liverpool, £20; Lamp Factors Company, Ltd., Liverpool, £65; Hinson & Co., Birkenhead, £25; Gallie Bros., Birkenhead, £22; Kowe Bros. & Company, Ltd., Liverpool, £30; Vulcan Electrical Company, London, £20; Siemen Bros. & Company, London, £20.

Benn Brothers' Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"The Cabinet Maker"; "Annual Dinner of the Bedstead Manufacturers' Federation"; "The Seventy Years' History of a Retail Furnishing House"; and "Foreign Trade in Furnishing During September."

"Chemical Age"; "Annual Dinner of the Society of Chemical Industry"; "Chemical Industry and the Stability of Peace," by Major V. Letchum; and "Hydrogenated Phenols and Alcohols Substitutes."

"Farm and Home"; "Practical Dairying"; "State Credit for Farmers"; and "Road Traction" (illustrated).

"The Fruit Grower"; "Colour Problems in Fruit"; "Combating White Fly on Tomatoes"; and "The Lorette System."

"Gardening Illustrated"; "Plants that Bloom in the Spring"; "Fruit Tree Planting"; and "The Grouping of Annuals."

"The Gas World"; "Institution of Gas Engineers, Full report of the Annual Meeting and commercial subjects were discussed."

"Hardware Trade Journal"; "The Art of Salesmanship: An Efficiency Expert's Talk to Traders"; "Renovating Old Plated Goods," by Electrographer; and "The Density of Copper Zinc Alloys," by T. G. Bamford, B.Sc.

Arrangements for the Week.

FRIDAY, Oct. 14th (to-day).

EDINBURGH ELECTRICAL SOCIETY.

8 p.m. At the Philosophical Institute, 4, Queen-street, Edinburgh. Paper on "Electro-Chemistry," by Mr. R. W. J. Stark.

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, London, S.W. Paper on "Electric Cranes," by Mr. C. H. Woodfield.

ELECTRO-HARMONIC SOCIETY.

8 p.m. At the Great Hall, Cannon-street Hotel, London, E.C. Smoking concert.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

At the Library and Philosophical Society, Westgate-road, Newcastle-on-Tyne. 6.15 p.m. Presidential address by Sir Wm. J. Noble, Bart. 7.30 p.m. Lecture on "The Position of Aviation To-day," by General Sir Sefton Branker, K.C.B.

WEDNESDAY, Oct. 19th.

INDUSTRIAL LEAGUE AND COUNCIL.

7.30 p.m. At Caxton Hall, London, S.W. Lecture on "Economic Axioms of Industry," by Mr. E. W. Petter.

ROYAL INSTITUTE OF PUBLIC HEALTH.

4 p.m. At the Royal Institute of Public Health, 37, Russell-square, London, W.C. Lecture on "Problems of Industrial Hygiene in Relation to Public Health," by Sir Thomas Oliver, M.D.

FRIDAY, Oct. 21st.

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, London, S.W. Lecture on "Pyrometry for Boilers: Some Questions Pertinent and Impertinent," by Mr. C. E. Foster.

SATURDAY, Oct. 22nd.

BIRMINGHAM AND DISTRICT ELECTRIC CLUB.

6.30 p.m. At the Grand Hotel, Birmingham. Eleventh Annual Ladies' Night.

INSTITUTION OF MECHANICAL ENGINEERS.

6 p.m. At Storey's-gate, London, S.W. Eleventh Report of the Alloys Research Committee "On Some Alloys of Aluminium," by Dr. W. Rosenheim, F.R.S., and Messrs. S. L. Archbutt and D. Hanson.

Books Received.

- "Entropy as a Tangible Conception." By Mr. S. G. Wheeler. (London: Crosby, Lockwood & Son.) Pp. 76. 8s. 6d. net.
- "Appareils et Installations Telegraphiques." By E. Montoril. (Paris: Librairie J. B. Balliere et fils.) Pp. vi.+625. 40frs.
- "Electric Lighting in Factories and Workshops." By L. Gaster and J. S. Dow. (London: Sir Isaac Pitman & Sons.) Pp. 37. 6d. net.
- "Diagnosing of Troubles in Electrical Machines." By Prof. Miles Walker, M.A., D.Sc. (London: Longmans, Green & Co.) Pp. xi.+450. 35s. net.
- "The Induction Motor and other Alternating Current Motors." By B. A. Behrend. (London: Hill Publishing Company.) Second edition. Pp. xxiii.+272. 24s.

Prices of Metals, Chemicals, &c.

		TUESDAY, OCT. 11.			
		Price.	Inc.	Dec.	
Copper—					
Best selected	per ton	£70 5 0	15s. 0d.	—	
Electro Wirebars	..	£77 10 0	£3	—	
H.C. wire, basis	per lb.	0s. 11 ³ / ₄ d.	£3d.	—	
Sheet	..	0s. 11 ¹ / ₄ d.	—	—	
Phosphor Bronze Wire (Telephone)—					
Phosphor-bronze	..				
wire, basis	..	1s. 3 ³ / ₄ d.	1 ¹ / ₄ d.	—	
Brass 60/40—					
Rod, basis	..	0s. 8d.	—	—	
Sheet, basis	..	0s. 10 ¹ / ₄ d.	—	—	
Wire, basis	..	0s. 11 ¹ / ₄ d.	—	—	
Pig Iron—					
Cleveland Warrants	per ton	£6 10 0	—	—	
Galvanised steel	..				
wire, basis 8 SWG	..	£23 0 0	—	—	
Lead Pig—					
English	..	£24 0 0	—	5s. 0d.	
Foreign or Colonial	..	£23 2 6	—	2s. 6d.	
Tin—					
Inset	..	£156 0 0	—	£1 10 0	
Wire, basis	per lb.	2s. 11d.	—	3d.	
Salammoniac— Per cwt. 65s.-60s.					
Sulphur (Flowers)—	Ton £13.				
" (Roll-Brimstone)—	Per ton	£85.			
113.		Sodium Bichromate.—	Per lb. 7 ¹ / ₂ d.		
Sulphuric Acid (Pyrites, 168°).—		Sodium Chlorate.—	Per lb. 4 ¹ / ₂ d.		
Per ton, £9 17s. 6d.					
Rubber.— Para fine, 1s. 1 ¹ / ₄ d.; plantation 1st latex, 9 ¹ / ₄ d. lb.					
The metal prices are supplied by British Insulated & Helsby Cables, Ltd.					

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by MESSRS. MEWBRUS, ELLIS & CO., Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.

COMPLETE SPECIFICATIONS.

- 6165 14 MAGERLE & MARTINEK. Electro-magnetic devices for maintaining in motion rolling bodies. (15/6/16.)
- 122 640 LOWENSTEIN, F. Electro-magnetic wave signalling arrangements. (19/1/18.)
- 131 899 SPLITDORF ELECTRICAL CO. Operating mechanism for electrical generators and magnetos. (16/1/15.)
- 140 070 MEISSNER INVENTIONS CORPORATION. Telephone transmitters. (12/3/19.)
- 146 131 PRESSED METAL RADIATOR CO. Radiators or liquid coolers applicable especially to electric transformers. (27/11/16.)
- 148 433 OPTISCHE ANSTALT C. F. GOERZ AKT-GE. Electric arc lamps. (11/6/19.)
- 153 027 DUBILIER CONDENSER CO. LTD. High-potential electric condensers. (7/3/1919.) (Divided application on 140 046.) Comprises a block of condenser elements enclosed within a casing, wherein pressure is applied to the condenser elements through the medium of a member engaging an end surface of the elements to which pressure is applied by means within the casing, but exterior to the elements, the pressure being applied along the common axis of the elements.
- 162 247 METROPOLITAN-VICKERS ELECTRICAL CO., LTD. Electrical switchboards. (23/4/20.)
- 164 014 MOLLER, E. Apparatus for the separating of suspended bodies from electrical insulating gaseous fluids. (31/7/14.) (Divided application on 11 088/15.)
- 166 409 LANGER, W. H. Electrode for arc welding and like purposes and method of making same. (28/10/20.) (Addition to 132 354.)
- 166 500 FERRANTI, S. Z. DE, WALL, G., & FERRANTI, LTD. Alternating current electricity meters and the like. (17/1/20.) (Divided application on 155 131.)
- 166 502 DOBSON, E., & FOSTER ENGINEERING CO., LTD. Electrical switches. (4/9/19.)
- 166 594 BRYDON, S., & CUSINS, A. G. T. Wireless telegraphy and wireless telephony and the like. (27/9/19.)

APPLICATIONS FOR PATENTS

May 13, 1921.

- 13 557 BROOK. Device for explanation of construction of armatures.
- 13 559 CATTESON-SMITH. Resistance element for electric heating apparatus.
- 13 566 ECCLES. Methods of controlling relative phases of alternating current.
- 13 572 LEPINE. Wiring systems for electric light and power installations.
- 13 596 REYROLLA & SCHUL. Switches.
- 13 601 BEAVER & CLAREMONT. Lapping strips of paper, &c., on electric conductors.
- 13 604 GENERAL RAILWAY SIGNAL CO. Universal relays. (19/7/20, U.S.)
- 13 619 METROPOLITAN-VICKERS ELECTRICAL CO. Cooling arrangements for electric machines. (17/5/20, U.S.)
- 13 621 Soc. d'ELECTRO-CHIMIE ET D'ELECTRO-METALLURGIE. Electrolytic deposition of iron. (9/6/20, France.)
- 13 622 Soc. d'ELECTRO-CHIMIE ET D'ELECTRO-METALLURGIE. Obtaining metallic electrolytic deposits easily detachable from the cathode. (18/6/20, France.)
- 13 630 EASTERN TELEGRAPH CO., DAVIES & RYAN. Electric signalling.
- 13 642 AKT. GES. DES MASCHINENFABRIK ESCHER, WYSS ET CIE. Electric trains with resistor cats. (25/5/20, Switzerland.)
- 13 657 HIRST. Device for automatic synchronization of electric clocks, &c.
- 13 661 & 13 662 BURGESS BATTERY CO. Dry cell (15/5/20, U.S.)
- 13 666 FROST (J.) CO. & WELCH. Electrically heated vulcanisers.
- 13 668 TWINBROW. Current-collecting shoes.
- 13 671 STONE (J.) & CO. & DARKER. Automatic reversing switch, &c. for electric machines.
- May 17, 1921.
- 13 681 NIBLETT. Primary and secondary batteries.
- 13 682 SHIPLEY TANK CO. Regulating current for welding apparatus.
- 13 714 WALKER. Electric controlling devices.
- 13 730 DAGOBERT, TIMAR & CO. Heating forgings electrically. (22/12/20, Germany.)
- 13 731 SCHROEDER. Electric rivet heaters.
- 13 761 BREAREY. Electric energy control systems.
- 13 762 RICHTER. Electric liquid heating appliances.
- 13 774 CREWS. Electric lighting of vehicles, &c.
- 13 782 STAR ELECTRICAL ACCESSORIES, LTD. Die casting machines.
- 13 783 STAR ELECTRICAL ACCESSORIES, LTD. Method of casting metals of high melting point.
- 13 794 WESTERN ELECTRIC CO. Magnetic material for loading telephone and telegraph conductors.
- 13 804 FRANCE & MITCHELL. Electrically controlled locks.
- 13 815 SIEMENS-SCHUCKERTWERKE. Conducting additional transformers to a supply circuit. (14/5/20, Germany.)
- 13 816 SIEMENS-SCHUCKERTWERKE. Vacuum rectifiers. (15/5/20, Germany.)
- 13 824 COMPAGNIE GÉNÉRALE ÉLECTRIQUE. Apparatus for starting synchronous non-synchronous motors. (6/10/20, France.)
- 13 825 COMPAGNIE GÉNÉRALE ÉLECTRIQUE. Parallel coupling of polyphase current generators.
- 13 831 BARON (Aldendorf). Automatic exchange telephone system.
- 13 865 SACHSENWEIK LICHT U. KRAFT A.G. & HABERLE. Transformer windings. (25/5/20, Germany.)
- 13 866 MUNDLE & STANBROOK. Electric locomotives.

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Notes of the Week.

An Echo of the London Electricity Inquiry.

THOUGH three months have elapsed since the termination of the inquiry into the schemes for the reorganisation of electricity supply in London and the Home Counties, no decision has yet been published by the Commissioners. This is not to be wondered at when the complexity and difficulties of the problem are considered, and all will agree that adequate time must be given for digesting the evidence before anything in the nature of a satisfactory scheme can be evolved. Judging from an elaborate, but not too friendly review of the inquiry, recently prepared by the Town Clerk of Croydon (Dr. J. M. NEWNHAM), the prospect of the formation of a joint authority for the whole of the area is not rosy. For Dr. NEWNHAM expresses the opinion—an opinion which seems to be shared by about a dozen extra-London municipal undertakers—that "it would appear doubtful whether there is such a general consent of the parties interested as to make it possible to frame any scheme for a joint authority that would obtain the approval of Parliament at the present time."

Commissioners Should Take Action.

WE agree that there was not sufficient general support for any one of the three major schemes—those of the London County Council, the Conference of Local Authorities, and the Joint Committee of nine London companies—to justify the adoption of any one of them in its entirety, but each possessed certain merits, and it should not, therefore, be impossible to devise a scheme which should contain some of the favourable features of each, and so become more acceptable than those considered at the inquiry. We are afraid that if the Commissioners postpone their decision until there is general consent to a scheme among those interested, we shall have to wait until the Greek Kalends for the reorganisation of the industry and the advent of

a cheap and abundant supply of electricity in London. We would, therefore, urge that too much weight should not be given to the "general consent" idea, for there is no scheme outside heaven that will satisfy everybody. If, however, the Commissioners can placate the majority of those interested without inflicting any appreciable injury upon the others, in our opinion, they would be justified in taking such further appropriate steps as would put their proposals into definite shape. For it would be nothing short of a calamity if all the labour and expense involved in the public inquiry are in vain, simply because everyone's ideas cannot be included. Rather than there should be failure, we hope that the Commissioners will not hesitate to prepare a scheme of their own.

Objections of Outer London Authorities.

WHEN the objections of Dr. NEWNHAM to the formation of a joint authority are analysed they appear to be mainly of a financial character, though there are also difficulties of an administrative nature. No doubt these are raised in good faith, for the purpose of safeguarding the position of undertakings belonging to local authorities outside the London area, but, while refraining from passing judgment upon their character, we consider that all the demands are capable of adjustment by friendly negotiation between the respective parties. For instance, there are demands for separate representation on the joint authority of all local authorities outside the County of London, not less favourable than that included in the Conference scheme, for a definite and explicit system of charging by the authority, for limitations being placed upon the authority's control of undertakings not assenting to the scheme, for the fixing of a definite basis for the valuation of all works to be acquired. There also appears to be unanimous objection to the pledging of the rates or the grant of power to levy any charge on any municipality or undertaking without its assent. All these points were fully debated at the inquiry, and only the last one presents any real difficulty. In the absence of adequate

legislative authority, a complete scheme cannot be prepared, and local authorities are therefore justified in assuming a waiting attitude in the meantime. We hope, therefore, that no time will be lost in passing a Bill somewhat similar in terms to that of the Electricity Supply (No. 2) Bill of 1921, for otherwise we shall have local authorities justifying their do-nothing attitude to the disadvantage of the electrical industry.

The London Toll Exchange.

ON another page of this issue we give a description of the London Toll Exchange. The most interesting point about this new development is that it represents in the concrete an attempt to improve the telephone facilities of the metropolis, of whose shortcomings we have read and heard so much. The first advantage of the new method of dealing with telephone traffic which this new exchange will make possible is that it will to a large extent eliminate "tandem" working. That is, a call from one small outer London exchange to another will no longer have to pass through one or more of the large central exchanges, causing delay to itself and to others, but will obtain direct communication through the Toll exchange. A second advantage is that calls to and from a number of exchanges in the outer ring, *i.e.*, within, roughly, twenty-five miles of Charing Cross, will cease to be "trunks," and will be worked through the Toll exchange on the "no delay" system. To effect both these improvements a large amount of careful planning and extension work has been necessary, and for this a much maligned Government department deserves at least its share of praise. We are glad to learn that this progressive policy has been justified, and that even in the short time the new exchange has been open the improvement in the traffic working has been quite noticeable. It may be added that it is hoped before long to extend similar facilities to a fifty-mile radius, thus bringing in such towns as Brighton, Reading, Southend, Bedford and Chatham. This should accelerate communication between London and these important towns and between each other in no uncertain way. At the same time the scheme for erecting a tandem exchange will help to speed up calls in the inner London area.

The Basis of Telephone Tariffs.

INCIDENTALLY, this new departure will have a beneficial influence on the vexed question of tariffs. Until the recent revision took place the system of charging was full of anomalies, of which the most was made in the course of the arguments that took place when the increased rates were published. This is really not surprising, considering that the telephone system has been built up by the joining together of smaller systems spreading out web-wise from the various big towns. The result from the economical standpoint was that some calls were being charged at too low and others at too high a rate. This latter class were conveniently overlooked during the arguments we have just mentioned. But under the mileage system of charging, which is now the standard, these anomalies are done away with, and the fee for a call depends solely on the distance of the called from the initiating exchange. Viewed in that cool atmosphere which never accompanies controversy, it is obvious that this is the most equitable way of dealing with a difficult matter, and it is to be hoped that before long the results obtained, combined with the improved service which the new exchange will give, will bring this home to the general public.

The Ethics of Municipal Wiring.

IN a letter which we publish on another page of this issue Mr. GEORGE W. KEATS, Borough Electrical Engineer of Woolwich, criticises our recent contention that "it is not equitable for a local authority to enter into competition with its own ratepayers," or, in other words, that municipal electricity supply undertakings should not engage in wiring and other work, which is primarily the contractor's job. Frankly, we thought that our expression of opinion in these modern days was axiomatic, and we are not a little surprised at the views which Mr. KEATS enunciates at such length. But really he is arguing on false premises. The case of a municipal electricity supply undertaking competing in the same line of business with its own ratepayers cannot be compared with the competition which takes place with a concern like a gas company. And even if it could, we should still contend that the attitude Mr. KEATS takes up is wrong. It would, of course, be possible for any municipal electricity supply department gradually to supersede the contractor, but it is highly doubtful whether it would be expedient not only from the point of view of the supply department, but from the larger point of view of the electrical industry generally. The development of electricity supply, which we have at heart certainly as closely as Mr. KEATS, can, in our opinion, best be assured by each section of the industry doing its own work and co-operating with and encouraging every other section to do likewise.

Dimensions and Output.

A PAPER in a recent issue of the "Journal" of the American Institute of Electrical Engineers places Mr. LAWRENCE E. WIDMARK among the iconoclasts. He begins by speaking disrespectfully of that hoary formula d^2 , considering it to be no longer "a suitable measure of the electrical sizing up of a machine." His reason is that the expression deals with three factors, heat radiation, commutation and magnetic flux, and of these only the last is fundamental, the other two varying from day to day in accordance with the prevailing trend of current design. He contends that the foundation formula in electrical design should be independent of such varying troubles; and there will be found many to agree with him. This condition in Mr. WIDMARK's opinion seems to be met by using as the fundamental formula the product of the rotor volume and its diameter, and he gives examples to show that for small and medium-sized machines an exceedingly good standard value is obtained from the new expression. Or in other words the new expression is a "constant-constant," instead of being like the old one a "variable-constant," at any rate for small-sized machines. At the same time the new expression allows an interesting study of the most favourable design of machine as regards cost and how the design is affected by different conditions. The formula certainly seems to introduce a much needed simplification into the necessary calculations that are associated with this work, and from that point of view will doubtless be welcomed by designers.

The Cure for Trade Depression.

WE should like to register our whole-hearted agreement with the memorandum on trade depression prepared by the Federation of British Industries. But, while we agree that taxation must be reduced, production increased and every means taken, including the development of export credits, to win back and augment our trade both in the Overseas Dominions and abroad, we cannot subscribe to

the view that monetary deflation is alone responsible for the present deplorable position and that one of the best remedies is to return at least temporarily to a policy of inflation. We agree that such a policy on the face of it has much to recommend it. It would provide capital for the much-needed expansion of industry, it would increase the purchasing power of the consumer, and it would bring a relief of many commercial anxieties. But, as we pointed out a week or two ago, it has dangers—real dangers—which necessitate that the temptation of dallying with its advantages should be strenuously resisted. The condition of the industrial body at the present time may not unjustly be compared with that of a human body recovering from a severe illness. The rate of return to normal seems slower than it really is, and the patient is tempted to adopt remedies which will most unwisely speed up the rebuilding of his enfeebled frame, and result not in convalescence, but in relapse. This is a risk of which the Federation of British Industries and, indeed, industry in general, would do well to beware.

Better Suggestions.

THE suggestions made by Sir EDWARD STOCKTON, President of the Manchester Chamber of Commerce, in a letter to the Prime Minister, are, however, more likely to bring about trade revival than are those of the Federation of British Industries. Sir EDWARD suggests first the cancellation of inter-Ally indebtedness, and then the concession of more liberal facilities by the bankers to traders. These are, of course, matters of high importance. But more important still are the recommendations that the currency should not be re-inflated and that the cost of production must be reduced. It is, indeed, around this last point as a pivot that the whole question of trade revival and trade stagnation revolves. That this is so has been repeated so often that its essential truth is becoming obscured, and it is certainly not realised as it should be. Nevertheless, it remains the truth. Added to this the suggestion that wages should be stabilised for a period is worth attention. Such a stabilisation would not only greatly assist the development of trade, but would give the workers that feeling of security without which we cannot hope to secure an improvement in industrial conditions.

The Relief of Unemployment.

IN writing on the problems of unemployment a week or two ago, we blamed both the Government and all sections of the industry for their neglect to examine and build upon basic foundations of the matter. While we still hold that this examination is essential, not the least to prevent those distressing outbursts which are almost daily occurrences in our large centres of population, it is evident that some policy of a temporary and more speedily operating character is essential in order that the existing widespread unemployment may be dealt with in the wisest possible manner. Unfortunately, though this question has been widely discussed, innumerable suggestions for dealing with the problems have been put forward and committees are at work on the more feasible of the proposed solutions, very little has yet been done, and the omens are not at all favourable that much ever will be done. This failure is, we fear, not a little due to the inability or unwillingness of the parties concerned to discuss the matter coolly with the one aim of arriving as speedily as possible at a solution. There is, in fact, too much manœuvring for position, and too little determination to hammer out some course which shall be of real benefit to those most

intimately concerned. That this should be so is most deplorable, and renders only natural the resentment which is being felt in all quarters against the inaction of the Government. It is time, in fact, that our rulers insisted on the co-operation of both employers' and employees' associations that, after all, theirs is the primary responsibility in this matter. The new legislation, of which only meagre details are available at the time of going to press, hardly seems to meet the case from this point of view.

Shipping and Trade Development.

THE industry of this country, the electrical industry equally with the others, depends for much of its prosperity on the position of British shipping. For British trade must largely be conducted in foreign markets, and it is desirable, if not essential, that our goods should be borne in vessels owned by British firms. Some figures given by Sir WILLIAM NOBLE in his presidential address to the North-East Coast Institution of Engineers and Shipbuilders are, therefore, of grave importance. When war broke out the world's steam tonnage was 42½ million tons gross, of which 44½ per cent. were owned by the United Kingdom, though in real efficiency the percentage was much higher. In fact, 90 per cent. of the steamers over 1 600 tons gross flew the British flag, and the British mercantile marine was responsible for over 50 per cent. of the world's sea-borne commerce. But the position to-day is very different. Our tonnage has decreased by 13½ per cent., and the decrease in efficiency is much more. At the same time, the importance of owning a national mercantile marine has become clear to other nations, and our supremacy at sea is being challenged in no uncertain way. It is therefore essential for their own good and the good of the nation that the shipbuilding industry gets down to real hard work without the least delay.

The Need for Better Education.

FROM this point of view Sir WILLIAM NOBLE does well to emphasise the fact that the real interests of employers and employed are identical. At a time when all is not well with Labour, when the old shibboleths are being found wanting, when the hotheads are discredited and when a new policy is being feverishly sought to keep the trade union machine going, there could be nothing wiser or more likely to lead to an improvement in industrial conditions than an insistence on this unity of aim. Much has been done in this direction, for alliances of employers and employed, welfare work and profit-sharing schemes are all indications of an improved spirit which every effort must be made to develop. But what is wanted above all is more and better education, not only in the science and technology of the trade in which a particular worker is employed, but in sound, economic doctrines, in self-discipline and in spiritual outlook.

Telephony in the United States.

TELEPHONE engineers should be greatly interested in a recent publication of the Bureau of Standards, Washington. We are often told that the telephone service in the United States is infinitely better than it can ever be over here, and, presuming we take this to be correct, the details which have been collected together in this circular should go a long way towards showing the reason for this superiority. The pamphlet in question contains a good deal of matter about the various forms of telephone services, historical details are not lacking, and the relation of the telephone service to the public generally is dealt

with. But the most interesting portion is the four sections which deal with telephone plant and its operation. Manually operated and automatic equipment are both considered, the latter section being sub-divided into chapters dealing with the auto-manual system, the panel type machine switching system, and what may be called automatic telephony proper respectively. The outside work has a section to itself. And even if we do not agree that our telephone system on the technical side lags behind what is being done in the United States, the publication is worth reading in that it collates a large amount of information between two covers that can usually only be found after long and wearisome investigation.

The Cult of the Carpet.

THE days when the carpet was a symbol of the employer's relation to his workpeople has passed, even though that dust-collecting piece of equipment may still distinguish the rooms where live the higher lights of the office staff from those occupied by those whose labour is distinguished by a smallness of pay and responsibility. Now, instead of the employer keeping the workman at arm's length, he is in many ways endeavouring by means of works' committees to bring about a closer contact between the management and the more directly productive members of the staff. But even this, good as it is, is hardly going far enough towards that combination of interests which is necessary for the general well-being. For it is one of the principal duties of the modern employer to assist the education of his workpeople in economic principles, to showing them that increased production means increasing prosperity, and doing all he can to neutralise those pernicious doctrines, which, fair as they are in appearance, are very Dead Sea fruit in taste. The work of the Industrial League and Council is worth attention from this point of view. The lectures and discussions which are held in various centres throughout the country form a basis upon which more local activities can be built, and are a propaganda of which the employer should take full advantage.

The Work of the Industrial League and Council.

THE policy of the Industrial League and Council was clearly laid down at a recent meeting in London, which was convened "to consider the best means of promoting whole-hearted co-operation among employers and employed, and methods of efficient and increased production." As was justly pointed out by Mr. G. H. ROBERTS this can best be achieved by bringing employers and employed into closer and friendlier relations. And this relation can best be cemented by reducing the cost of living, and by stabilising the rate of exchange. We are glad to see that Mr. ROBERTS also protested against the policy of re-inflation, and that he looks upon insurance as one of the soundest methods of dealing with unemployment. It is unnecessary to add anything by way of comment on this plan of campaign, except to say that its basis, no less than the spirit in which it is being worked out, must ensure it a success which will be withheld from the many plans of a similar nature that are so freely diluted with quackery.

Electrical Fires.

A SHORT time ago we commented on the campaign which is being inaugurated in the United States to persuade insurance companies that they should not ascribe fires to electrical causes unless there is some evidence for that view being taken. This is the more necessary as the interesting statistics which have been collected by the Society for Electrical Development show that of the total number of

fires that occur, the proportion which are really due to electrical causes is exceedingly small. We are now of opinion that some such propaganda is equally necessary over here, and we recommend the idea to the British Electrical Development Association, or for that matter to any other body interested in electrical progress who cares to take the matter up. This propaganda might take the form of the preparation of statistics, which would allow the misrepresentation and exaggerations on this subject to be nailed to the mast. It would even allow such subtle misrepresentations as which recently appeared in that sober journal, the "Morning Post," on the subject of the recent fire at Magasin au Printemps in Paris to be neutralised. In this pronouncement that writer coolly presumes that fires are less frequent in Paris than in London, and adds to this the still more extraordinary presumption that this is due to the lesser development of electric lighting in France than in England. It would be difficult to find a better example of weak premises and bad argument, and we recommend it to the logicians with that end in view. But it would, perhaps, be most charitable to suppose that the remark was thrown off in the hurry which attends the getting to press of a daily paper. Nevertheless the writer must have had at the back of his mind some dim photographic idea that electric lighting is in some way dangerous. For it is out of the fullness of the brain that the pen writeth. It is this idea that has to be eradicated.

The Minimum Charge Again.

THOUGH the imposition of a minimum charge for electricity supply is now the general rule and its principle is recognised in all special orders, it is, nevertheless, causing considerable trouble to supply authorities and engendering so much irritation among consumers that we believe it would be wiser to allow it to drop into disuse. Several engineers have recently been called upon for an explanation of the charge, and, although in theory it is quite easy to justify, it is doubtful if any statement would carry conviction to some people. The recent case of a customer at Newbury, who had not consumed any current, but was called upon to pay a minimum charge for a period, is an example. Somewhat naturally he pleaded that as he had received no consideration he was under no liability to pay the sum demanded. This, of course, is bad law, and he was therefore lucky to get off as cheaply as he did. But it is this question of consideration that is the cause of all the trouble, for the average man, who has not used a certain thing, cannot understand why he should be called upon to pay for its use. As we have repeatedly pointed out, there is a two-fold and valid consideration in these cases. In the first place, the local supply company went to the expense and trouble of laying a service to the consumer's premises, and in the next place they were under a continuing statutory obligation to give and maintain an efficient supply of electricity to him at all times. The majority of consumers readily recognise the reasons for the payment of a minimum sum for an electricity service, but as the practice did not become general until the period of the war and few persist in challenging its equity we would suggest the advisability of abandoning it as soon as possible, or, at all events, of using it only in exceptional cases. A dissatisfied domestic consumer is a bad advertisement for a supply undertaking, and if the few disgruntled ones can be appeased the better for everybody and the more rapid will progress be made. One way out of the difficulty would be to allow supply undertakings to impose a two-rate tariff.

The Fruits of Research.

SUCCESS in commercial engineering depends primarily on a wise policy and, secondly, on energy, enterprise and imagination in carrying that policy out. In more detail it depends on good design, economic production and well-organised selling; or, again, it depends on the closest co-operation between brain and hand in the progress towards a common goal. It follows almost as an axiom that in an ever-growing and ever-changing field such as electrical engineering it is not sufficient to lay down once and for all certain rules of conduct, but that the policy upon which the operation of any productive organisation is based must be constantly examined and, where necessary, changed in order that fresh tools may be devised and new methods evolved for dealing with an ever-recurring novelty in the problems that arise for solution.

Commercial Factors in Success.

Though this attitude has not perhaps been openly a factor in developing the commercial side of a business, it has, nevertheless, been an influence subconsciously at work. New markets, altered economic conditions, fierce competition have all been met as they arose, and have been given their due influence in shaping the policy to meet them. In fact, in all really live commercial undertakings there has been constantly at work a flow and interplay of ideas designed both to improve existing conditions, to combat harmful influences and to lay a sound foundation for future progress.

But it has recently been recognised that, important as this forethought is on the commercial side, it is still more important on the technical side, and that it is worth while spending large sums of money on the investigation into the possibilities of using new materials, new methods and new ideas, even though the money so expended may not be immediately productive. It is right to add that this has often been a hard-learned lesson, that it is only bitter experience that has shown the need for ever acquiring new knowledge, and that even now there are not lacking those who prefer to go on as they have been going on without reference to the necessity for fresh developments.

The growth of research associations shows how the new idea has taken root, and not only that, but that it is realised that such work can be more efficiently and economically done in co-operation by those who, normally rivals, are really co-workers in developing the same field.

The Remuneration of Knowledge.

Now, as we have shown above, research of this kind is undertaken with one object in view—an increase of knowledge not for its own sake, but in order that a particular undertaking may be developed, and so the well-being of all those connected with it increased. There is nothing derogatory in the idea, for, though there may be some who can, and do, work solely for work's sake, and though a percentage of this altruism is happily in the composition of us all, it is a fact that the possession of properly educated and enlightened self-interest is a necessary ingredient in the successful man, and may be used to the particular and the general benefit with no sacrifice of ideals.

Research—Practice and Politics.

These questions are, or should be, of more particular interest to the electrical industry than to many other of the commercial activities of the country, for, while like many other industries, we are faced with specific problems of manufacture and construction, these problems are more

closely related than in most other cases to pure science and mathematics, and on the other side to those economic and social questions which are politics in the best sense of the term. If there we can find the proper place which research should play in the development of industry we shall not only be solving our own problems, but providing an answer to a very much more general and important question.

The Qualities Required.

Such a problem demands the assistance of the best intellects of the country. It demands constructive ability, knowledge and grasp of affairs, keen perception of values and idealism—in a word, it requires all those qualities which are essential of successful leadership. These are the men who are required to conduct the research which is so necessary to the proper development of electrical engineering, but to do this they must be assured of a position which is at once the reward of good work and an incentive to still greater endeavour.

The Status of the Research Worker.

For reasons which we have outlined above, a status of this kind has, except in exceptional instances, not yet been conferred upon the research worker. Nor do we think it ever will be in quite the form that exists in the commercial world. The question of remuneration of research workers has recently been examined in this country, and a demand has been made that the worker should be directly compensated for the fruits of what he does in this way. The demand contains a fallacy unless it is equally demanded that no research worker should be paid until the research is successful—quite another and a much less popular proposition.

Research and Public Interest.

In this connection it is, we think, necessary first of all to establish that all research is in the public interest, and that ultimately its object is simply to increase the sum of human knowledge. This is not to say that a firm which through its research laboratory devises and develops a patentable invention is not entitled to the fruits of its enterprise. That it is so entitled is recognised in the patent law. But at the same time such an invention is of even more general than individual benefit. The firm may gain large sums of money for itself, but at the same time it will save even larger sums to the public.

This statement is equally true, however remote from practical application the invention may seem, for, as we have often pointed out, the division between the theoretical and practical fields of research is so shadowy and ill-defined that no one can say at what instant an abstract research may develop into an important practical application. In electrical industry there are, of course, many examples of this.

More and More Research.

These arguments all go to prove the need for more and ever more research conducted by the best minds in the industry, and directed, if it be thought essential, to the development of a particular firm. At the same time, the Universities must be assisted from the industry generally to carry out investigations into more fundamental matters, and to do so in the closest relation with the various industries concerned.

Such a policy it is obvious requires above everything money. Money to assist the Universities in the way we have described. Money to conduct private researches. Money to pay research workers. Money to put the results of the researches to the best use. But it will all be money well spent.

THE LONDON TOLL EXCHANGE.

Improving Telephone Communication in the Home Counties.

The shortcomings of the British telephone system and the alleged negligences of those responsible for its administration are made the subject of so much comment that it is quite a relief to turn to the brighter side of the picture and to chronicle a development which should do much to improve telephone communication, not only in London, but in the area immediately surrounding it. We do this with all the more pleasure as we have never been among those who found the Post Office wrong, whatever they did, and have always had much sympathy with the engineering department in their struggle with almost overwhelming difficulties.

Giving a "No-Delay" Service.

The particular development in question is a new exchange of a special kind. Until the middle of last month only those subscribers in the irregularly shaped London area who wished to speak to other subscribers in that area were given what is officially called a "no-delay" service, that is to say, the answering operator proceeded at once to put the call through. A subscriber wishing to speak to

Gerrard or City, not only causing delay, but increasing the congestion. This will no longer be necessary as these exchanges will all be connected to the Toll exchange, so that calls can be dealt with with a minimum of delay.

Much New Work Required.

This development has, of course, necessitated a large amount of new work as well as a rearrangement of existing methods. This applies particularly to the cable system, where to cope sufficiently quickly with the new traffic it has been necessary to put in hand six new main underground cables to provincial distributing points, so that each provincial exchange shall have direct communication with "Toll" over a sufficient number of circuits to render "no-delay" working possible.

Operating Details.

There are 600 circuits incoming at the Toll exchange from the local exchanges in the London area. These terminate on sixty

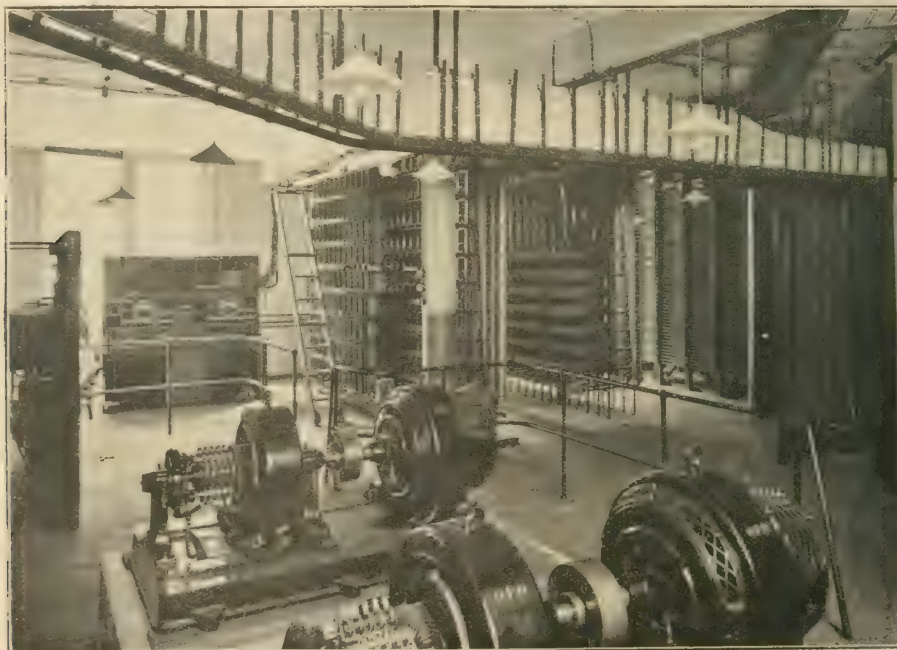


FIG. 1. APPEARANCE OF ROOM AND POWER PLANT AT THE LONDON TOLL EXCHANGE.

another subscriber outside the area, however short the distance might be, had to call up the trunk exchange and go through all the formula which is inseparable from the procedure of recording the calls there for completion in turn with others waiting. The Toll exchange alters this. All calls initiated within approximately twenty-five miles of London to other subscribers on any exchange in the same area will pass through the Toll exchange. This, of course, excludes purely local calls, which will continue to be dealt with as at present. The result is, as will be seen, that not only will the work on the trunk exchange (which still remains in operation for long distance calls) be lightened, but the traffic on certain of the larger London exchanges will be reduced. At the same time a better service will be given to subscribers who desire short

distance calls, "no-delay" calls as they are now called.

The reason for this is as follows:

How the Exchange Works.

Until recently a subscriber who wished to speak from a small exchange like Hendon to another small exchange like Rainham, had to be connected through one or more larger exchanges, e.g.,

positions called control positions. The term "control" means that the Toll exchange operator at a control position will be responsible for making out the tickets for the charges involved, and for supervising and clearing the lines on both sides. Lines outgoing to the provincial exchanges are multiplied once in every six panels throughout the Toll exchange. The junction lines outgoing to the London exchanges are also similarly multiplied. The total multiple capacity is 500 lines in each case. By means of the outgoing multiple to the London exchanges a control operator is able to complete a "delayed" call, that is to say a call which, for any reason e.g. excessive traffic over a particular route, has had to be dealt with as a "revertive" call on the ordinary trunk principle. In cases where there is delay on any particular route, incoming calls for that route are taken to a special position, where they are dealt with in turn.

The circuits coming into the Toll exchange from the provincial exchanges in the Toll area will terminate at special "incoming" positions, over which the outgoing Toll circuits as well as the junction circuits to the London exchange will be multiplied. It will thus be possible for calls between provincial exchanges in the Toll area



FIG. 2—GENERAL VIEW OF SWITCH ROOM WITH DESKS

to be completed through the Toll exchange, as well as calls incoming from provincial exchanges to London exchanges. These calls will be controlled in each case at the provincial exchange at which the call operates. The calls will be charged for periods of three minutes,

but no limit will be placed on the length of the call provided the general service is not interfered with.

A provincial subscriber desiring a long-distance trunk call will be connected through both the Toll and Trunk exchanges. In such

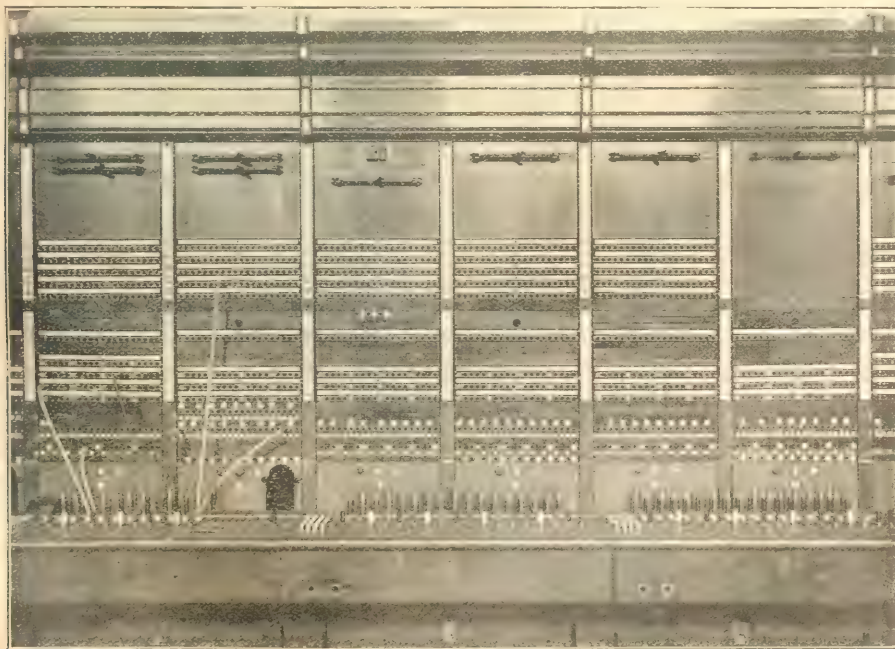


FIG. 3—THREE POSITIONS ON SWITCHBOARD, SHOWING CONCENTRATION SWITCHES.

a case trunk working will obtain. The Trunk exchange operator will record the call which will then become "revertive," being finally set up by the Trunk exchange over a junction line incoming at the Toll exchange from the Trunk exchange. Incoming trunk calls will be dealt with in the same way at three special positions in Toll exchange.

Traffic in the inner London area, *i.e.*, up to a distance of about ten miles from Charing Cross, will, of course, be unaffected by this change in working, except in so far as indirect, but none the less important, improvements in obtaining a quicker service result.

Technical Details.

The electrical equipment of the Toll exchange in general follows standard Post Office practice, with such modifications as are necessary owing to the peculiar working arrangements adopted. As will be gathered from what we have said above, the working of this exchange will differ from that of a Trunk exchange in that a minimum of clerical work will be required from the operators. On the other hand, it will differ from the ordinary local exchange in that there are no "A" positions, *i.e.*, no subscribers are directly connected

room, which contains two complete batteries, each with a capacity of 1 750 Ah at the 10-hour discharge rate for operating the exchange lamp, signals, and operators' telephones, and with an 8 V extension of 300 Ah capacity. This extension is necessary in order that a total voltage of 30 for signalling to the distant exchanges may be secured in the connecting cord circuits.

The Switchroom.

Turning to the switchroom—a general view of which is given in Fig. 2 and a close-up view of three positions on the switchboard in Fig. 3—it will be noticed that this is on two floors. The main board, which is on the lower floor, is of semicircular shape, and within the semicircle are contained, as will be seen in Fig. 2, accommodation for the monitors and supervisors' desks (*see* Fig. 4). The remaining portion of the switchboard can be seen on the extreme right of Fig. 2 in the gallery. The whole of this part of the exchange is lighted naturally from above during the day time, and is provided with the modern fittings of the Benjamin Electric Company's well-known make for use during the dark hours. A further electric fitting, as will be seen in the photograph, is the thirteen electric



FIG. 4. SECTION OF MONITOR'S DESK, AND GENERAL VIEW OF SWITCHBOARD.

to the exchange. The other modifications will appear from our description, but may be summarised in the statement that, for economy in traffic working, special methods have been taken to concentrate the lines on to a few positions during the less busy hours.

Power Plant.

The power plant for operating the exchange consists of two 13 H.P. Crompton motor generators, which are supplied from the City of London Electric Lighting Company's mains with direct current at 440 V. and deliver direct current at 22 to 30 V for operating the switchboard for the operators' instruments and for signalling to distant exchanges. These sets are controlled by a switchboard manufactured by the Park Royal Engineering Company.

As is usual, the cable racks are situated in the basement of the exchange, and here are also to be found the necessary fuses and lightning arresters, which are fitted to all incoming wires in accordance with standard practice. From these incoming cable racks connection is made through an intermediate frame to the outgoing junction and outgoing provincial multiples and to the incoming junction and provincial incoming terminations. A view of the motor generators with the control gear and the cable racks is shown in Fig. 1.

Adjacent to this power plant, also in the basement, is the battery

clocks, as accurate time is obviously of importance in a telephone exchange.

Exchange Positions.

Dealing in more detail with the positions on the switchboard, those numbered 1, 2 and 3 are the incoming plug-ended junctions connected to the London Trunk exchange for dealing with incoming distance calls. A diagram of these positions is shown in Fig. 5. These are, of course, used for dealing with calls from an exchange such as Manchester, the calls from which are still dealt with through the London Trunk exchange to a place like St. Albans, which is now in the Toll exchange area. The wiring of these positions is somewhat similar to that upon positions accommodating junction circuits incoming from the Trunk exchange at a standard C.B. exchange, but as the Toll exchange cord circuits do not provide for central battery speaking, it is possible to use comparatively high resistance (200 Ω) relays and retards for feeding the signalling current to the cord circuits (*see* Fig. 6).

The novel feature of the exchange is, however, to be found on positions 4 to 63, which accommodate the 600 incoming circuits from the London exchanges. These circuits terminate on jacks, ten per position. It is not practicable for more than ten to be dealt with by an operator at one of these positions on account of the fact that she has to act as the control operator, as already

mentioned. Groups of circuits incoming on these positions are concentrated at night time, or at times when the load is light, on positions 4 to 23. The concentration is effected by means of throw-over switches. These may be seen in the illustration (Fig. 3).

on the Toll positions Nos. 64 to 93. The concentration positions are Nos. 59 to 68.

The method of dealing with a call outgoing from a London exchange is somewhat different from the manner in which an out-

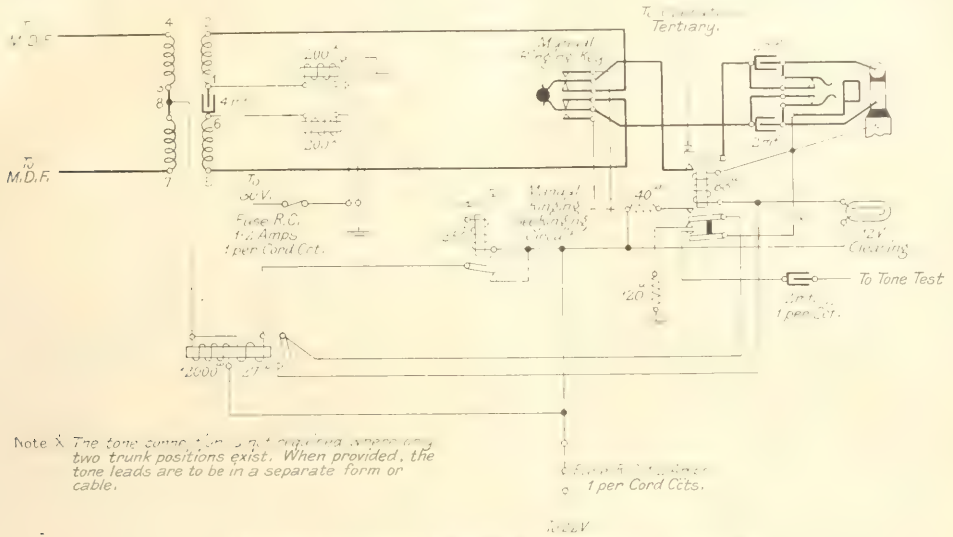


FIG. 5. DIAGRAM OF POSITION FOR DEALING WITH INCOMING TRUNK CALLS.

Duplicate jacks and lamps for the lines which are to be concentrated are fitted on the concentration positions. These are wired in parallel with the jacks and lamps on the ordinary day positions. The throwing over of the concentration switches on the ordinary and concentration positions transfers the lamp signal from the

going call from a provincial exchange is dealt with. Calls outgoing from a provincial exchange are controlled by the operators at the provincial exchange, but calls outgoing from London exchanges are controlled at the Toll exchange. In the case of a call outgoing from a provincial exchange, clearing signals from the distant

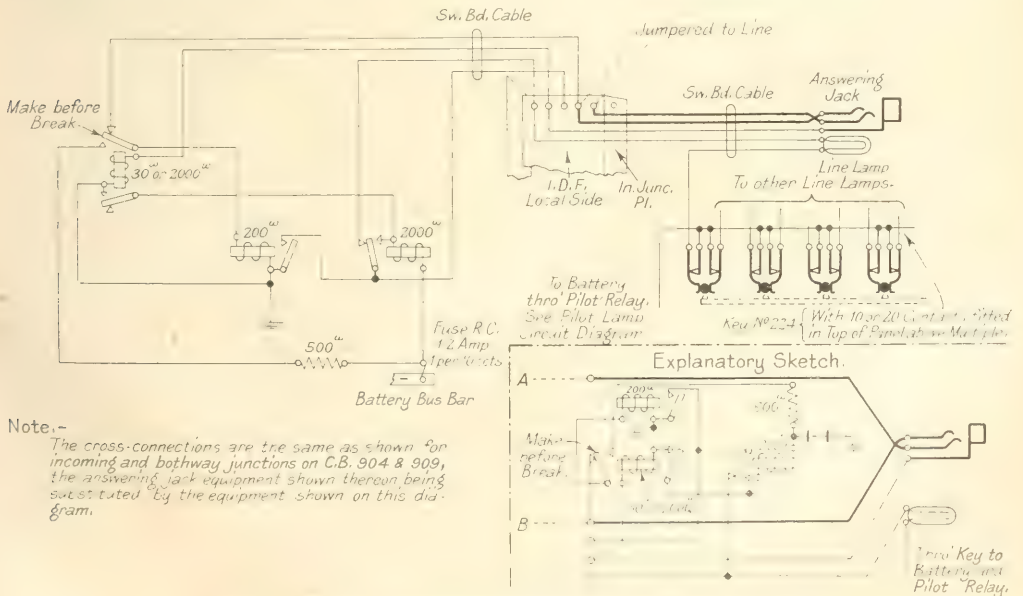


FIG. 6. DIAGRAM OF JACK CIRCUITS FROM INCOMING PROVINCIAL EXCHANGES.

normal position to the position on which the circuit is concentrated. Fig. 6 shows the wiring of the switches. Similar switches are provided for concentrating groups of lines incoming from the provincial Toll exchanges during the less busy hours of the day and at night time. These lines are accommodated for day working

subscriber are arranged to pass the Toll exchange and to appear at the originating exchange, but in the case of calls controlled at the Toll exchange, that is to say calls outgoing from the London exchanges, the clearing signals from the distant subscriber are received at the Toll exchange. A slightly varied arrangement of

apparatus is necessary on this account. This consists in the fitting of 30 O relays in the sleeve circuits of the terminating jacks in the case of circuits incoming from the London exchanges, and 2,000 O relays in the sleeve circuits of the terminating jacks in the case of circuits incoming from the provincial exchanges, as indicated in the illustration (Fig. 6). If a 30 O relay is placed in the sleeve circuit, an insensitive control relay in the cord circuit (Fig. 7) will operate, and the operation of this relay will prevent the clearing signal from the distant subscriber passing the Toll operator. If a 2,000 O sleeve relay be installed, however, its high resistance will prevent the insensitive control relay in the cord circuit from

estimated as about seven to eight years, when a permanent Toll exchange will be provided, to serve an extended area within a ten to sixty mile radius.

The general arrangements for trunk and junction traffic would then be: (a) Traffic to other exchanges within the ten mile area (exclusive of that dealt with over direct junctions) will circulate via the Tandem exchange; (b) traffic to exchanges outside the ten mile area, but within a sixty mile area, will circulate via the Toll exchange; (c) traffic to exchanges outside a radius of sixty miles will circulate via the Trunk exchange.

The difficulty experienced by the Post Office in obtaining supplies

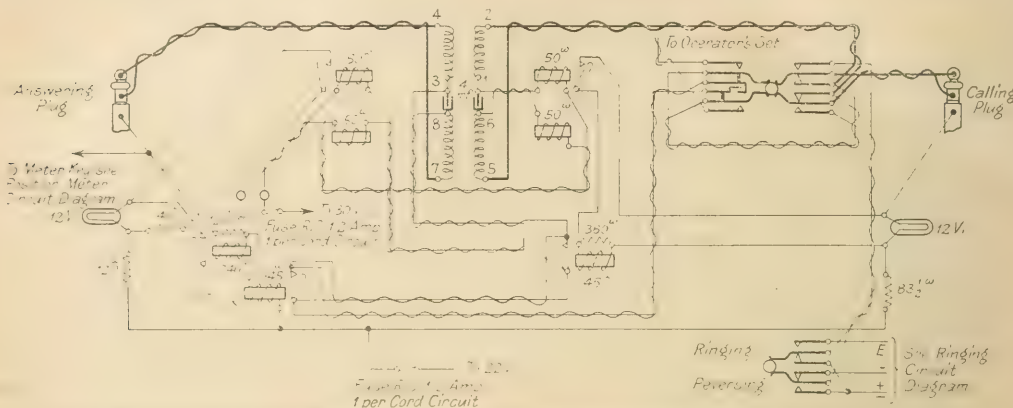


FIG. 7. DIAGRAM OF CORD RELAY CIRCUIT.

operating, and this will allow the clearing signal from the distant subscriber to pass the Toll exchange and to reach the originating exchange.

Group Testing for Disengaged Outgoing Junctions.

The means whereby a Toll exchange operator tests for a disengaged outgoing junction deserve attention. Manifestly, with large groups of lines, considerable time will be spent in finding a disengaged jack in the ordinary way. To obviate this, the junction jack strips are divided into groups of five, the first jack in a group being used solely as a testing jack. The bush of this jack is fitted with a metal peg having a concave head, and this affords a very convenient way of making the engaged test by connecting the tip of the plug to the concave surface of the metal peg. If an operator tests upon this metal peg and receives the click, she knows that the succeeding four jacks are all engaged, and at once makes a similar test upon the first jack of a second group. If now she does not receive the engaged click signal, she knows that there is at least one disengaged jack in that group of four, and tests individually until she finds it. By this means much time is saved. The whole of the exchange equipment was manufactured to Post Office designs by the Western Electric Company.

Future Policy.

As regards the future policy to be followed in handling telephone traffic other than that of a purely local character, it should be stated that the Toll exchange and the arrangements above described are regarded by the Post Office as being of a temporary character only.

It will be readily understood that the scheme could, with advantage, be made to include the greater London junction traffic. It has not, however, been possible to do this up to the present. Such a course would permit of economies being effected in the provision of line plant, since the traffic now dealt with on small groups of direct junction circuits between certain outlying exchanges could be concentrated in large groups connecting the Toll exchange and the outlying exchange.

The Tandem Exchange.

Further enquiry into the matter led to the following conclusions:

(1) That the through junction traffic for greater London could, with advantage, be dealt with at a separate exchange to be called the Tandem exchange.

(2) That the Tandem exchange should take, in addition to the London through junction traffic, the traffic incoming to the London ten mile circle from the more important provincial exchanges, including many of the exchanges in the present Toll area.

(3) That the present Toll scheme will be in use for a period of exchange equipment to relieve the congested post-war state of the telephone service is illustrated by the fact that the Toll exchange has just been opened, and is still not quite completed, although it is a small exchange of little more than 2,000 Toll and junction lines, and was ordered in the year 1919 from the largest firm of telephone equipment manufacturers in the world, the Western Electric Company.

More Electricity Inquiries.

AFTER an interval of three months the ELECTRICITY COMMISSIONERS will resume next month their inquiries into the organisation of electricity supply in the districts provisionally determined by them. Already five local inquiries have been held and in two cases decisions (West Lancashire and North Wales) have been given.

The next inquiry will be opened at Birmingham on the 15th prox., when the position in the South West Midlands will be investigated. A scheme has been submitted jointly by Birmingham Corporation and the Shropshire, Worcestershire, and Staffordshire Electric Power Company for effecting an improvement of the existing organisation for the supply of electricity in the district and for the formation of a Joint Committee. A preliminary scheme has also been submitted by the Corporation of Worcester for effecting an improvement of the existing organisation for the supply of electricity in the county and City of Worcester.

Representations or objections with regard to the schemes should be addressed to the Secretary, Electricity Commission, Gwydyr House, Whitehall, London, S.W. 1, not later than the 1st prox.

The inquiry in the NORTH EAST MIDLANDS ELECTRICITY DISTRICT will be held at the Town Hall, Sheffield, on the 29th November and following days, into a scheme which has been submitted by the Corporation of Sheffield for improving the existing organisation for the supply of electricity in the district and for the formation of a Joint Electricity Authority. There is a good deal of opposition by interested local authorities. Though Sheffield Corporation is the only authority which has submitted a definite scheme, the Yorkshire Electric Power Company, part of whose area of supply is within the district, have made representations in regard to their position as they did in the case of the Aire and Calder (West Riding) District. If the Sheffield proposals be accepted, the area will comprise part of Derbyshire (including Chesterfield, Baxton, Bakewell, &c.); part of Lincolnshire (including Barton-on-Humber, Brigg, Crowle, Gainsborough, &c.); part of Nottinghamshire (including Retford and Worksop); and part of Yorkshire (including Sheffield, Rotherham, Doncaster, &c.).

Interference with Communication Circuits.

In the electrification of a railway one of the chief problems is the determination of the measures necessary for preventing, as cheaply as possible, intolerable interference with communication circuits. Consequently the Austrian State Railway and Telegraph Administrations took up this matter at an early date, and as soon as certain schemes began to mature undertook to carry out a series of experiments on the Mittenwald Railway. These were carried out in 1914 and 1919, in conjunction with certain firms.

How a Power Affects a Communication Circuit.

A communication circuit can be disturbed by a power circuit in three ways; by electrostatic induction, by electromagnetic induction, and by conduction currents. Electrostatic interference is generally produced by high-tension lines only, and may become very unpleasant even in telephones with metallic (i.e., two-wire) circuits. Most telephonic disturbances are therefore due to this cause. Metallic telegraph circuits are almost insensible to this influence.

Interference due to electromagnetic induction on the other hand is produced mainly in all communication circuits with earth return which run along the track. Here the troubles may also be produced by low-tension power circuits, and they are particularly prominent where the earth is used as return for the power current. Since most telegraph circuits still use earth returns, most disturbances produced in telegraphs by alternating-current railways belong to this group.

The Genesis of Conduction Currents.

Conduction currents may arise either from the power line itself or from the earth current. Disturbances from this cause usually occur in conjunction with disturbances from electrostatic or electromagnetic induction, and can generally be easily avoided by taking a certain amount of care.

The investigations on the Mittenwald Railway, described in this article, dealt mainly with the two groups of interference caused by electrostatic and electro-magnetic induction. For the experiments, a double-wire line was hung on the posts supporting the overhead conductor along the section Leithen-Reith-Seefeld, 5.6 km. in length. In this section the 50,000 V transmission lines were supported by the same poles. The two experimental wires were 4 m. above the rail-head, and were crossed every 150 m. In addition observations were also made on the service telephone conductor of the railway, on one of the State telegraph lines from Innsbruck to Scharnitz, and on a railway telegraph cable, 1.94 km. long, laid along the track.

Electrostatic Effects.

The electrostatic effects were naturally the most pronounced in the experimental line. With a pressure of 17,000 V in the overhead conductor and the transmission line cut out of circuit, the charging pressure in the experimental line to earth was 3,350 V. On earthing one of the experimental wires the pressure in the other sank to two-thirds of this value. The effect of the 50,000 V transmission line, which was 8 m. above the rail-head and immediately over the experimental line, was relatively small, and induced a charging pressure of only 335 V. The pressure, however, rose rapidly when the balance in the transmission line was disturbed. For instance, earthing a phase of the transmission line raised the charging pressure in the experimental line to 1,650 V; cutting out a phase raised the pressure to 2,550 V.

The Effect of Earthing.

If a communication circuit subjected to electrostatic influence is earthed, a capacity current $i = 2\pi fCV$ will flow from it to earth, where f = frequency, C = capacity of communication circuit to earth, and V = charging pressure in the insulated communication circuit. In one wire of the experimental line Reith-Seefeld, this current reached a maximum of 8.5 mA when the other wire was insulated, and 6.5 mA when it was earthed. The current is independent of the earth resistance, when this is small compared with $1/(2\pi fC)$. Much higher currents, up to 140 mA, were measured when the line was earthed through a spark gap. Oscillograms showed that during one cycle of the pressure in the power circuit several discharges occurred, the number depending on the ignition pressure across the gap. The large current in the spark discharge is due to the fact that a strong charge becomes possible, if the earth resistance is small, because before each discharge the pressure must rise to the ignition pressure. On the contrary, earthing direct through a low resistance keeps the charging pressure about zero, so that a large charge cannot collect and consequently only a small current can flow.

Distortion of the Current Curve.

The charging pressure in the insulated line has a similar shape to that in the power line; on the other hand, with direct earthing, the

capacity current is proportional to the frequency (see the above formula), so that the harmonics are correspondingly more pronounced than in the pressure, and the current curve becomes very distorted compared with the pressure curve. Oscillograms revealed a strong eleventh harmonic in the capacity current in the experimental line, and the peaked shape remained unaltered so long as the power line was unloaded. As soon, however, as a train passed over the section, a harmonic, corresponding to the speed and the number of slots in the motors, was superposed on the current curve, which at times made the original shape unrecognisable. Usually there were about 80 ripples per cycle, thus yielding (with a fundamental frequency of 15) a frequency of about 1,200 cycles per second—the most sensitive region of the telephone.

Double-Wire Circuit Essential.

In the present stage of developments, a communication circuit near to a high-pressure circuit must unquestionably be a double-wire circuit. In such a circuit the charging pressure can either be left at its full value, in which case—if this exceeds a certain magnitude—the communication circuits must be erected according to the same rules as high-tension circuits, or it can be reduced by suitable means. Both possibilities were experimented with. With the full charging pressure in the communication circuit, satisfactory results were obtained with both telephones and telegraphs. The telephone service, however, was very sensitive to insulation failures. As devices for reducing the charging pressure, good results were obtained with earthing resistances, condensers and earthing coils. It was found that ordinary telephone, telegraph and block apparatus could be used without trouble in the communication line when the pressure was thus reduced. An earth in the line obviously rendered speech through the telephones impossible. When the pressure is removed from the installation by any of these earthing devices, all such apparatus must be balanced to prevent capacity currents flowing. In the experimental line Leithen Reith-Seefeld, if the telephone at the middle station Reith was connected in series with a branch line and the installation in Leithen had an earthing coil, then the interference current in Reith was so large that the telephone bell would ring without the receiver being removed. On the other hand, if the equipment was in perfect order, the oscillograph would not show any interference current in the balanced apparatus, particularly when earthing resistances or coils were used.

Disturbances Due to Electromagnetic Induction.

Disturbances due to electromagnetic induction can be rather easily overcome with metallic communication circuits. By carefully crossing the two wires the induced pressures are neutralised. Apparently good results were also obtained by displacing the wires so that their plane was in the direction of the lines of force.

The inductive effect of a power circuit with earth return on a communication circuit with earth return was very great, and even such cables were not exempt. The effect increases with the amount of the current which flows through earth. In an alternating-current railway, usually 40 to 60 per cent. of the current flows in the rails and the rest through earth. Accordingly telegraph lines with earth return and anywhere near the railway were usually affected, though in some cases the effect was too mild to be disturbing.

Measurements of Electromagnetic Effects.

Several measurements of electromagnetic effects were taken with a steady short-circuit current of 48 A in the overhead line. In the conductor (earthed at both ends) of a cable 1.94 km. long—between Innsbruck West Station and Hötting—an induced pressure of about 6 V was measured, in which the pressure drop in the Innsbruck earth was included. In the 3.6 km. experimental line Reith-Seefeld, a pressure of 27 V was measured in a wire earthed at both ends, which includes the pressure drops at the earthed points. Further, the inductive effect was measured in the State telegraph line from Innsbruck to Scharnitz—33 km.—with a current of 48 A in 3.6 km. of the overhead conductor, and nothing in the remainder. The current with the telegraph line earthed at Innsbruck and Scharnitz was 7 mA. The telegraph wire was 8 to 100 m. away from the power line, and a direct influence on the earths was therefore out of the question. When the overhead conductor between Innsbruck and Reith carried 48 A, the current in the telegraph wire remained 7 mA; but when earthed at Innsbruck and Reith the current rose to 16 mA, and the Morse apparatus could no longer be used. The oscillogram of the induced current was a pure sine wave.

In every case the numerous measurements agreed very well with calculations.

The experiments proved that metallic (two-wire) circuits in cables form the best protection, but in many cases other solutions are quite satisfactory. The remedies to be used depend on local conditions. The experiments have revealed the manifold difficulties which have to be taken into account and have assisted in developing ways and means to overcome them.

* From a lecture by L. Truxa, reported in *Zeitschrift des Österr. Ingenieur- und Architekten Vereines*, vol. 73, p. 149.

The Regulation of Electric Steel Arc Furnaces Using Movable Electrodes.

B. W. G. MYLUS.

The regulator which has been chiefly used for electric furnaces hitherto is the well-known "Step-by-Step" regulator, due to Thury. The objection to this type of regulator is that it is necessarily slow. Other types have the general disadvantage that they are liable to overshoot the mark and therefore to be subject to hunting. The regulator here described is rapid in its action, and, at the same time, is so designed that hunting is eliminated.

The Principle of the Regulator.

The principle of the present regulator, which is now being placed on the market, will be understood by reference to Figs. 1 and 2. The two sets of contacts 3 and 4 (Fig. 1) control the electrode operating motors through the medium of magnetically operated contactors, which are mounted on the regulator panel. Assuming that the furnace is about to be started, an inspection of Fig. 1 will show that neither of the solenoids on the main control element V or A will be energised while the main circuit-breaker on the high voltage side of the transformer is open. Under these conditions the two springs 1 and 2 will hold the lever in a horizontal position, maintaining contacts 3 and 4 open. On closing the main breaker a potential will

to open. If during the time that the contactor was closed the motor has not moved the electrode a sufficient distance to adjust the current to the value for which the regulator is set, the pull of coil A will still overbalance that of coil B, and the "raise" contactor will again close contact 4. A vibrating condition will thus be set up between the control element and the contactor. If the current per phase is more than approximately 15 per cent. on either side of its normal value, the change in pull on short-circuiting a part of the winding on coil A by the auxiliary contacts will be insufficient to allow the core to drop. The contactor will therefore remain closed and the electrode motor will operate continuously in a direction to compensate for the abnormal current. As soon as the current reaches to within approximately 15 per cent. of its normal value the change in the pull on the solenoid A when the auxiliary contact 5 closes is sufficient to allow the core to drop out and to bring the lever to its horizontal position. Between this 15 per cent. point and the normal value of the current the regulator assumes a vibrating condition, and the motors are subjected to a series of impulses, the average time the motor is connected to the circuit being a function of the amount the furnace current deviates at any particular instant from its normal value.

Stages of Operation.

There are two distinct stages, therefore, in the operation of the regulator, one being the continuously-running stage and the other the vibrating stage. The vibrating feature permits the motors to operate at a high speed until the current in the electrode has been brought back to within 15 per cent. of normal (approximately), when the speed is gradually reduced to zero. High speed and freedom from over-shooting are thus obtained.

This feature is of great importance, since with previous types of regulators, especially with the elementary contact-making ammeter type, there exists a zone of considerable extent within which the regulator will not respond. This great lack of sensitiveness in a regulator, together with the congested ammeter scale on low power, makes it so difficult to balance the currents accurately in the several electrodes that it is quite possible for an electrode to get down into the bath and give carbon to the metal without the knowledge of the melter, when the furnace is being run on low power awaiting the result of a test.

With the voltage element, as embodied in the new regulator, it is impossible for an electrode to run down into the bath, even if the current in the other electrodes fail. For example, if the electrodes are all withdrawn by hand control and one electrode is put on automatic control, it will descend only until the electrode makes contact with the bath.

The voltage element in the control of each electrode makes each regulator independent of the others. For instance, in a three-phase furnace, operating with balanced currents in the electrodes, one electrode may be withdrawn without disturbing

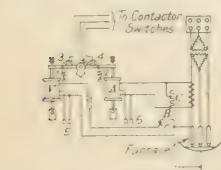


FIG. 1. DIAGRAM OF CONTROL ELEMENT CIRCUIT.

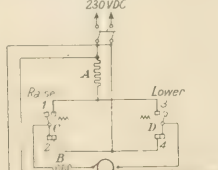


FIG. 2. DIAGRAM OF ELECTRODE MOTOR CIRCUIT.

be immediately created between each electrode and the shell of the furnace. Voltage coil V is now energised and pulls up on its core, closing contact 3, and operating the electrode motor in a direction to lower the electrode continuously and at full speed until it makes contact with the bath. As the voltage coil is connected between the electrode and the furnace shell, its current will be shunted and it will become de-energised the instant the electrode makes contact with the steel, thus allowing the lever of the main control element to return to its horizontal position and open the motor circuit. As no alternating current can exist in any electrode until two or more are in contact with the bath, current coil A will not be energised until one of the other electrodes is lowered a sufficient distance to strike the bath. As soon as the circuit is completed, current coil A becomes energised. Contact A is thereby closed, which causes the electrode motor to raise the electrode, thus drawing an arc to the bath. The sequence of operations is similar for the remaining electrodes. The motor continues to raise the electrode until the voltage between it and the bath increases and its current decreases to such an extent that the pull of coil A is equivalent to that of coil V. The lever will then assume a horizontal position, opening the motor circuit. Any disturbance of the equilibrium between the pull of coils A and V due to the variations in the current will cause either contact 3 or 4 to close, thus operating the electrode in a direction to compensate for the disturbance.

The current-adjusting rheostat C is connected across the current transformer, and by changing its position the value of the current per phase for a given current in the current coil of the element can be altered at will within the limits of the apparatus. This current can be varied approximately 20 per cent. of the normal value.

Auxiliary Contacts.

Auxiliary contacts 5 and 6 are mechanically attached to, but insulated from, the magnetically-operated contactors which control the electrode motors. Contact 5 closes when the "lower" contactor closes, and contact 6 closes when the "raise" contactor operates. These contacts, therefore, shunt respectively a part of coils A and V, and after the lever has been moved in a direction to operate the "raise" contactor, the corresponding auxiliary contact will close, thus shunting a part of coil A and tending to restore the lever to its horizontal position. If the change in pull is sufficient to allow the lever to operate, its contacts will separate and allow the contactor

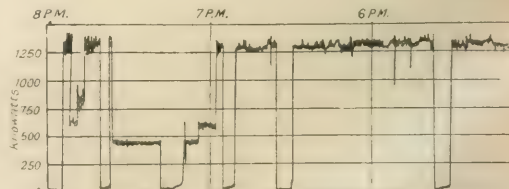


FIG. 3. POWER CONSUMPTION CURVE OF SIX-TON HÉROULT FURNACE, CONTROLLED BY NEW TYPE OF REGULATOR.

the equilibrium of the other two. With simple current regulators any change of current in one electrode disturbs both the other regulators.

The voltage element also serves as a no-volt release. The control element is mechanically balanced with all power off, so that both main contacts are open; hence, if the power fails, the control levers instantly come to equilibrium between the main contacts, all contactors drop out, and the electrode motors stop. No other no-voltage release feature is necessary.

Fig. 2 is a diagram of one electrode motor circuit. The working of the regulator may be judged from Fig. 3, which is a typical curve taken with a direct-acting recording wattmeter on a six-ton Héroult furnace melting cold scrap. It will be seen that there is a noteworthy absence of high current peaks.

Correspondence.

THE ETHICS OF MUNICIPAL WIRING.

To the Editor of THE ELECTRICIAN.

SIR: As one of the London municipal electrical engineers who has had the problem of the best method of dealing with the wiring of consumers' premises in all its aspects before me for the past eighteen years, I am of opinion that the conclusions which you arrive at in regard to municipal wiring, on page 432 of your special issue of Oct. 7, 1921, are not only illogical, but against the best interests of the electrical industry.

The article states: "It is not equitable for a local authority to enter into direct competition with its own ratepayers." If this is an established axiom, then it may be argued that local authorities in London should not own electricity supply undertakings, for the simple reason that they are in competition with the gas companies, who, in every instance, are most substantial ratepayers.

If your views are generally supported, then, in my opinion, you would hamper the development of municipal electricity supply by not allowing the same freedom of action which all the up-to-date gas companies have found it necessary to possess, i.e., to be in a position to deal with every phase of the gas supply, or, in other words, to manage their business in a businesslike way.

In the early years any ironmonger was good enough to be a gas-fitter, but now all gas companies managed on business lines do not place the work with contractors; they carry it out themselves—in my opinion, the only proper and logical course to take.

Generation of electricity cannot make headway unless the distribution is sound, and neither is of any use unless the installation section is efficient. If the "installation section" (the outlet of all undertakings) is not efficiently and thoroughly carried out, the gas interests make headway.

My experience for many years past has convinced me that no installation contractor, unless he works with side-lines, can put in installations on a reasonable margin of profit and maintain his overhead charges.

The statement that municipal officials, generally speaking, only take up this work to avoid absolute stagnation is again, in my opinion, a libel on the municipal engineers, who have had to fight so hard in regard to the development of supply, harassed, as they are, with difficulties in raising capital owing to short loan periods, coupled with high prices of materials.

It is stated in another section of the article that "it is to the credit of the great majority of borough electrical engineers that they are not in favour of engaging in this kind of business," and if this be the criterion, then the municipal engineers are wanting in their duties. I view it as my duty to develop the electricity supply industry in every possible manner, and the best aid to development is to treat the installation section of an undertaking as a vital adjunct.

I am in agreement with your article that installation work must be organised on business lines, but my own experience is that the stability of a public electricity supply undertaking is infinitely more sound if every phase of development is dealt with by the supply authority, who cannot have any interests in common with private installation contractors, a great many of whom are limited in their scope for lack of capital.

In the past we have been compelled to employ special officials to check the crude workmanship of the installation contractor, who has generally finally disappeared, leaving a record of high charges and dissatisfied customers behind him.

Sir, I would remind you that the very fine organisation of the gas companies can only be reasonably held, and the electricity industry develop, when the opposing supply authorities are enabled to meet on identical conditions of operation, with full freedom of development.

To follow the advice given in your article would be

disastrous to the industry, and clearly the line of action which the gas companies wisely scrapped years ago is one which every electricity supply industry should follow. If it wishes to develop it must be organised to handle any kind of house or factory equipment, and the best assistance and co-operation should exist between them and the manufacturers, who might leave much of the sales work to the supply authority, and devote their attention to supplying apparatus which can hold its own as a commercial proposition with our opponents.

If you can put me on to any firm who will supply me with electric cookers for hiring at 2s. 6d. per quarter, with practically no maintenance costs, which our gas friends will do, it will not be necessary to find a scapegoat in municipal wiring, you will be too busy in recording the huge expansion of sales of energy as a result of open and fair competition. I am, &c.,

G. W. KEATS, Borough Electrical Engineer.
Woolwich, Oct. 12.

THE "PENNY" FARE.

To the Editor of THE ELECTRICIAN.

SIR: In your editorial comment upon the recent proceedings of The Municipal Tramways Association you refer to my proposal that the token value of the penny should be increased. It would appear that you have assumed that this suggestion is put forward merely as a device to extort higher fares, whereas my intention is to provide facilities for a reduction of 20 per cent. from the existing 1½d. fare (which is the minimum charge on over forty undertakings) to the suggested new value of the penny, viz., one-tenth of the shilling.

According to the Press, the L.C.C. trams are now carrying about one million fewer passengers per week, and the Liverpool undertaking has lost thirty-six million passengers in a few months. This lost traffic can only be regained by the adoption of lower fares, and, as the management obviously cannot restore the original penny fare, they should be given the opportunity of charging a "penny," which, while covering their cost in many cases, would represent a very substantial concession to the passenger.

Mr. McElroy truly said that tram fares are inevitably fixed by the token values of the copper coins, and it is unreasonable to expect that the representatives of the £60 000 000 now invested in our Municipal Tramways will be content to allow their capital to remain unremunerative by reason of the unavoidable reduction in the purchasing power of their essential coins.

I believe the position in the tramway industry is symptomatic of the difficulties confronting every other penny-basis industry, and that the national adoption of the high-value penny would prove a boon to buyer and seller alike.

The high-value penny would speedily restore the "penny" post and the highly convenient single-coin payments for countless items of daily expenditure. The alternative appears to be the payment of a multiple of copper coins involving higher prices and endless giving of change. I am, &c.,

HARRY ALLCOCK.

Manchester, Oct. 17.

Stoke Electricity Extensions.

The Corporation of Stoke-on-Trent, have approved the plan for the proposed extension of plant at the HASTLEY power house at an estimated cost of £200,000, and the Electricity Commissioners have been asked to sanction the application for a loan as soon as possible. The whole of the site adjacent to the power house will be allocated for electricity purposes.

The scheme for the reorganisation of electricity supply in the North-West Midlands has been deposited with the Electricity Commissioners, and a meeting of the General Committee of the Joint Conference of Authorities and Undertakers has been called to consider the preparation of the case for the local inquiry. Stoke Council have, however, resolved that any scheme for the formation of a Joint Electricity Authority will only be agreed to, provided that the terms upon which the generating stations are to be transferred from the Corporation to the Joint Electricity Authority are acceptable, that the existing stations be extended and developed to their fullest effective capacity before a capital station or stations be constructed, and that such scheme include the modifications suggested by the Borough Treasurer and Electrical Engineer.

The Capitalistic System.

By E. J. P. Benn, C.B.E.

(Continued from page 498.)

Profits and Profit-seeking.

Most of the eloquence that is directed against the Capitalistic System centres round the question of profits. In considering this point it is necessary that we must go back to the period of the war. No argument about economic conditions can be based upon any experience acquired during the years of the war. We must also remember, if our memories are long enough—for the public memory as a whole is lamentably short—that before the war there was such danger of profits disappearing altogether, profits were so hard to get and so scarce, that the most popular movement of the day, among both employers and employed, was a movement known by the name of Price Maintenance, designed to save that little bit of profit which was then universally recognised as the only way of keeping industry in being.

Let us go a little deeper into this matter of profit and consider what it is and how it arises. Let us build up an imaginary case, a simple case and a bad case. Imagine, if you will, a number of men digging a hole to extract, say, coal from the bottom, laboriously carrying that coal up to the top and eking out some sort of existence in that arduous way; when I, a rapacious, objectionable, shameless profiteer come along with a rope and a pulley and I say to these men, "Now, if you will use this rope and this pulley you can haul up ten times the amount of coal from the bottom of that hole for the same effort that you were exerting before." That seems a good proposition. I further say, being this horrible profiteer, "but if you use this pulley and rope you must give me one basket in ten of the coal that comes to the top." Having made that bargain, I go to sleep at the top of the hole, as a profiteer would, and the men proceed to haul up for themselves nine times the product that they were previously getting, while I, being asleep, have all the time piling up by my side a heap of wealth which under that iniquitous bargain is mine. Now that is a pretty bad case of a profiteer, about as crude and immoral as I think, perhaps, it is possible to construct. But let us face the facts. Every civilised country in the world has found such an urgent need for pulleys and ropes that it has gone out of its way to invent legislation and say to us all, "If you will produce a pulley and a rope we will give you Letters Patent and so many years during which you can exploit this pulley and rope to your heart's content." And that has been done by democratic governments guided by all the wisdom that we collectively possess. And at the end of it we are woefully short of pulleys and ropes and earnestly praying for more people to be willing to go through the effort of producing pulleys and ropes which will help us to get along.

You will say, "Oh, it really is too absurd for words!" But I doubt it. Personally, I am firmly convinced that the genius who first had the temerity to suggest that a bit of rope over a round thing called a pulley would work was either burned at the stake or put in prison for life on account of communication with the Evil One. This objection to profits arises from that human weakness known as envy, malice and hatred. That is my conclusion. I shall be asked, "What about the Trusts?" I venture to say no such thing as a Trust ever existed. No business man as yet that I know of has been able to discover the thing which we mean when we speak of a Trust. The nearest approach to a Trust which has yet been developed is undoubtedly the Labour Movement as we know it to-day. When you get an artisan class organised 100 per cent., and able to dictate absolutely the terms upon which they will perform their service, that is as near as we have ever yet attained to a Trust. But it is not a Trust; it exists, like the whole Capitalistic System, upon public opinion. Those men are only able to extort those terms because public opinion as a whole accepts them, and the moment public opinion takes the view that those terms are not to be allowed, then the men themselves will come out of the Trust, or if they won't another set of men will take their places.

Profits lead us to the question of incentive. We are continually told that it is a horrible idea that we should depend upon the incentive of greed, which according to the wonderful orators who are going to abolish the system is the leading force behind industry and trade. That is a very low view of the human race. But is it really greed that makes it necessary for us to have profits? I, in my wisdom, think I would like an apple. I have seen an apple and tasted an apple and it occurs to me that it would be a good idea if I could get an apple. I inquire into it and find that in order to get an apple it will be necessary to dig a hole, to plant a tree, to graft and prune and manure and water for perhaps a couple of seasons, at the end of which time, if I am lucky, I may get a nice apple. Well, we will assume that acting from this base motive of greed I determine to go through that process, and at the end of the time I secure an apple. It is perfectly certain the apple will be

somewhat below my expectations, but still, I have got it. At that stage there comes along a neighbour who says, "Oh, look here, I have the right to maintenance; half that apple is mine." Being a good, charitable, easy-going sort of chap, I say, "Very well, you haven't got an apple; I have; here's half of it." So far so good; the story is working extremely well. But then arises the question of another apple. Now two years ago I was in two minds as to whether it was worth while to bother with the apple at all; when I got it I was certainly doubtful as to whether the thing was worth the trouble; at any rate, it was not as good as I thought it would be, and now I only get half. I say at once, "The next apple the other chap can grow! It certainly is not worth while for half." My neighbour presumably takes the course he did before and leaves it to me, and there is no second apple.

That little apple story, I submit, is literally true, and has actually happened within the last few years in Russia. It will happen here, is happening to some extent here, and will happen to an ever increasing extent so long as we go on tilting at the natural order of things, which is called the Capitalistic System.

Elements Essential to Success.

There are four elements which are essential to success in industrial matters, four elements which are inseparable one from the other, and which must always go together. They are: high profits, high wages, high production, and low prices. These four things you will, I believe, find in every instance where you can point to a conspicuous or a real industrial success. In a free market the profit is the cheapest of the items that go to make up the cost of an article. Profits may be defined as a commission on economy. No form of control yet discovered has proved half as economical as the most rapacious profiteer. Profit might be defined as the reward of service gladly given of its own free will by a satisfied public to those who have rendered it the best service.

(To be continued.)

Association of Mining Electrical Engineers.

At the recent annual meeting of the ASSOCIATION OF MINING ELECTRICAL ENGINEERS, which was held at Newcastle-on-Tyne, the following officers were elected for the ensuing session: President, Mr. A. B. Muirhead; Vice-Presidents, Mr. C. B. Baw and Mr. W. T. Anderson; and Honorary Treasurer, Mr. Alexander Anderson.

Presidential Address.

In the course of his presidential address Mr. A. B. MUIRHEAD first of all defined the position of the Association as being of first importance in the realm of mining, and made it clear that it was the duty of the members of the Association to decide what apparatus was suitable or otherwise for use, as there could be no standard method of procedure, owing to the wide variations in the characteristics of mines.

It was unfortunate that electrical engineers and mining officials had to contend with much interference and ill-informed criticism from inside sources, of which the Miners' Federation and the Home Office Inspectors for Safety in Mines were chiefly responsible.

They gathered, for instance, from the Miners' Federation (the authorised voice of Labour) that the inevitable reduction in wages which brought about the strike of last year was not due to economic laws, but was caused by inefficient management and the failure to make use of plant and machinery for the proper development of the mines. No foundation could be found for this charge, because since 1904 there had been a steady increase in the amount of electrical plant installed, and in use, in mines. This installation of plant was checked by the demands for nationalisation, but there was sufficient plant in use in the mines in November, 1920, after last year's strike, to permit of outputs being attained which were a record since 1914.

The Home Office as an Obstacle.

With regard to the Home Office, while it might be freely admitted that the efforts of that office were constructive in intention and had resulted in increased reliability and safety, he complained that the inspectors were too ready to dictate as to what plant might or might not be used. The colliery officials were not averse to guidance and suggestions from the Home Office, but naturally resented criticism which was based upon an assumption of superior knowledge which was not substantiated by the training of the average inspector. There was naturally an objection to the tendency to dictate and pronounce, with an air of final judgment, a decision on a matter which could only be a question of opinion. The Home Office regulations applied equally to all mines, and as there were no two mines alike it was obvious that the regulations must be taken as applying very generally.

The colliery owners and officials were both anxious that all operations should be carried on with a maximum of safety, to reduce the dangers to life to the lowest possible level, to raise the conditions of work to the highest possible level, and to increase the remuneration to the maximum which the industry could stand. There was a long way to go before all these objects could be achieved.

* Address delivered before the Industrial League and Council, at Aston Hall, Westminster, on Wednesday, Oct. 5, 1921.

No More Kinked Cables.

By the courtesy of the MIDLAND TRADING (NOTTINGHAM) COMPANY, Ltd., we were recently afforded an opportunity of inspecting a special reel for the taking in and paying out cables in workshops.

It is common knowledge that in many workshops, garages, &c., cases occur when it is desirable to bring a light to a particular spot, or to use a portable tool, such as a small drill. However well equipped, electrically, a shop may be, the need for such local assistance cannot always be avoided. Accordingly it is usual to provide plugs, to which flexible cables supplying light or power can be attached.

This practice has certain drawbacks. It is inadvisable to allow lengths of cable to trail over the floor. They may easily be ruptured, and are not always removed as soon as the work is done. Moreover, with such improvised methods, proper safeguards against shock may be neglected.

In the device now introduced by the Midland Trading Company 25 ft. of specially insulated flexible cable, very strongly protected and capable of carrying up to 40 A., are provided. This length of cable is wound on a compact metal drum, which can be conveniently installed on a wall or a low ceiling. The drum has two directions of rotation, the ordinary motion round a horizontal axis necessary for paying out the cable, and also rotation of the reel as a whole about a vertical axis through its support. The latter motion involves a sliding ring-contact, which is, however, the only contact employed, and even this is very carefully designed and insulated. The method of leading in the wires and carrying them to the correct points on the drum can only be properly explained with the various working parts of the drum to demonstrate with, but it may be mentioned that at each stage the two live wires are carefully insulated with ebonite, and finally terminate on two connectors on the drum, to which the flexible cable is attached. The flexible cable is easily removable for renewal, and the permanent wiring should hardly ever need attention.

Protection Against Shock.

A feature of special interest is the full protection afforded against shock through possible leakage. The metal surface of the drum is securely earthed, and there is attached to it a third earthing wire, which passes, in company with the two live wires, the full length of the flexible cable. This earthing wire emerges at the extremity of the cable, and is attached to the metal holder. Thus both this holder, and any metal protector or reflector used with a lamp, is in permanent connection with the earthed metal work of the reel. If tools or other metal apparatus are used these are also earthed.

The cable, when paid out, is retained taut by an ingenious ratchet device, and is readily restored to the reel when no longer required. All parts used on these reels are standardised and interchangeable. Some slight degree of lubrication is desirable for the bearings of the vertical axis, round which the reel is free to move, but this is attended to on assembly. No further lubrication of this or any other part is considered necessary once the reel is installed.

Apart from the convenience and tidiness of the device it is claimed that it may often effect a considerable economy in the number of outlets in a shop, as a single reel can cover a considerable area, and if necessary a number of reels can be fed from a single outlet.

B.E.D.A. Literature.

The latest batch of publicity matter from the BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION may be divided into two classes, literary and pictorial. Among the former we note that soul-stirring drama, the "Awakening of Peterkin," to which we have already referred, and the beginning of what we hope is a series of no less dramatic scenes in Suburbia which attract by their treatment no less than by their subject matter. Some of these literary efforts are illustrated, and the "Beginning of a Perfect Day" may be taken as an example of this class. In the sterner stuff are some

notes on the exhibits at the Hereford Agricultural Show by Mr. R. Borlase Matthews, and the "Power Behind the Worker"; while figures that give one to think deal with domestic electricity supply in Norway. The pictorial representations are as good as usual, and include blotters, book marks, and leaflets of the more ordinary kind. After this display of attractiveness no electrical man whatever his walk of life need complain that there is any lack of publicity literature. In fact, that is what all this stuff is for, not merely to look at and praise, but to use; and it can always be given a local flavour by suitable over-printing. Mr. Beauchamp will be pleased to receive orders or inquiries—preferably the former—for large quantities of any of these "stunts" that catch the eye.

Heating and Cooking Sales Campaign.

In order to popularise electricity for heating and cooking and to stimulate the demand for their well-known "Magnet" Heating and cooking appliances, the GENERAL ELECTRIC COMPANY, LTD., have inaugurated a vigorous campaign in which they invite the co-operation of their trade customers. Although extensive general advertising is included in the plan, the main effort will be expended in intensive publicity in order to drive home to the public the many advantages of the "ALL-ELECTRIC" house. Realising that the average re-seller cannot usually afford to indulge in elaborate local propaganda, the G. E. C. are prepared to confer with individual dealers and to help them to organise and conduct heating and cooking campaigns suited in each



"MAGNET" WINDOW DISPLAY.

case to the particular conditions obtaining in the district. Re-sellers taking advantage of this generous offer will not only reap the benefit of the experience and exceptional facilities possessed by the G. E. C. Publicity Organisation, and the services of the company's heating and cooking experts, but they will also be backed by the high reputation already won by "Magnet" specialities.

One of the most important features in the campaign will be a series of exhibitions which will be organised on the premises of the various dealers. The G. E. C. offer to loan suitable apparatus and trained demonstrators in addition to providing suitable publicity matter for advertising the exhibitions. They will also co-operate in any local Press advertising which may be deemed necessary, as well as supply quantities of specially written literature overprinted with the dealer's name.

A special window display featuring "Magnet" apparatus is also available, and a photograph of this is reproduced herewith. It has been specially designed to point out the cleanliness and convenience of electric heating and cooking appliances compared with older methods. The "horrid examples" of a beanie, sooty kitchen range, &c., are displayed on the background, whilst in front are marshalled their electrical equivalents. Each article is linked by coloured ribbons to a central easel which announces in bold lettering the advantages of the "Magnet" (electrical) way. The key to the whole idea is contained in a large representation of a switch bearing the G. E. C. slogan, "JUST SWITCH ON, THAT'S ALL!" Dealers desirous of taking advantage of the substantial assistance proffered by the G. E. C. are invited to make early application to Magnet House, Kingsway, London, W.C. 2, or to any of the company's provincial branches.

Ornamental Cast-Iron Electric Fires.

Hitherto electric fires have been somewhat light in construction, and have been limited in size to some 2,000 watts. With the increasing use of electric heating came the demand for fires of more substantial construction, larger capacity, and handsomer appearance. The GENERAL ELECTRIC COMPANY, LTD., have produced a series of fires expressly designed to meet this demand. The bodies of these fires are iron castings of substantial proportions and beautiful design. Several patterns are available and each can be obtained in various finishes. A typical fire of this type is that shown in the accompanying illustration, the black body being relieved by brass ornaments.

The standard fires are made in 2,000 watts and 4,000 watts sizes, and are provided with high efficiency heating elements of the glowing wire-coil pattern. A selection of cast-iron fires can be seen



AN ORNAMENTAL G.E.C. FIRE

at the company's showrooms, Magnet House, Kingsway, and at any of their provincial branches. At attractive price folder (No. H. 2 604) has been recently issued, in which these fires are illustrated and described, and copies will be sent upon request.

Ayrshire Electricity Schemes.

Important schemes are under consideration by the corporations of KILMARNOCK and AYR for the extension of electricity supply in the county. Kilmarnock Corporation are promoting a Provisional Order to authorise electricity supply within an area extending for twelve miles to the north and south of the burgh and twenty miles to the east, covering more than three-quarters of the industrial area of the county. The extended area would include the burghs of Ardrossan, Saltcoats, Kilwinning, Stewarton and Cumnock, and the parishes of Beith, Dunlop and Stewarton, and parts of many other parishes.

The project of the burgh of Ayr is to obtain a supply of 3,000 kW from the water power at the outlet to Loch Doon. It is calculated that current from Loch Doon can be delivered in Ayr at 4d. per unit less than the offer of Kilmarnock for current in bulk, which was recently under consideration. The intention is to generate three-phase current and to run two main overhead transmission lines—one running *via* Dalmellington and Waterside to Ayr and a second *via* Straiton and Maybole, with a branch line from Maybole to Girvan. It is also intended that Ayr should supply three-phase current in the Maybole, Dalrymple and Coynton districts and in the town of Girvan. The supply in the burgh of Ayr is two-phase, and it is not proposed to alter this, but to convert the three-phase 50-cycle current generated at Loch Doon into two-phase current for use in Ayr. The Law Committee of the County Council are generally favourable to the Kilmarnock scheme, but further details are wanted in regard to Ayr. In regard to the Kilmarnock project the cost would be between a quarter and half a million, but as the committee did not think joint control was worth what they would have to pay for it, the matter has been left to the

Miners' Electric Safety Lamps.

In pursuance of Sect. 86 of the Coal Mines Act, 1911, and under the provisions of the Mining Industry Act, 1920, the Board of Trade have made the following draft Regulations which shall apply to all mines to which the Coal Mines Act, 1911, applies:—

1. Every outer case of an electric safety lamp of approved type shall be inscribed by the maker of the lamps of that type with his name and the name of the type of lamp, and all the integral parts of the lamps of that type shall be inscribed with a distinctive trade mark registered by the makers of the lamp. For the purposes of these Regulations the integral parts of the lamp shall be the outer case, the whole of the accumulator, the bulb, the detachable part (if any) of the outer case, and such other parts (if any) of the lamp as are named in the official specification.

2. All the integral parts of any of such lamps as aforesaid shall conform with the provisions as to integral parts contained in these Regulations, and any such lamp containing an integral part which does not so conform, shall be deemed not to be a lamp of the approved type: Provided that nothing in this Regulation shall preclude the Board of Trade from approving the said lamp as a lamp of a different type, subject to such conditions as the Board may see fit.

3. The respective makers of all approved types of electric safety lamps shall inspect, gauge, or test before issue, in such manner as the Board of Trade may prescribe, all lamps and all integral parts of lamps bearing their name or trade mark.

Objections to the Regulations may be made to the Secretary for Mines.

Electrical Imports and Exports.

IMPORTS.—The following are official values of electrical machinery, apparatus, and material imported into this country (a) during September, 1921, and (b) the aggregate figures from Jan. 1 to Sept. 30, with increase or decrease compared with corresponding periods of 1920:—

Electrical machinery, (a) £55 187 (decrease £52 415), (b) £503 628 (decrease £244 972); telegraph and telephone cables, submarine (a) nil, (b) (decrease £50); other than submarine, (a) £4 598 (increase £3 799), (b) £68 395 (increase £59 899); telegraph and telephone apparatus, (a) £18 359 (decrease £6 119), (b) £259 503 (increase £135 984); other electrical wires and cables, rubber insulated, (a) £4 310 (increase £968), (b) £25 981 (increase £3 421); with other insulations, (a) £11 583 (decrease £2 843), (b) £85 542 (decrease £450); carbons, (a) £14 746 (increase £4 172), (b) £85 357 (decrease £10 583); glow lamps, (a) £16 419 (increase £5 552), (b) £200 959 (increase £160 887); arc lamps and electric searchlights, (a) £35 (decrease £219), (b) £5 630 (increase £2 616); parts of arc lamps and searchlights (other than carbons), (a) £472 (decrease £304), (b) £13 916 (increase £3 688); batteries, (a) £5 548 (decrease £4 248), (b) £96 313 (increase £35 859); meters and measuring instruments, (a) £3 243 (decrease £8 057), (b) £127 755 (increase £57 005); switchboards, (a) £8 346 (increase £8 154), (b) £15 749 (increase £14 404); electrical goods and apparatus unenumerated, (a) £35 045 (decrease £57 912), (b) £582 107 (increase £31 177). Total of electrical machinery, apparatus, and material, other than uninsulated wire, (a) £178 900 (decrease £119 282), (b) £2 172 835 (increase £258 885).

EXPORTS.—The exports of electrical machinery, apparatus and material (a) during September, 1921, and (b) from Jan. 1 to Sept. 30, with increase or decrease compared with corresponding periods of 1920, were as follows:—

Electrical machinery, (a) £380 783 (increase £123 829), (b) £3 565 308 (increase £2 049 262); including railway and tramway motors, (a) £19 304 (increase £132 252), (b) £183 928 (increase £152 882); other generators and motors, (a) £212 430 (increase £65 910), (b) £2 052 470 (increase £1 111 056); and electrical machinery unenumerated, (a) £149 049 (increase £44 667), (b) £1 428 910 (increase £785 324); telegraph and telephone cables, submarine, (a) £56 502 (decrease £16 490), (b) £2 012 510 (increase £787 885); other than submarine, (a) £175 899 (increase £127 510), (b) £1 280 575 (increase £567 175); telegraph and telephone apparatus, (a) £195 627 (increase £120 051), (b) £1 472 682 (increase £620 620); other electrical wires and cables, rubber insulated, (a) £58 314 (decrease £96 523), (b) £1 059 680 (decrease £16 744); with other insulations, (a) £159 470 (decrease £2 148), (b) £1 581 875 (increase £55 391); carbons, (a) £1 767 (decrease £6 317), (b) £55 595 (decrease £23 563); glow lamps, (a) £25 828 (decrease £3 109), (b) £368 268 (increase £174 656); arc lamps and searchlights, (a) £524 (decrease £1 426), (b) £12 096 (decrease £3 309); parts of arc lamps and searchlights (other than carbons), (a) £256 (decrease £2 100), (b) £5 478 (decrease £4 920); batteries, (a) £55 507 (decrease £10 954), (b) £558 276 (increase £159 085); meters and measuring instruments, (a) £42 601 (increase £4 186), (b) £386 991 (increase £92 919); switchboards, (a) £27 703 (increase £14 743), (b) £180 930 (increase £106 073); electrical goods and apparatus unenumerated, (a) £114 659 (decrease £85 913), (b) £1 633 507 (increase £267 250). Total of electrical machinery, material and apparatus, other than uninsulated wire, (a) £1 305 550 (increase £150,359), (b) £14 294 881 (increase £4 691 602).

The October issue of the "FARADAY HOUSE JOURNAL" contains, in addition to a number of interesting items of house news, an article on "The Capacity between Spherical Conductors," by the principal, Dr. Alexander Russell.

The Need for Harmony in Industry.

The Lord Mayor of London presided on the 13th inst. at a Conference organised by the INDUSTRIAL LEAGUE and COUNCIL, to consider the best means of promoting wholehearted co-operation between employers and employed, and also methods of efficient and increased production.

The LORD MAYOR said there was no question to-day which absorbed the thoughts of men so much as the industrial problem. The short period of prosperity which followed the war was being succeeded by a state of unemployment unexampled in the history of Great Britain. No blame could be allocated, because it was caused by circumstances outside the control of Governments, financiers, capitalists, or labour leaders. It was, therefore, to organisations such as the Industrial League and Council that they must look for guidance. Only by the combined efforts of employers and employed could the evils that confronted us be remedied.

The Right Hon. G. H. ROBERTS, M.P., moved the following resolution: "That this Mansion House meeting of the Industrial League and Council reiterates its considered policy that prosperity to this country can only be achieved as a result of closer and friendlier relations between employers and employed. It views with satisfaction the action of the Prime Minister in calling together to the counsels of the nation representatives of employers, labour, commerce, and finance to explore all possible avenues towards a solution of the present industrial trouble, and urges the Government to use every means available to relieve the present situation, by encouraging and fostering all possible means to reduce the cost of living, to lower the cost and increase the measure of production, and by international arrangements to stabilise the rate of exchange."

Objects of Industrial League.

Mr. ROBERTS said the Industrial League came into existence for the purpose of bringing representative employers and labour people together, and to see how far it would be possible, after the war, to assist the nation to recover. One of their primary hopes was to be able so to order society as to make it possible to maintain the higher standards of wages and living which developed during the war. It was wrong to ascribe the necessity for drastic wage reductions to any conspiracy on the part of the employers. It was sheer economic necessity, for, after all, no more could be taken out of an industry than was created within it. He was naturally an optimist, but he confessed that he was gravely troubled respecting the immediate future. The situation was so complex that no action on the part of the Government alone could solve the problem.

Government and Unemployment.

Too much was expected of the Government. He believed that if the circumstances were fairly reviewed one would have to acknowledge that our Government and our country had played a great and noble part, so far, in recreating peace in the world. Those who drafted the resolution were right in drawing attention to the fact that too much must not be expected from the State in the way of action in respect to industry. If, however, they had to admit inability to so regulate industry as to keep people regularly employed, then methods must be devised to furnish them and theirs with the necessities of life. He believed that unemployment would always exist in varying degrees, and some means of meeting the periodical times of enforced idleness were necessary. He could not as yet see any other method than that of insurance.

The unemployed situation was grave to-day because of the fact that since the armistice Labour had pursued a wrong policy. He was told the other day that the Government ought to have foreseen this unemployment and ought to have provided for it. His retort was, "Who foresaw unemployment so grave as it was at present? Did Labour see it?" If so, Labour had acted criminally in expending the amount of money that had been wasted through the incessant strikes. The dispute in the coal trade destroyed the reviving conditions of trade. He knew many employers who had almost entirely exhausted their own resources in their anxiety to do the right thing to those in their service.

Need of Foreign Trade.

This country could not long maintain a population of 50 millions unless they could restore and expand its foreign trade. They of the Industrial League foresaw that, after the war, world competition would be keener than before, and that the world must be poorer because of the expenditure of wealth during the war, and therefore, to be able to sell, they would have to produce cheaper and more efficiently than they had ever done before. The two sides should get together, and he would like to see trade unions concerning themselves with efficient means of production and requiring their employers to prove that their methods were efficient. The Industrial League was in existence for this purpose of bringing the two sides together and getting them to understand each other's point of view. The present situation was not hopeless—we could recover if we had this co-operation. Without it, some historian could start writing "The Decline and Fall of Great Britain."

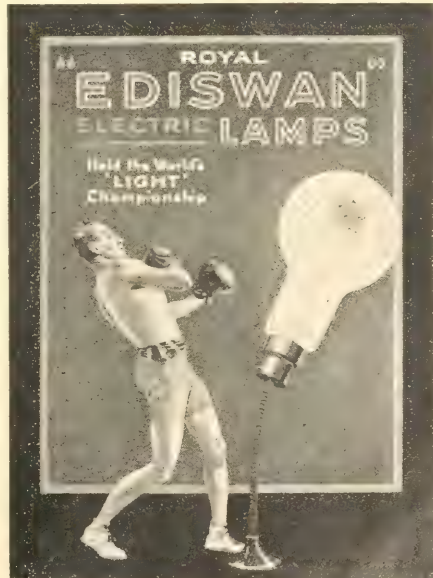
Viscount BURNHAM, who seconded the resolution, said the Industrial League and Council was the auxiliary force of the industrial settlement, and they were met to see how far they could utilise it for the common good. They should recall the general's advice, and try to look at the problem from the other man's point of view. The meaning of the financial situation was that they were suffering from the halfpenny mark. He believed a great deal could be done

to stabilise the exchange if some financial agreement were arrived at between this country and the United States, because it was in the United States that all the gold was hoarded, and this country was nearest to the point of stability in the European system. He hoped that from the Disarmament Conference there would arise a desire for a conference on the financial situation of the world. It was to be hoped that the Government would tender such a suggestion, and that the United States would be disposed to act upon it. At home we wanted the spirit of co-operation, not only in lip service, but in actual performance. Mr. Clynes, for whom he had the greatest respect, made a speech two days ago protesting against the theory that any class stood to benefit by the curtailment of production. On the other hand, they found resolutions from platforms in all parts of the country in which no spirit of co-operation was to be found between employers and employed, but a denunciation of capital, as if there were anything that could be put in its place. This was a deterrent to enterprise—a threat to those who, after all, could place what money they had elsewhere, for capital, as they knew, had wings to fly. Such threats were, in themselves, a cause of unemployment.

Mr. H. E. BLAIN and Mr. G. N. BARNES supported the resolution, which was carried, with an addition proposed by Mr. V. A. MALCOLMSON, that special consideration be given to the claims of agricultural development, both in the United Kingdom and throughout the Empire.

A "Striking" Ediswan Showcard.

A novel and attractive showcard, entitled "The World's Light Championship," has just been prepared by the EDISON SWAN ELECTRIC COMPANY, LTD., Ponder's End, Middlesex. Nicely printed



in colours and measuring 14½ in. by 10½ in., it is calculated to catch the eye at once, and it will therefore form an excellent advertisement of Royal Ediswan lamps. The showcard is being distributed to the trade, and we learn that cards of similar design will shortly be on exhibition in the Metropolitan District Railway cars, the Tube lifts, &c.

Important Radio-Telegraph Combination.

An agreement, which will have an important effect upon the future of wireless telegraphy, has been entered into by the four principal wireless telegraph companies of the world, viz., Marconi's Wireless Telegraph Company, the Radio Corporation of America, the Compagnie Générale de Télégraphie de France, and the Gesellschaft für Drahtlose Telegraphie of Germany. It is stated that these companies will in future co-operate in the full development of scientific and technical improvements of wireless telegraphic services throughout the world. The extent and scope of the agreement is not stated, but it is the outcome of a conference held in Paris. It is claimed that the arrangement, which is a comprehensive one, will prevent the wasteful use of the relatively few wave lengths available for long-distance communication.

Henley Service Cut-Outs.

The installation of electricity in blocks of flats and groups of houses has always required careful planning, but with the advent of modern municipal and other housing schemes the problem has become more important. The difficulties which are common in all these schemes revolve round the primary cost of the installation and the expense of opening up the ground, as well as the high cost of materials.

A few electrical manufacturers have turned their attention to requirements that will help to reduce the cost of installation, and among these are the W. T. HENLEY'S TELEGRAPH WORKS COMPANY. The new list of cut-outs of this company will be found of practical interest to supply engineers, electrical contractors, and others. The firm appear to have carefully studied the main consideration, as it is claimed that their "Isco" loop-in cut-outs almost eliminate the use of joint boxes, and reduce the cost of "opening up" to a minimum.



THE ISCO "D" CUT-OUT.

Practically any arrangement of feeding can be adopted, and each block of houses or flats, or a number of blocks, can be fed by one supply cable, or they can be fed from both ends. In the latter case (where the supply is tapped off either a three-wire or a three-phase four-wire main), by isolating a loop between two houses, one tapping can be taken off the positive side and the other off the negative side, or off any phase and the neutral. They are provided with suitable cable entries, sealing chamber, and fuses in one cast-iron case, and each consumer, being directly connected to the main, provision for other circuits can be made. A tapping can also be made through the party wall to the next consumer. By a simple process of altering the position of the links the balance of the system can be easily adjusted.

Street-lighting tappings can also be taken off the Isco "H" cut-out. Armour grips are provided when desired, and the method of bonding the lead of the cable has received the experienced attention Messrs. Henley's usually pay to this important point. A copy of the list (No. W. L. 2), which includes a four-page reproduction of blue prints, giving diagrams of cable connections, may be obtained from the engineering department of Messrs. Henley's Telegraph Works Company. The illustration shows the Isco "D" cut-out, suitable for two twin cables up to 0.0225 sq. in., and provided with sealing chamber, link chamber, and fuses.

The Key Industry Comedy.

It would require the gifts of the late Sir W. S. Gilbert to do justice to the confusion and trouble created in the business world by the decisions of the Board of Trade under the first part of the Safeguarding of Industries Act. Last week we reported that dolls' glass eyes had been declared to be scientific glass, and consequently that the dolls were liable to a duty of 35 per cent. This decision has since been modified, and in future the eyes are to be taxed on a basis of 5 per cent. of the doll! The artificial glass ornaments of ladies' hats, Christmas-tree ornaments, and similar articles, are also liable to duty. Pocket batteries, toy magic lanterns, toy magnets, and many other things are being held up, and, while the accumulation of goods at the docks is causing confusion, the business of the country is also being held up.

Serious Effects of the Act.

In a considered statement, sent by Mr. H. H. DAVIS, chairman of the Fancy Goods' Section of the Vigilance Committee of the London Chamber of Commerce, it is pointed out that the Safeguarding of Industries Act is being interpreted and administered in such a way that resolutions were unanimously adopted at a meeting of fancy goods and other traders last week expressing 'grave concern at the very serious dislocation of business created by the Act, particularly on account of the extraordinary wide interpretations which are being placed on certain items referred to in the Key Industries schedule,' and also calling upon the Government to bring in an amending Act suspending the operations of the Safeguarding of Industries Act in so far as it concerns commodities not produced in this country. Over 2000 of the articles declared by the Board of Trade to have now become dutiable are actually not manufactured in this country at all and many of them are important raw materials. Therefore the effect of the Act is to penalise important British industries.

Glass and Arc Lamps.

The utmost confusion exists as to the interpretation of "lamp-blown ware," and it has also been laid down that, under the arc

lamp, carbons clause the Customs are entitled to hold up consignments of pocket torch batteries because they contain a minute piece of carbon rod, although these are obviously not going to be used in connection with arc lamp carbons at all, nor could be. In addition, a consignment of 600,000 carbon rods wanted by a firm of British dry battery manufacturers has already been held up.

It will be remembered that in the Ways and Means debates Ministers assured the House that half watt lamps were not to be protected. Yet electric lamps are held up at all the ports and are to be taxed as containing tungsten.

We have some doubts as to the validity of some of the steps taken by the Board of Trade, and it might be advisable to take steps to test the legality of the Board's attitude in a suitable case. When the Key Industries schedule was before the House of Commons no one contemplated that it would be extended so as to include a list of 6,300 articles, and that these thousands of articles in their turn would, many of them, be ruled to include a large number of other goods which would not have been supposed to have anything to do with key industries.

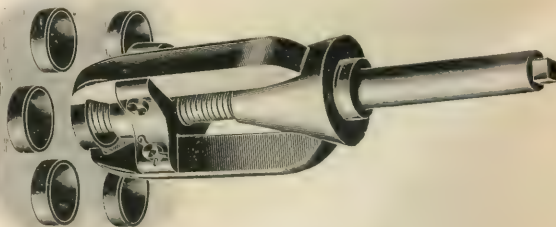
Osram Huntalite Electric Candles.

Electroliers, wall brackets, and standards for candles have always been popular fixtures, especially for rooms with "period" decorations where, indeed, simulation candles are often essential. The effect of these fittings is often marred, however, by badly-designed candles, which are obvious imitations. The OSRAM "HUNTALITE" ELECTRIC CANDLE, described in leaflet No. O.S. 2520 just issued by the General Electric Company, Ltd., is specially designed as a most faithful imitation of a white wax candle. The utmost care has been taken to reproduce the exact proportions and dimensions down to the smallest detail. Osram "Huntalite" electric candles, especially when provided with suitable silk shades, maintain the illusion so well that there need be no hesitation on the score of good taste in installing them in the most correctly equipped "period" room. An additional advantage is the lamps, being made in one piece, they remain absolutely rigid and perfectly upright in the sconces without the use of clips or other devices. "Huntalite" electric candles consume 20 watts, and are made in a range of standard voltages from 25 to 250 volts. Copies of the leaflet can be obtained on application from the General Electric Company, Ltd., Magnet House, Kingsway, W.C. 2., or from any of the company's provincial branches.

"Paragon" Boiler Tube Loosener.

The accompanying illustration shows the "Paragon" boiler tube loosener, a new labour and time-saving device for all users of steam boilers with straight tubes, which has been put on the market by O. N. BECK. Among the advantages claimed for the "Paragon" loosener are that it only requires one man to operate it and a few minutes for the removal of the tube; that it does not in the slightest degree damage the boiler plate or strain the headers; that it reduces the stoppage of working to a minimum, and saves labour, time, and vexation.

The method of operating the tool is very simple. The apparatus, with its claw embracing the tube, is pressed against the tube plate,



THE "PARAGON" BOILER TUBE LOOSENER.

the screwed spindle or mandril tightened up until the tube end expanded into the tube plate becomes loose. By turning the spindle in the opposite direction the claws are loosened and the tool is turned axially by about 60 deg. The same operation is repeated until the tube loosens its hold in the plate, and is then driven out by means of a drift. A further advantage of the apparatus is the fact that, as the claws only slightly indent the tube end, tubes which are otherwise in good condition may be used again. Thorough cleaning and liberal oiling are very important. Care must be taken not to let the long arms of the claws come off the mandril in their terminal positions. The apparatus is made in all sizes for tubes of from 1½ in. to 5½ in. outside diameter. The weight varies from about 16 lb. to 35 lb., according to size. A patent has been applied for.

Newport Special Order Inquiry.

COL. T. C. EKIN, M.I.C.E., conducted an inquiry on behalf of the Electricity Commissioners at Newport on Friday last in reference to an application by the Corporation for a Special Order extending their electrical supply area so as to include Caerleon, Christchurch, Nash, Bettws, Duffryn, Malpas and St. Woolos. The application had been opposed by the South Wales Electrical Power Distribution Company, the Gas Company, the Newport Ratepayers' Association, and the Magor and St. Mellons Rural District Councils.

MR. WROTTESELEY, counsel for the Corporation, explained that they had come to an agreement with the Power Company to divide a number of the parishes mentioned, and they now applied for powers to supply Caerleon, Nash and Christchurch, but to divide Malpas, Bettws, Duffryn and St. Woolos. Since the start of the electricity undertaking, in 1891, the Corporation had spent £408,000 on it, exclusive of the tramways. They had 3,200 consumers, and had the sanction of the Ministry to expend a further £200,000 on extensions. He urged that the Commissioners should not include the "Northumberland Clause" in the Order: it had not been included in the Cardiff and Swansea Orders. If the undertaking was run as a private commercial company they could have paid a dividend of 5 per cent. and put a substantial sum to reserve.

ALD. J. MOXON, chairman of the Electricity Committee, said the electricity undertaking was one of the best assets the town had. If there were no inquiry and they could have paid £50,000 to reserve. In fact, they had placed £21,000 to reserve. They had made a contract with one firm that month to supply electricity, the minimum price of which would be £8,000 a year, and they expected about £20,000 per year.

MR. L. H. HORNEY (for the Newport Ratepayers' Association) said their point was that if the undertaking was properly assessed it would be practically bankrupt. It would be a huge gamble for the Corporation to embark on the supply of electricity in the rural districts.

MR. A. NICHOLS MOORE, M.I.E.E., Borough Electrical Engineer, gave details of the cost of the proposed works, and urged that from a business point of view the Corporation should be allowed to proceed with the proposals.

Commercial Motor Exhibition.

This exhibition, which has been held at Olympia, London, during the week, included several new features, and indicates that, notwithstanding the trade depression, British manufacturers are tackling the work of improving their products and cheapening production in order to increase the fields of usefulness of the motor and open up new markets. There were a number of chars-à-bancs and some luxuriously fitted motor coaches, with electric lighting, and there were also a number of commercial electric vehicles.

Among the numerous exhibitors were the TILLING-STEVENS MOTORS, LTD., of Maidstone, who showed a 40 H.P. double-deck omnibus, with a petrol-electric chassis, a Tilling-Stevens petrol-electric char-à-banc de luxe, and a 4-ton petrol-electric chassis.

CLAYTON WAGONS, LTD., showed, in addition to steam wagons, a 3-ton electric wagon, with an Exide battery; the GENERAL ELECTRIC VEHICLE COMPANY exhibited an electric wagon with Exide battery; GARRETT & SONS had on view an electric as well as steam vehicles, while RANSOMES, SMITH & JEFFERIES exhibited steam and also electric wagons and a runabout electric crane.

The accessories section of the exhibition attracted considerable attention. No fewer than fifty of the electrically-equipped commercial cars and chars-à-bancs on show (just over 50 per cent. of the total) are fitted with the well-known C.A.V. lighting sets. Many improvements have been introduced in the C.A.V. specialities. The standard omnibus lighting sets are equipped with the new circular type dynamo and C.A.V.-Willard battery, and among the improvements in the smaller type of dynamo is a waterproof terminal connection. The C.A.V. illuminated advertising signs for commercial vehicles, which are on view, have been taken up by most of the prominent commercial vehicle users.

New Works of Ingleby & Company.

In these days of industrial depression it is encouraging to see signs of progress and development in any branch of industry, and to note the presence in our midst of those who have sufficient confidence in the future to make preparation for the revival in trade which we all hope will not be long in coming. One such sign is to be found in the building of new works by Messrs. INGLEBY & COMPANY, LTD., dynamo and motor manufacturers, on a site of approximately 10 acres adjoining Old-lane, Beeston, Leeds.

The works, which were formally opened on the 11th inst. by the Lord Mayor of Leeds, consist of two buildings, the larger of which comprises commodious offices and large machine shop of structural steel arranged for overhead travelling crane. The other also includes a tool shop as well as winding department and stores for finished motors and other materials. The works, which are capable of turning out electric motors for industrial purposes, ranging from ½ H.P. to 200 H.P., were designed by Mr. J. C. B. Ingleby, elder of the two brothers Ingleby, who commenced business in rented premises in Elland-road in 1908. During the war this became a controlled establishment, and supplied a large number of motors to the Government factories. In the construction of the buildings special attention has been paid to light, ventilation and heating, and an important feature is the way the works have been laid out for future extensions.

Legal Intelligence.

A MUNICIPAL TRADING ACTION.

MR. JUSTICE RUSSELL has fixed Nov. 1 for the hearing of the action Attorney-General v. Liverpool Corporation. It is brought at the instigation of certain ratepayers who seek to restrain the Corporation from carrying on a retail business in electrical fittings. The defence is that, as a corporation constituted by charter, they were entitled to do what they had done.

GIBBS v. METROPOLITAN ELECTRIC TRAMWAYS.

ON the 6th inst. Mr. Justice McCardie awarded £425 damages to Hannah Ellen Gibbs for injuries to her left foot, received in a collision between two trams belonging to the Metropolitan Electric Tramways, Ltd., in April, 1920.

MR. DOUGHTY said the plaintiff was fourteen years of age, and the car in which she was riding was at a standstill when another car ran into it. As soon as the passengers realised what was happening they fled to the exit, and plaintiff, who was at the end of the car, had the misfortune to get her feet between the two cars at the moment of impact. The foot was badly crushed, and the girl had been rendered a cripple for life. She had won a four years' scholarship, and was to have become a teacher, but the accident had interfered very much with her prospects.

In giving judgment, his lordship said the point at issue in the case had caused him anxiety and doubt, seeing that defendants had paid £350 into court. The accident had rendered the girl lame, and she could only walk with a stick eighteen months after the accident. The injury would have a permanent effect of her physique, mind and temperament. The indirect effects of accidents were often under-estimated. The sense of being a cripple would have a serious effect on the health and hope and working power of a person. According to the medical opinion, another operation was necessary to remove some of the toes, and under all the circumstances, having regard to the changed value of money, he awarded £425, with costs.

DISPUTE ABOUT MOTOR GENERATOR REPAIRS.

AT Southwark County Court, on the 13th inst., an action was brought by Messrs. Newbury & Thomas, electrical engineers, to recover £16 15s. from I. Levinsky, proprietor of a cinema, for work done. Defendant made a counter-claim for £36 2s. 6d.

Counsel for plaintiffs explained that the claim was for repairs to a motor generator used at the theatre. In August, 1920, plaintiffs were asked to estimate for certain repairs; the work was completed, and the machine was returned to the theatre. Some time after defendant complained that the work done was not satisfactory, and ultimately he had been compelled to call in the Crypto Electrical Company, whose bill was the subject of the counter-claim. After repair the motor generator was used for two months by defendant, who made no complaint. It was used six days weekly on full load. In November, three months after the order was completed, defendant rang up plaintiffs and again complained of certain defects, which had nothing to do with the work entrusted to plaintiffs. The firm, however, gratuitously put right certain defects, and six months after delivery defendant once again complained.

MR. HY. THOMSON, one of the partners of the plaintiff firm, stated Levinsky complained three months after delivery that the generator was not running smoothly, and that it wasumpy. As a result one of the staff went to the theatre and for two hours watched the pictures, but nothing happened, whereupon a member of the theatre staff remarked, "Of course, while you are here it will not play any tricks, but as soon as you are gone it will start again." There were defects, added witness, but they were not in consequence of the work his firm had done. He gave a list of the repairs which formed the basis of the claim.

HENRY EASTON, electrical engineer, said he examined the machine on the previous day and it had every appearance of being overloaded. In fact, it was not big enough for the job. If the motor had been badly wound, as alleged by defendant, it would have become apparent within six hours.

DEFENDANT gave evidence, and said that after plaintiffs had completed their work, there was no improvement, the generator proving very unsatisfactory. A transformer, used as a stand-by, had to be pressed into service. He used the generator only one and a half hours after it was returned by plaintiffs, and the transformer had to be substituted. He had to call in the Crypto Electrical Company, who charged for overhauling and repairing the motor generator.

MR. HOBBS, of the Crypto Electrical Company, said he examined the generator in March, and the machine was absolutely impossible to run. The whole thing had been running for years.

In answer to the judge, witness said the apparatus was running practically all the year. It had been in for repair several times, and when he saw it practically every part of it wanted renewing, the result of overwear.

His Honour gave judgment for plaintiffs for the amount claimed. He accepted the statement on behalf of plaintiffs that there was no complaint until after two months. He thought that what really happened was that defendant wanted to have the machine "tinkered" instead of spending a proper sum to put it into thorough repair. Plaintiffs had done what they engaged to do and had done it thoroughly, and the work which had since become necessary was due to the reason he had explained. There would be judgment for plaintiffs for the amount claimed with costs, and the counter-claim would be dismissed with costs.

Electricity Supply.

Messrs. CHURCH, of Belfast, have begun work on the electricity scheme for PORTERHILL.

STEELEFORD Urban Council has increased the price of electricity by 2d. per unit as from Oct. 1.

The price of electric current for lighting at DELABOLE has been increased from 8jd. to 11d. a unit.

A new sub-station is to be equipped in the north-western district of ST. PANCRAZ, at a cost of about £35,000.

HEMEL HEMPSTEAD Council has approached Watford Urban Council in order to obtain their terms for the supply of electricity to the district.

PORTSMOUTH Council will reduce the price of electric current for lighting from 8d. to 7jd. per unit at the end of the current quarter.

TALGARTH Parish Council have decided to make another offer to the local electricity company to induce them to supply electricity for street lighting.

In order to provide employment MANCHESTER Education Committee propose to wire and fit the elementary schools for electric lighting at a cost of £12,400.

The introduction of electric lighting at the Pier Head, LIVERPOOL, has proved eminently satisfactory, the lamps giving 50,000 candle-power, at a cost of £850 per annum.

DOVER Corporation have decided to lay electric supply mains in St. Margarets. The Admiralty have agreed to continue the present scale of payments for electric current.

TRURO Town Council is to ascertain whether a grant in aid of public work for the unemployed can be secured in order to carry out the proposed electric supply scheme.

Provision has to be made to meet an estimated further loss of £6,750 on the REDDITCH Council's electricity undertaking. This is equal to a 2s. 6d. rate in the ensuing half-year.

The postponed visit of the DUKE OF YORK to SHEFFIELD has now been fixed for the 4th prox., when the official inauguration of the Corporation's new power station will take place.

BATH Corporation have been authorised to borrow £22,000 on account of the £30,000 required for electricity extensions. New feeders and distributors are to be laid, at a cost of £1,882.

LONDON COUNTY COUNCIL Education Committee have decided to substitute gasfilled lamps for the present inverted arc lamps used in the woodwork and art rooms of the Shoreditch Technical Institute.

YSTRADGYNLAIS Urban Council have decided, with only one dissentient, to purchase the Glantawe Electric Supply Works for £18,000, and the clerk has been instructed to make application for a special order from the Electricity Commissioners.

The KINGSTOWN (Dun Laoghaire) Urban Council have appointed an electric supply committee, with Mr. M. F. O'Brien as chairman, in order to consider a scheme for the supply of electricity in the district. A provisional Order was obtained in 1914.

The Retail Section of the WOLVERHAMPTON Chamber of Commerce have asked the Corporation to make an immediate reduction in the charge for electricity, the abolition of the minimum charge, and the 12s. per cent. added during the war to the meter rents.

Owing to an extremely low tide in the Thames on the 13th inst. and to insufficient condensing water being available, the pressure of the FULHAM electric supply was reduced for a couple of hours, but soon after 9 p.m. matters were put right, and the lights brightened up.

MIDDLESBROUGH Corporation has received sanction to borrow £54,463 for mains, converting plant, gas sets, and building work in connection with the electricity undertaking, but the application for sanction to borrow £13,875 for prospective expenditure on mains and service is still under consideration.

A Special Order authorises Col. J. A. Stirling and Messrs. A. H. Anderson, D. C. Blair, H. Marshall, and A. B. Wilson, all of Dunblane, to supply electricity in the burgh of DUNBLANE and part of the parish of Dunblane and Lecroft. Objections are to be sent to the Ministry of Transport by Nov. 3.

WOODSTOCK Guardians have appointed a committee to consider an engineer's report on the electric lighting plant. It appears that the battery is in a poor condition, and requires renewal. A new battery of the same size will cost £150, while a larger one will be £240. The rest of the plant is in fair condition.

HOLSWORTHY is to be without public lighting this winter. Being dissatisfied with the gas lighting, and as the local Gas and Electric Supply Company has refused to entertain the idea of electric lighting on the ground that the plant is already working at its fullest capacity, the Urban Council has decided to abandon street lighting.

At a recent meeting of the HARRINGTON Urban Council a letter was read from the United Steel Company respecting the lighting of Lowca village by electricity, and offering to fix and supply with electric current twelve 32 c.p. lamps for six months for the sum of £25, subject to the council erecting permanent iron lamp posts.

The proposed extended area of supply from the Portobello power station of EDINBURGH Corporation is, apparently, insufficient in the opinion of the EAST LOTHIAN County Council. The City Council suggested an area within a radius of ten miles from the station, but the country authorities require a twenty-miles radius, and, provided this is agreed to, the City Council's application for a Special Order will not be opposed.

The output of the LIVERPOOL electric supply department dropped by nearly 4,000,000 units during the first six months of the year compared with the corresponding period of 1920, or about 8.7 per cent. Since the settlement of the coal dispute the demand for electricity had steadily improved. There are 18,550 consumers connected, an increase of 2,500. Considerable extensions to mains had been carried out to supply the new housing areas, and it is expected that sanction will shortly be received for further extensions at two other estates.

The Ministry of Transport have issued an Order empowering the LLANDRINDOD WELLS Electric Light & Power Company, Ltd., to increase their charge to a maximum of 1s. 2d. per unit, with a minimum for the winter quarters of 17s. 6d. for 15 units or less, and a minimum of 11s. 8d. in the summer quarters for 10 units or less. In view of the serious increase, and as the power has been conferred for five years, the Council met in committee to consider the position. There is a proposal to purchase the undertaking provided terms can be arranged.

At the recent local inquiry at COOKHAM into the two applications for Special Orders for supplying electricity to Cookham and district, it was stated that the Bourne End Electricity Corporation, Ltd., who have electricity works at Bourne End, desired to extend their cables to Cookham, through Cookham Dean and Cookham Rise, to Marlow, as well as Little Marlow to Woodburn. The second application, by Mr. George Young and three other promoters, related to a scheme to supply Cookham village, and Cookham Dean and Cookham Rise from hydro-electric plant. The turbines would be driven by Thames water-power at Cookham Mill.

LITHERLAND Urban Council is transferring its provisional Order to BOOTLE Corporation. The latter will supply electricity for street lighting in Litherland at one-third of the private lighting rate, but at not less than 1d. per unit, and subject to Litherland Council paying all charges for connections, equipment and maintenance. Work is proceeding on the laying of mains in Litherland, and the Bootle Electrical Engineer reports that the only satisfactory way to provide the capital required for service connections will be for consumers requiring the supply to pay for the cost.

The General Purposes Committee of BIRMINGHAM City Council, reporting on the steps taken during the coal strike to ensure fuel and light control, state that the effect on the finances of the electric supply department was to involve it in a loss of £43,100. The subsequent and continued effect in loss of business and disorganisation of working it was impossible to assess. The estimated reduction in the sale of electricity during the three months is put at 6.8 million units, of a gross selling value of £59,000, and deducting the cost of producing this extra quantity the loss is £32,400. Extra fuel and labour costs are estimated at £10,700, a total of £43,100.

There is a possibility of the revival of the DARTMOOR HYDRO-ELECTRIC scheme in a modified form. Messrs. J. & W. Purves, consulting engineers, of Exeter, have succeeded in getting Messrs. Armstrong Whitworth & Company interested in the scheme, and it is stated that there is every prospect of something being done, provided the Government give a small amount of assistance. The Torquay District Unemployment Committee have notified Messrs. Purves that they would welcome any form of enterprise which would bring employment to the area, but that if the Government assistance sought was financial the committee was not prepared to support the principle.

The trouble between the COVENTRY Corporation electricity department and E.P.E.A., which had reached so acute a stage that notices of withdrawal of their services had been given by the whole of the staff, has been settled by the Anomalies Committee of the National Joint Board, to which both parties agreed to refer dispute. The sub-committee met in London under the chairmanship of Ald. Walker, and after a full hearing decided unanimously that the notices to cease work must be withdrawn, and no further attempts made to interfere with the arrangement made by the Corporation. It was also recommended that the gentleman who had been appointed to the staff of the electricity department should rejoin the E.P.E.A.

The irrepressible COUNCILLOR GRAVES has again raised the question of the charges for electricity. At the meeting of the Corporation last week he moved that "the Electric Supply Department charge for all electric current supplied to the Town Hall, libraries, hospitals and all buildings and institutions within the city which were wholly or partially supported from the rates, a price which was not more than the lowest rate at which electricity was supplied for light to any consumer within the same radius of one of the Corporation's power stations." He said he wanted to alter the existing system of charging all sorts of prices, which was entirely indefensible. All current for the free libraries was charged at 6d. per unit, and across the way at the Green Dragon they charged only 3d., and a good many thousands of houses, and a great many more customers of various sorts paid 3d. or 2d. per unit. About 425,580 units were supplied to the buildings specified in the resolution at an average price of 4.46d. per unit. That was a fraud upon the ratepayers, who had no option in the matter. After some discussion the matter went to the Committee.

Electric Traction.

DONCASTER Tramways Committee propose to construct a loop line on Thadford-street.

Extensions of the Skircoat-road tramcar depot are proposed by the HALIFAX Tramways Committee.

ABERDEEN Corporation have decided to construct additional tramways, at an estimated cost of £84 000.

LONDON County Council have authorised an expenditure of £3 250 on the construction of an additional crossover to the lay-by in Park-road, Forest Hill.

It is estimated that there are at present over 9 200 COMMERCIAL ELECTRIC VEHICLES in the UNITED STATES, of which about 5 000 are in the New York district.

Seven new tramcars have been purchased, at a cost of £3 045 each, by SWANSEA Tramways Committee. It is intended to run the smaller cars on the trailer system to cope with the traffic on certain routes.

BUXTON Urban Council are complaining of the inadequate railway facilities between the Midlands, Lancashire and Yorkshire and Buxton, and it is proposed to approach the railway company with a view to the electrification of the lines.

MANCHESTER Tramways Committee have decided to make an experiment with motor omnibuses in dealing with suburban traffic. Two large double-deck buses, each capable of carrying fifty passengers, are to be placed on routes beyond the termini of the electric tramways in order to test their revenue earning capacity.

Among the projected schemes for giving employment is the ELECTRIFICATION of the SOUTHEAST RAILWAY. The Midland Railway Company already possess the necessary statutory powers, and as it would be a very useful development there is a possibility of the work being undertaken, provided the capital can be raised.

NEWCASTLE-ON-TYNE Transport and Electricity Committee has received tenders for the supply of the tramway rails for the route from Barras Bridge to the High Level Bridge. The Benwell extension and the Gosforth light railway will also be constructed very shortly. A start has been made with the extensions of the tramway sheds at Byker.

A sub-committee of the GLASGOW Tramways Committee is investigating the proposal to acquire the undertaking of the Paisley Tramways Company, and conferences have been held with representatives of interested authorities. Should Glasgow Corporation agree to its acquisition the present Paisley system will be maintained in its entirety. The cars will, however, run from the centre of the city, and fares will be adjusted to bring them in line with those in Glasgow. The Corporation have decided to make no change in the present system, a proposal to reintroduce the halfpenny fare for a single stage being rejected.

Personal and Appointments.

SIR PHILIP DAWSON, K.B.E., the newly-elected M.P. for West Lewisham, took his seat in the House of Commons on Tuesday.

A large photograph of the DOVER Corporation tramway staff has been presented to the manager, Mr. E. H. Bond, as a token of esteem.

The King has accepted the resignation of Sir ERIC GEDDES as Minister of Transport, to take effect as from the 15th inst. Mr. A. Neal is now in temporary charge of the Ministry.

M. WILLIAM LOTH has been awarded a prize by the FRENCH ACADEMY OF SCIENCES for an invention enabling ships to be taken in and out of harbour by means of electro-magnetic cable-guides.

MR. H. W. WILSON, who has been for fifteen years Mains Superintendent at MAIDSTONE, and is leaving to become distribution engineer at Croydon, has been presented by the electricity works staff with an armchair, and by the townspeople with a pair of field glasses in case, a smoker's cabinet, and a case of fish knives and forks.

MR. G. W. O. HOWE, D.Sc., M.I.E.E., head of the Department of Standards and Measurements at the National Physical Laboratory, Teddington, has been appointed to the newly-founded James Watt Chair of Electrical Engineering in the University of Glasgow. Dr. Howe received his academic training at Armstrong College, Newcastle-on-Tyne, and was for some years assistant professor in electrical engineering at the City and Guilds Engineering College. He is the translator of Thomalen's work "Electrical Engineering," and has written several Papers on electrical engineering, radio-telegraphy, &c.

MR. Wm. J. Goudie, D.Sc., has been elected to the recently founded James Watt chair in the Theory of Heat Engines at GLASGOW UNIVERSITY, and Mr. Percy A. Hillhouse, D.Sc., becomes professor of Naval Architecture, in succession to Sir John Biles, who retired some time ago. Prof. Hillhouse, who is a graduate of Glasgow University, is chief naval architect to the Fairfield Shipbuilding & Engineering Company. Dr. Goudie, after Graduating at Glasgow University, joined the engineering staff of the University of London (University College), becoming assistant professor in 1910, three years later. During the last two years of the war he carried out research work on anti-aircraft shell fuses. In October, 1919, Prof. Goudie was appointed lecturer on heat engines in Glasgow University, a position which he held until his present appointment as first occupant of the chair on the subject.

Institution Notes.

MR. R. BORLASE MATTHEWS has been invited to read a Paper on the 21st inst. before the ROYAL DUTCH INSTITUTE OF ENGINEERS (Nijmegen) on "Applications of Electricity to Farming," a subject to which he has given considerable attention during recent years, as he has carried out considerable experimental work on a commercial scale on his 600-acre farm.

On Saturday, the 29th inst., there will be a visit of LONDON STUDENTS of the INSTITUTION OF ELECTRICAL ENGINEERS to the works of the British Electric Transformer Company at Hayes, Middlesex. Students who wish to attend should notify Mr. Howard, 115, Queen's-road, S.W. 19, before the 19th inst.

The opening meeting of the Session 1921-22 in connection with the S. MIDLAND STUDENTS' SECTION of the INSTITUTION OF ELECTRICAL ENGINEERS, will be held on Tuesday, Oct. 25, at the University, Edmund-street, Birmingham, at 7.30 p.m. Mr. E. Gallizia will deliver a short chairman's address, and this will be followed by a Paper on "Single-Phase Commutator Motors," by Mr. N. Elliot. A successful smoking concert was held on the 11th inst.

The inaugural meeting of the INSTITUTION OF RUBBER INDUSTRY was held on Wednesday, at the Royal Society of Arts, London, when Mr. J. H. C. Brooking, M.I.E.E., delivered his presidential address, and Sir Henry Wickham and Mr. Herbert Rogers read papers dealing with rubber growing and manufacture. Numerous papers dealing with rubber growing, manufacture, vulcanisation, &c., written by experts, will be read at the meetings during the ensuing session.

The third ANNUAL DINNER to the members of the National Executive Council of the ELECTRICAL POWER ENGINEERS' ASSOCIATION (Southern Division) will be held at the Hotel Cecil, Strand, London, on Saturday, 29th inst., at 5.30 for 6 p.m. Tickets (10s. 6d. each) may be obtained from the Technical Representative or Section Secretary.

At a meeting of the Southern Division of the Association at the Central Hall, Westminster, at 7 p.m., on Friday next (Oct. 28), a lecture will be delivered by Mr. J. E. Johnson, entitled "Notes on Surface Condensing Plant."

At the congress, organised by the INSTITUTE OF TRANSPORT at the Commercial Motor Exhibition on Monday, Mr. P. F. Smith read a paper on the "Evolution of the Motor Vehicle for Goods and Passenger Service." He said the steam vehicle system of propulsion would never compete seriously with the internal combustion motor for useful loads under five tons. The petrol gear-driven vehicle had done and was doing splendid work in aid of freight carrying and passenger transport, but he thought its development was almost at an end. The petrol-electric vehicle had steadily developed, and was now the most formidable competitor of the gear transmission. Post-war designs of this system from 1919 onwards had proved that, under all road conditions, they were as good as, if not superior to, any other form of propulsion. The petrol-electric system was the acme of "safety first." A driver might at his discretion put his controller in the reverse position and crawl down a hill at about two to three miles per hour, without having recourse to his mechanical brakes. Equally, if the engine should fail in the centre of a dangerous hill, the vehicle could not run backwards at a greater speed than that mentioned, because the electric motor automatically became a dynamo for the time being. In a few years from now petrol-electric transmission would occupy the position which the "gear-drive" held at present.

Educational.

MR. L. BOLTON, winner of the £1 000 prize offered by "The Scientific American" for the best essay on Einstein's theory, will give two LECTURES on "RELATIVITY" at BIRKBECK COLLEGE, Fetterlane, E.C. 4, on Oct. 24 and 31, at 5.30. Admission is free, without ticket.

The Privy Council have rejected the petition of UNIVERSITY COLLEGE, READING, for the grant of a Charter of Incorporation as a University. It is considered that the number of students studying for University degrees ought to be larger, and that the annual income ought to be raised to £80 000. When these conditions can be satisfied the Privy Council will reconsider the question.

THE UNIVERSITY OF BIRMINGHAM has just reached its "majority," and it has been celebrating the event by a conversation. The 900 guests were received by Sir Gilbert Barling, Bart., the vice-chancellor, with whom was the principal (Mr. C. Grant Robertson) and the deans of faculties and professors. The Lord Mayor of Birmingham (Alderman W. A. Cadbury) headed the civic representation. The seven surrounding counties which constitute the sphere of influence of this great Midland University were all represented, and there were also many representatives of the industrial and commercial interests of the district. The chemical department was ablaze with light, a striking effect being produced by means of a powerful arc lamp, which with other high-power lamps played over the whole of the University grounds. The effect was enhanced by the production of a dense white smoke cloud, on which were projected coloured beams from three powerful searchlights, lent by the British Thomson-Houston Company. In the electrical engineering section (one of the best-appointed departments in the English Universities) a feature was the reception of wireless signals by telegraph and telephone, and there were many experiments interesting to the non-scientific mind.

Imperial Notes.

It was proposed to light the town of UTTAMA (Victoria) electrically, and to take current from the Swan Hill Shire Council's system.

THE HYDRO-ELECTRIC ZINC COMPANY produced at its Risdon Works, Tasmania, 5,809 tons of zinc slabs (valued at £251 13s) during the past year.

It is stated that an order for boilers, at a cost of about £50,000, has been placed with a Lancashire firm in connection with the new generating plant which is to be installed at NEWCASTLE (N.S.W.).

The Tasmanian Parliament has authorised the Government to advance the HYDRO-ELECTRIC POWER AND METALLURGICAL COMPANY a further sum of £30,000. Preparations are being made for the resumption of the manufacture of carbide.

At LAURA (South Australia) the Council has purchased the distribution plant and mains from Mr. A. H. Forder, who has hitherto been the contractor for the public electric lighting, and the Council will in future take the necessary electrical energy from the Laura Milling Company.

A new company, HADFIELDS (AUSTRALIA), LTD., with a capital of £500,000, has been formed to take over the works of the Australian Electric Steel, Ltd., at Alexandria, Sydney, and at Perth (West Australia), and to extend both plants for the manufacture of high-grade steel products. Among the directors are Sir Robert Hadfield, Bart., and Mr. J. M. Deschamps, the latter acting as managing director.

The movement for the development of INTER-IMPERIAL TRADE is growing in NEW ZEALAND, and the new American tariff will accentuate the feeling in favour of British goods. At a recent conference of the New Zealand Association of British Manufacturers and Agents, and representative of the importing motor, electrical and engineering and other trades distributing British manufactures, a strong pronouncement was made on the imperative need for giving all possible assistance to the furtherance of inter-imperial trade. On the motion of Mr. G. H. Scott, president, a series of resolutions were adopted to the effect that the units of the British Empire should carefully consider their position in regard to trading with foreign countries whose policies practically exclude products of the British Empire; that a policy should be laid down by Great Britain and the Dominions in conference, whereby their mutual trade could best be conserved and increased; and that the best interests of New Zealand would be served by expansion of trade within the British Empire, with preference to Great Britain.

Foreign Notes.

In the reconstructed PERSIAN CABINET the Minister of Posts and TELEGRAPHS is Shahab ed Dowleh.

By a Decree of the Spanish Ministry of the Interior, the INTERNATIONAL OHM and AMPERE have been made obligatory in specifications involving the measurement of resistance and current strength.

In consequence of the recent BATIONOLES RAILWAY TUNNEL disaster the French Minister of Public Works (M. le Trocquer) has lighting in trains as soon as possible. The directors will be held personally responsible in cases of accident due to neglect to carry out the instructions. All express trains are to be converted to electric lighting before Jan. 1, 1923, by all other trains by January, 1925. The lighting in suburban trains must be converted before Jan. 1, 1924. The practice of heating the carriages in winter with coal stoves is also forbidden, but two years are allowed for its complete abolition.

The Chinese Foreign Office is negotiating with the French Government with a view to securing the cancellation of the Sino-French agreement relative to the formation of the PEKING TRAMWAYS COMPANY. The Tsung Hua Electric Apparatus Manufacturing Company, Ltd., organised by Shih Shao-tsen, has petitioned the Ministry of Agriculture and Commerce for registration.

The Commercial Secretary to H.M. Legation at Christiania (Mr. C. L. Paus) reports that the Norwegian Storting has granted a concession to "A/S Akershanerne" for the construction of an ELECTRIC RAILWAY FROM CHRISTIANIA TO ØSTENSJØ, a distance of about eight kilometres. Work on this line will probably be commenced simultaneously with the construction of the Majorsteun-Sognsvandet railway, a concession for which was also granted recently.

THE GERMAN MINISTER OF FINANCE has issued an Order increasing from 900 to 1900 per cent. the premium or "agio" which is leviable when the "gold" duties of the Customs Tariff are paid in paper currency. The effect of the Order is to double the paper currency duties by requiring 2,000 paper marks to be paid for each 100 marks "gold" duty leviable. The new Order is to take effect on the 20th inst.

The *Manchester Guardian Commercial's* London correspondent states that the vast amount of exports on the NEW SPANISH TARIFF is that, as the Spanish import duties have already been raised once this year, the Board of Trade ought to take active steps to prevent the promulgation of the further increases in the import duties which are scheduled to come into operation next January. It is pointed out that, under a commercial treaty made between this country and Spain in the 'nineties, the Board of Trade could bring considerable influence to bear on the Spanish Customs authorities to modify their present proposals.

Telegraph and Telephone Notes.

On Wednesday evening Mr. J. Scott-Taggart delivered a lecture on "MODERN WIRELESS ACHIEVEMENTS" before the United Wars Club, at Cannon-street Hotel.

It is announced that Mr. Hughes, the Australian Commonwealth Premier, will submit to Parliament proposals for the participation by Australia in a scheme for establishing DIRECT WIRELESS COMMUNICATION WITH GREAT BRITAIN. It is estimated that a quarter of a million will be required for carrying out the project.

Tuesday's issue of the "New York World" contained facsimile reproductions of messages in the handwriting of M. Briand and General Pershing, transmitted from Paris by WIRELESS to AMERICA. It is claimed that this achievement is a step in advance of the transmission of photographs by cable, and is made possible by an invention of M. Edouard Belin.

Press MESSAGES from the BORDEAUX WIRELESS STATION were received aboard the P. & O. steamer "Bradine" throughout her voyage from England to Cape Town. The high-power American stations, including Annapolis and San Francisco, were also distinctly heard throughout the voyage. The vessel is fitted with the latest Marconi three-electrode valve receiving apparatus.

The new CABLE LAYING AND REPAIRING STEAMER "ALL AMERICA," which has been built and engaged by Messrs. Swan, Hunter & Wiggin Richardson, of Newcastle-on-Tyne, to the order of the All America Cables Incorporated, has now run successful trials. The vessel is a twin-screw steamer, about 295 ft. in length over all. She has four cable tanks, three forward and one aft, having a total coiling capacity of about 14,000 cubic ft.

In order to find work for the unemployed, the POST OFFICE authorities have drawn up proposals for extensions of the UNDERGROUND TELEPHONE CABLES, and will be submitted to the Cabinet Committee on Unemployment for examination. If the scheme be approved, work can be found for a considerable number of unskilled men within a few weeks, in laying conduits to carry the new cables. In the manufacture of cables also there would be employment for many men and women. Many hundreds of miles of cables have yet to be laid to complete the linking-up underground of the more important towns throughout the country.

A TELEPHONE CALL OFFICE has been recently opened at RADFORD SEMELE, Warwickshire. From the "Telegraph and Telephone Journal" we learn that this is not the only small parish with a quaint name which the telephone reaches. Ampney Crucis, Zeal, Monachorum, Steeple Bumpstead, Kingston Bagpuze, Lytchett Matravers, Middle Wallop, Upper Slaughter, and many others are thus favoured; but Ryne Intrinsec, Toller Porcum, Whitchurch Canonorum, Kingsbury Episcopi, Collingbourne Ducis, Broadwood Widger, Berrick Salome, Plyford Flavell, Ewyas Harold, Messing, Mucking, and Great and Little Snoring are also amongst those strangely-named villages which are never in a telephonic sense "engaged."

Improvements are projected in the MAURITIUS TELEPHONE SYSTEM, but the Oriental Telephone Company, who own the undertaking, want an extension of the system. The Chamber of Commerce, whose views have been sought on the question, have appointed a committee to deal with the subject. Some of the members are in favour of granting the concession, provided the charges are reduced and the lines throughout the country are overhauled and extended. Important improvements have already been effected by increasing the number of exchanges, but it is now proposed to effect further improvements by affording facilities for connecting private residences in the remote parts of the island with Port Louis.

The motor ship "Seminole," which has arrived at New York, was twice DIVERTED BY WIRELESS INSTRUCTIONS during her voyage from England. She left Avonmouth on Sept. 27 for the Gulf of Mexico to load oil, but on Oct. 4, when she was well on her way across the Atlantic, the owners diverted her to Norfolk (Virginia) by means of a marconigram. On the following day further information made it desirable that the "Seminole" should proceed to New York direct. She was then some 2,000 miles from England, but the Marconi wireless station at Poldhu was able to speak her, and on the 7th inst. the owners received a message from the captain acknowledging the receipt of both sets of instructions. The double diversion by wireless was instrumental in saving much valuable time.

Business Items, &c.

MR. F. S. J. HARDING is now sole proprietor of the Swan Electric Works, Clewer, near Windsor.

MR. J. W. RUSSELL, electrical engineer, of Loates-lane, Watford, has opened additional show-rooms at 8, Queen's-road.

At the quarterly meeting of the ASSOCIATION OF BRITISH CHAMBERS OF COMMERCE this week, a good many strong resolutions were submitted on postal, telegraph and telephone matters. The London Chamber urged the extension and cheapening of postal and telegraphic services, and the restoration of pre-war rates and conditions, with such improvements as may be practicable. Leeds, Great Yarmouth, Derby and Dudley Chambers demanded the resumption of the collection and forwarding of letters on Sundays; and Leicester desired that letters posted on Saturdays should be delivered on Mondays with no greater delay than was the case before the new regulations were put into operation. Northampton protested against the "huge increases in the parcel-post rates" and the new high rates of postage on postcards.

Tenders Invited and Accepted.

UNITED KINGDOM.

LOUGHBOROUGH CORPORATION. OCTOBER 31.—Steam-raising plant. Particulars from Mr. C. H. Wordingham, at 7, Victoria-street, Westminster, S.W. 1; or 11, Moseley-street, Manchester.

GLASGOW PARISH COUNCIL invite tenders by Oct. 24 for the supply of electric lamps and fittings, ironmongery, &c., for twelve months. Tender forms from Mr. M. A. Reynard, 266, George-street.

LONDON COUNTY COUNCIL. OCTOBER 24.—Electric goods lift (50 cwt.) for Stamford Hill Stores Depot. Specification, &c., from the Chief Engineer, Spring-gardens, S.W.

H.M. OFFICE OF WORKS. OCTOBER 24.—Electric lamps. Tender forms from the Controller of Supplies, King Charles-street, Westminster, London, S.W.

CWM MON. OCTOBER 31.—Re-wiring the Cwm and Tallstown Institute.

FALKIRK PARISH COUNCIL. NOVEMBER 5.—Six months' supply of electric lamps to Blinkbonny Home. Forms of tender from the Governor.

LONDON COUNTY COUNCIL. NOVEMBER 23 (4 p.m.).—Manufacture, supply and erection of water-tube boilers, with superheaters and economisers, &c. Specifications and tender forms from, and tenders to, the Clerk of the Council, County Hall, Spring Gardens, S.W. 1.

AUSTRALIA.

VICTORIAN RAILWAY COMMISSIONERS. NOVEMBER 2.—* Storage battery, with accessories and spares (contract No. 34 229).

VICTORIAN GOVERNMENT RAILWAYS. NOVEMBER 9 (extension of time).—The date for receiving tenders for armature banding machinery, with motor and starting gear (contract 34 378).

VICTORIAN GOVERNMENT RAILWAY COMMISSIONERS. JANUARY 4, 1922.—*60 tons-galvanised telegraph wires (contract No. 34 705); 23 steam meters and accessories for Newport power house (No. 34 611); and 150 electric train stops for power signalling (No. 33 546). Tenders must be accompanied by a preliminary deposit of half per cent. of total amount of tender, and local representation is essential.

NEW ZEALAND.

WELLINGTON, PUBLIC WORKS DEPARTMENT. NOVEMBER 29.—In connection with Mangahoe electric power scheme. * Section 12: Three water-wheels of 6 450 B.H.P., and two water-wheels of 3 225 B.H.P., complete with governors, couplings, and accessories; Section 13: Three 6 000 kVA and two 3 000 kVA alternating-current generators; Section 14: two three-unit exciter sets, each consisting of one 375 B.H.P. Pelton wheel, one 250 kW direct-current generator, and one 350 H.P. asynchronous motor; Section 15: seven 4 000 kVA single-phase transformers and accessories; Section 17: insulators for 110 000 V, 50 cycle transmission lines; Section 18: lightning arresters for operation on two 110 000 V three-phase transmission lines; Section 19: switchboard, switches, and accessories.

WELLINGTON, PUBLIC WORKS TENDER BOARD. NOVEMBER 1.—* New or second-hand auxiliary plant for the Rotorua electric supply as follows:—One oil engine (200 to 250 B.H.P.) and one three-phase 50 cycle alternator of 190 kW (power factor of 0.8), with exciter, &c. Also for steel pipe lines and fittings in connection with the Mangahoe power plant.

WELLINGTON, CONTROLLER OF STORES, POST AND TELEGRAPH DEPARTMENT. NOVEMBER 21.—* 750 red and 750 white switchboard cords (three conductor, to specification No. 87).

INDIA.

CALCUTTA ELECTRIC SUPPLY CORPORATION, LTD. NOVEMBER 9.—One 15 000 kW turbo-alternator and condensing plant, and two water-tube boilers, each of 60 000 lb. evaporative capacity. Specifications from the consulting engineers, Messrs. Kennedy & Donkin, 17, Victoria-street, S.W. 1.

SOUTH AFRICA.

RAND WATER BOARD'S MAIN PUMPING STATION, VEREENIGING. NOVEMBER 7.—Two steam-driven electrical generating sets of 350 kW capacity, each complete with switchboards and all accessories. Tenders to the Secretary of the Board, Central House, P.O. Box 1 703, Johannesburg.

ADMINISTRATION OF THE SOUTH AFRICAN RAILWAYS AND HARBOURS. NOVEMBER 7.—* For twelve months, from December 31, of 85 560 incandescent train lighting lamps (tungsten filament) for 24 V, 8 to 10 c.p.; 8 125 engine head lamps, 150 W, 32 V (gasfilled $\frac{1}{2}$ W type, with concentrated filament); 50 472 incandescent lamps (tungsten filament); 5 545 incandescent lamps (carbon filament).

MUNICIPAL CORPORATION OF HUMANSDORP, CAPE PROVINCE. NOVEMBER 30.—Machinery and plant. Section A: one water turbine and dynamo, switchboard with connections, battery of accumulators, and accessories for same; Section B: electricity supply main and public lighting; aerial distributing lines, street lamps, fittings and accessories, section boxes, service cut-outs, meters, &c.; Section C: ferro-concrete pipe line; Section D: reinforced-concrete tank; Section E: buildings and foundations. Further particulars from the Town Clerk, Humansdorp.

JOHANNESBURG MUNICIPAL COUNCIL.—Nov. 18.—*One water-tube boiler with superheater, economiser, mechanical stokers, &c. Tenders to Town Clerk. Local representation is desirable.

* Particulars from the Department of Overseas Trade.

SOUTH AMERICA.

ARGENTINE STATE RAILWAYS. NOVEMBER.—* One year's supply of railway signal material, telephone and telegraph materials.

ARGENTINE DEPARTMENT OF NAVIGATION AND PORTS.—Nov. 3.—* Electrical anemometers and anemographs, thermographs, barographs, tide gauges, and rain gauges. Specification, &c., can be seen until Oct. 15 and obtained on loan after that date at the Department of Overseas Trade, 35, Old Queen-street, S.W.

GREECE.

ATHENS.—Nov. 14.—*New telephone installation of central battery type and of an approximate capacity of 5 000 local lines, forty inter-urban lines, and at least fifty special lines connecting Athens with the Piræus.

ROTTERDAM CORPORATION have accepted the tender of L. J. L. J. for wiring and fitting 100 houses.

PORTSMOUTH Council has accepted the tender of Pierson & Company for steel work at the electricity station at £525.

The tender of W. P. Galloway, Ltd., at £7 590, has been accepted by EDINBURGH Corporation for the supply of tramway poles.

GLASGOW Corporation have placed an order with Allan & McGowan for wiring and fitting at Merkland Wharf at £1 947.

FULHAM (London) Council have accepted the tender of Mather & Platt for circulating pumping plant at the electricity works at £1 547 11s.

The Urban District Council of ST. ANNES-ON-THE-SEA have accepted the tender of Siemens Brothers & Company for the supply and laying of cables.

The METROPOLITAN ASYLUMS BOARD have accepted the tender of the Commercial Telephone and Electric Company for wiring ward blocks, &c., at the Grove Hospital at £1 292.

DONCASTER Corporation have accepted the tender of Sprakes & Sons for the construction of waterway and sump in connection with plant extensions at the electricity works, for £964.

STOUBRIDGE Council has accepted the tender of the Woodrow General Mechanical and Electrical Engineering Company for wiring the Town Hall offices, Market Hall, and Corn Exchange, at £428 15s.

EDINBURGH Corporation have accepted, on the recommendation of the Electricity, a British tender for steel for Gorgie and Morning-side sub-stations, and for the pump-house at Portobello. The Committee did not accept the lowest offer in view of the large amount of unemployment, the lowest tender being by a foreign firm.

In connection with the ELECTRICAL EQUIPMENT OF THE NEW COUNTY HALL, the London County Council have recently accepted a number of tenders, including the following:—

Waygood Otis, Ltd., for three passenger lifts, with car bodies and spares, £6 150; Express Lift Company, one lift in well-hole at junction of blocks 1, 4 and 7, £1 354 (including £200 for a cage suitable for handling furniture, &c., and subsequent installation of one for passengers, and £120 for contingencies), two book lifts, £1 080, and one passenger lift for £1 855.

For the supply and installation of main and circuit cables, six tenders were submitted, varying in amount from £2 724 (Pirelli General Cable Works, Ltd.) to £3 508 (Siemens Bros. & Company), and the lowest tender was accepted. Subsequently the building contractors were instructed to obtain from the Pirelli General Cable Works additional main and circuit cables, at an extra cost not exceeding £3 100.

Messrs. Dorman & Smith are supplying, at an extra cost, estimated not to exceed £1 500, additional main lighting switchboards for the new County Hall on the basis of their existing sub-contract. The work of installing synchronised clocks has been entrusted to Gillett & Johnston at £2 566. There were five tenders for the clocks, the highest being £5 722.

Arrangements have been made with the building contractors for the protection of the new Hall against lightning, at an estimated cost of £2 800. Designs for the electric light fittings for the Council-chamber, lobbies, and rooms on the principal floor (including chief officers' rooms) have been approved. The electric fittings in certain of the finished rooms used as offices are in the first instance to be of a temporary nature, so that the type and arrangement of the permanent lighting fittings can be determined after the office furniture and fittings are placed in permanent position in the rooms.

In our issue of Aug. 5 last we referred to the acceptance by LONDON COUNTY COUNCIL of the tender of Brown, Boveri, & Company for the supply of an 8 000 kW turbo-alternator for Greenwich power station, subject to certain conditions. The Highways Committee reported at the last council meeting that they decided, with the concurrence of the General Purposes Committee, to accept the alternative offers of Brown, Boveri & Company, amounting to £45 939. The following were the amounts of the tenders received: the alternative offers (which are in parenthesis) being on the condition that there was no objection to material being obtained from abroad:—Ateliers de Construction Oerlikon (British, Irish, and Colonial Department), £45 886 at 22fcs. to £1; Brown, Boveri & Company, £45 916 at 22fcs. to £1 (£45 939, irrespective of rate of exchange and including £500 in respect of special works); Escher, Wyss & Company, £52 484; Daniel Adamson & Company, £60 104 (£50 800); English Electric Company, £61 738 (£52 340); C. A. Parsons & Company, £62 639 (£53 110); British Thomson-Houston Company, £62 713 (£53 303); Richardson, Westgarth & Company, £62 860 (£53 280); Belliss & Morcom, £63 341 (£54 290); Metropolitan-Vickers Electrical Company, £63 387 (£50 725); James Howden & Company, £64 954 (£47 410, incomplete); Fraser & Chalmers Engineering Works, £64 954 (£55 050).

Miscellaneous.

The late Mr. R. Braithwaite, of Liverpool, bequeathed £20 000 to the LIVERPOOL UNIVERSITY.

The death is announced of Mr. H. LAWS, an official of the Ilford electrical department. While riding a bicycle he collided with a motor-car, and he succumbed to his injuries.

The death took place on Oct. 8, at the age of 43 years, of Mr. E. R. SIMMONDS, who was the original partner with Mr. Allen in the firm of Allen & Simmonds, electrical engineers, of Reading.

The death took place at Berlin on the 14th inst. of Mr. WILHELM EDWARD MANDLERIK, formerly secretary and business manager of the London Underground Railways and of the General Omnibus Company.

The late Mr. FREDERICK GUSTAV BYNG left estate of the value of £87 872, with net personality £76 774. The testator gave £2 000 to the Provost and scholars of Oriel College, Oxford, for a scholarship for pupils of Harrow School; and £1 500 for charitable institutions.

In the article dealing with "COSMOS" DOMESTIC APPLIANCES, on page 462 of our Autumn Trade Promotion Number (Oct. 7), the "correct ironing temperature" of the domestic iron was given (in consequence of an error in the copy) as 150 deg. F. This should be 150 deg. C.

An arrangement has been made in the LIGHT CASTINGS TRADE for the withdrawal of the Ministry of Munitions bonuses, in three equal instalments, on Oct. 31, Dec. 5, and Jan. 2, 1922. The Employers' Federation agree that no application for further reduction of wages shall be made by them before May, 1922. Between 20 000 and 30 000 workers are affected.

Lady Ellis, wife of the chairman of the ENGLISH ELECTRIC COMPANY, LTD., opened the clubhouse equipped for the use of the girl employees of Messrs. Dick, Kerr & Company on Oct. 12. Mr. R. Livingstone, the works manager, presided. The club, which is situated in Strand-road, will have, including debating and dramatic societies, classes for dancing and occasional lectures.

The first meeting for the winter session of BENN BROTHERS' SOCIAL CIRCLE was held on Friday last at the Eustace Miles Restaurant, and took the form of a whist drive. The directors were represented by Mr. F. H. Elliott, and the prizes were distributed by Mrs. Elliott. A pleasant evening concluded with music and dancing. The Debating Section has made a successful start, and on Monday evening there was a spirited discussion on the Irish question. Arrangements are in progress for the formation of a Dramatic and Musical Section.

Catalogues, Price Lists, &c.

A stock list of two and three phase induction motors has been issued by Messrs RAYNER & HEALD, LTD., of Derby.

The new price list of the WELCO PATENTS, Birmingham, includes particulars of a number of electric fires, kettles, toasters, irons, and other appliances of a domestic character.

An illustrated price list of E. M. I. ELECTRIC FANS AND SMALL POWER MOTORS has been issued by Messrs. Hogan & Wardrop, 88, Golden-lane, E.C. 1. Particulars and prices are given of a variety of desk, bracket, ceiling and porthole fans for d.c. and a.c. circuits, small power motors, grinding and polishing machines, &c. The firm specialise in ceiling fans (a.c. and d.c.) for tropical climates, as well as standard types of desk and porthole fans and small motors.

A neat and inexpensive leaflet setting out effectively and in clear terms the advantages of ELECTRIC FIRES has been issued by the ELECTRICAL DEVELOPMENT ASSOCIATION, 84, Kingsway, London, W.C. 2. As we are at the commencement of the heating season, contractors and supply engineers might with advantage distribute these leaflets, which can be obtained at 36s. per 1 000, or, in smaller quantities, at 4s. per 100. The name and address can be over-printed at a small extra cost.

Details of the design and construction of the REES-ROTORBU PUMPS are given in a well-illustrated pamphlet which has been issued by the Rees-Rotorbu Manufacturing Company, of Wolverhampton. In addition to several illustrations of complete pumps, there are sectional views of the parts of double and single entry types of single-stage as well as of multi-stage pumps. The pamphlet concludes with a summary of the advantages claimed for the Rees-Rotorbu, which include universal self-regulation, high efficiency, robust construction, accessibility, and small number of parts, which are standardised.

Particulars of the design and construction of the ALCO ELECTRIC WASHER and wringer are set out in list No. 337 of the SUN ELECTRICAL COMPANY, LTD., 118-120, Charing Cross-road, London, W.C. 2. The Alco is made in two sizes, single-tub and double-tub, and operates on the dolly principle. The machine is of very substantial construction, and it is claimed that it will be equal to the hardest day's work. It is provided with a full swinging wringer that can be locked in any position, and a folding bench is attached without extra charge. The company state that in the present position of the development of washing machines, the cylinder type, represented by the A B C SUPER-ELECTRIC, is the best way of electrically washing clothes, yet the Alco is an efficient device which operates on a system known to large numbers of the British public. Either of the Alco machines is so designed as to operate model D "A B C" ironer in the same way as the Super-Electric washer.

Companies' Reports, &c.

Presiding over the annual meeting of the TRAFORD PARK ESTATES, LTD., on the 13th inst., the chairman (Mr. A. Marshall Stevens, M.P.) said that, in spite of the adverse conditions of trade, they were still disposing of land, and during the year several firms had acquired more land. Messrs. S. Dixon & Son, of Leeds, had established a depot in the park, as also had the Ingersoll Rand Company, and other companies. The Park Electrical Company were building new premises.

The Tramways.

In regard to the tramways, a loss had been turned into a profit, but new conditions had to be faced. The agreement with the Manchester and Salford Corporations terminated at the same time as did the agreement between those corporations and the Stretford and other local authorities. There was a disposition at present amongst tramway authorities to avoid further expenditure upon permanent way, and it might be that under any new arrangement the overhead electric wires would be utilised for trackless omnibuses, in addition to, or entirely to replace, the ordinary electric trams, and if it be found necessary for the statutory company to make an application to Parliament, and a friendly arrangement could be come to with Eccles Corporation and the Davyhulme authority, it might be decided to join the Trafford Park and Patriotic by an overhead trolley service.

The net profit for the year amounts to £67 581, an increase of £11 581 over last year, and an increase of £31 119 over 1919. The balance to credit of profit and loss account amounted to £187 603, after providing £10 900 for corporation profits tax, paying a dividend of 8 per cent., which will absorb £52 000, leaving £135 603 to carry forward.

The directors of INDICATORS, LTD., are inviting subscriptions for 15 327 7 per cent. cumulative preferred participating shares of £1 each.

The directors of the ANGLO-AMERICAN TELEGRAPH COMPANY, LTD., have declared an interim dividend for the quarter ended Sept. 30 of 15s. per cent. on the ordinary stock.

The directors of the INDO-EUROPEAN TELEGRAPH COMPANY, LTD., have declared an interim dividend for the past half year at rate of 5 per cent. (tax free), as in previous year.

The directors of the UNITED RIVER PLATE TELEPHONE COMPANY, LTD., announce an interim dividend of 3 per cent. (3s. per share) on the old ordinary shares (Nos. 1 to 324 000), tax free, and payable Nov. 1.

The directors of STOTHERT & PITT, LTD., have declared a final dividend of 7½ per cent. actual (tax free), making 12½ per cent. for the year (as in previous year). A sum of £21 721 has been carried forward.

The directors of the NORTH WALES POWER AND TRACTION COMPANY, LTD., are offering privately £200 000 8 per cent. first mortgage debentures at 97, which are guaranteed by the Aluminium Corporation.

The profit of the ASSOCIATED FIRE ALARMS, LTD., for the year ended June 30 (after reserving £1 082 for income tax and corporation tax, was £3 126, plus £3 841 brought in, making £6 967, which it is proposed to carry forward.

The Stock Exchange Committee have specially allowed dealings in provisional scrip certificates for 50 000 8 per cent. £10 cumulative second preference shares (£3 paid and fully paid) of the CLYDE VALLEY ELECTRICAL POWER COMPANY.

A petition has been presented in the High Court of Justice for confirming a reduction of the capital of P. R. JACKSON & COY., Limited and Reduced, from £120 000 to £60 000. Any person not entered on the list of creditors and claiming to have been a creditor on Sept. 25, 1921, should send particulars to Messrs. Taylor, Kirkman & Mainprice, 8, John Dalton-street, Manchester, by Nov. 9.

The report of the directors of the NORWICH ELECTRIC TRAMWAYS COMPANY for the past year states that the receipts were £79 814, compared with £72 463 in the previous year, and the net profit was £3 933 (compared with £10 863). Receipts increased, owing to higher fares, in spite of a reduction in the number of passengers carried, from 14 671 084 to 12 856 372. Car miles also showed a reduction from 947 448 to 943 423. Earnings per car mile were 20.30d. (18.36d.), and expenses 18.65d. (14.94d.).

The report of the directors of DRAKE & GORHAM, LTD., for the year ended June 30, 1921, states that, after payment of all charges, including bonuses due to staff, interest paid and accrued on seven-year notes, interest on loan, writing off expenses in connection with issue of notes and loan, and making provision for contingencies, the net profit is £13 433. With £12 235 brought forward the total is £25 668, out of which it is proposed to pay a dividend at the rate of 6 per cent. for the year (£7 500), to write down goodwill by £5 000, to place £7 400 to reserve for excess profits duty and corporation profits tax, and carry forward £5 768. Although the results in the earlier part of the financial year were satisfactory, they were adversely affected during the later months by general trade depression and the electricians' and coal strikes. In December an issue of £50 000 10 per cent. seven-year notes was made, the amount being largely over-subscribed. A loan of £12 000 has also been secured on the lease of the head offices. The capital thus provided was essential for the conduct of the business then in hand, but owing to the reduction in turnover which has since taken place the directors are considering the advisability of extending the sphere of the company's operations in other directions.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Partnerships Dissolved.

CROSLAND, George Frederick Benjamin, and BATESON, Herman Douglas, as electrical engineers, at Bradford-road, Batley, under the style of Crosland & Bateson, by mutual consent as at Oct. 8, 1921. Debts received and paid by G. F. B. Crosland.

HORTON, Joseph, PARKIN, Frank, PRICE, George, PARKIN, John William, PARKIN, Fred, and JONES, Henry, as electrical welders, at Grove Works, Grove-lane, Smethwick, under the style of the Smethwick Arc Welding Company, as from Oct. 8, 1921, by mutual consent.

KNOWLES, Joseph Leslie, and ELLISON, John, as electrical factors, under the style or firm of the Key Electrical Supplies Company, at 109-111, Portland-crescent, Leeds, by mutual consent as from Sept. 23, 1921, so far as regards J. L. Knowles, who retires. Debts received and paid by J. Ellison, who will continue the business.

Bankruptcy Information.

BLOWER, Arthur Ernest, Braeside, The Common, Uxbridge, Middlesex, lately carrying on business at 1 and 3, Paul's Bakehouse-court, Godman-street, London, E.C., under the style of Blower & Cooper, electrical engineers' merchant. Date of receiving order, Oct. 11, debtor's petition. First meeting, Oct. 25, 11 a.m.; and public examination, Dec. 15, 11 a.m., Bankruptcy-buildings, Carey-street, London, W.C. 2.

WORTHINGTON, Vincent Broughton, Ellesmere-yard, Walkden, co. Lancaster, electrical and mechanical engineer. First meeting, Oct. 25, 3.30 p.m., Official Receiver's Offices, Byrom-street, Manchester. Public examination, Nov. 9, 10.30 a.m., Court House, Encombe-place, Salford.

Notices of Dividends.

DICKINSON, Albert Edward, 157, Hunslet-road, Leeds, under the style of the Crown Electrical Company, electrical engineer and contractor. Amount per £. 11½d., first and final, payable Oct. 25, Official Receiver's Offices, 24, Bond-street, Leeds.

LORD, Albert, residing and carrying on business at 33, Westgate, Burnley, electrical contractor. Amount per £. 5½d., first and final, payable Oct. 24, Official Receiver's Office, 13, Winkley-street, Preston.

STEEL, Charles Henry, 1, Nelson-square, Bradford, lately carrying on business at 53, Queen-street, Cardiff, and 65, High-street, Merthyr Tydfil, electrical engineer. Amount per £. 2s., first and final, payable Oct. 21, Official Receiver's Office, 34, Park-place, Cardiff.

Company Winding-up Voluntarily.

THE T.B.S. ELECTRICAL CONSTRUCTION COMPANY, LTD. F. C. Goodman, of the firm of Albert Goodman, Sons, Pollard & Braybrooks, chartered accountants, of Broad-street House, E.C. 2, appointed liquidator.

Liquidators' Notice.

AMALGAMATED ELECTRIC WORKS, LTD. T. J. Wilson, of 59-60, Old Bailey, E.C., has been appointed sole liquidator in place of J. Lindsay Mahon on his retirement.

Edinburgh Gazette.

The estates of JAMES F. BOLAND, electrical and motor engineer, Flemington Garage, Motherwell, were sequestrated on Sept. 21. William Brodie Galbraith, chartered accountant, 87, St. Vincent-street, Glasgow, has been elected and confirmed trustee; and John W. Morton, a partner of Bergougnan Tyre Service, 83, Douglas-street, Glasgow, Peter John Nicholls, accountant of the General Electric Company, Ltd., 71, Waterloo-street, Glasgow; and Andrew Taylor, partner of the firm of Andrew Taylor & Son, 47, Oswald-street, Glasgow, have been elected and confirmed commissioners. Public examination of the bankrupt Oct. 20, 1921, at the Sheriff Court House, County Buildings, Hamilton, at 10.30 a.m. Second meeting of creditors at the chambers of Walter & W. B. Galbraith, C.A., 87, St. Vincent-street, Glasgow, Nov. 28, at twelve noon. Oaths and grounds of debt must be lodged by Nov. 3.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors, we do not report subsequent county court judgments against him.]

DURAL RECORDER COMPANY, LTD., 110 and 116, Victoria-street, S.W., dealers in motor accessories. £34 0s. 6d. Sept. 9.

ELECTRIC INSTALLATION COMPANY, 16, The Arcade, Dudley-street, Wolverhampton, electrical engineers. £21 1s. July 8.

MODERN FACILITIES INCORPORATED, 4, Monson-street, Lincoln, electrical engineers. £15 8s. Sept. 10.

MORGAN, Mr., 18, Maywood-avenue, Fishponds, electrician. £15 8s. 1d. Sept. 13.

SMITH, George, 7, Wellington-square, Chelsea, electrical engineer. £45 0s. 11d. Sept. 5.

SMITH, George, 146, Sloane-street, Sloane-square, S.W., constructional and electrical engineer. £77 9s. Sept. 5.

Bill of Sale.

[The undermentioned information is from the Official Registry. It includes Bills of Sale registered under the Act of 1882 and under the Act of 1878. Both kinds require registration every five years. Up to the date the information was obtained it was registered as given below; but payment may have been made in some of the cases, although no notice had been entered on the Register.]

BORRITT, Thomas, 20, Hall-street, Great Lever, Bolton, electrician. Oct. 13. £30.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

TWISS ELECTRIC TRANSMISSION, LTD. (late Twiss Engineering and Electric Transmission, Ltd.), London, S.W.—Registered Oct. 7, £12,000 debts. (filed under sect. 93 (3) of the Companies (Consolidation) Act, 1908), present issue £6,000; general charge. * Nil. June 10, 1920.

Mortgage Satisfaction.

EXCHANGE TELEGRAPH COMPANY, LTD., London, E.C.—Satisfaction registered Oct. 7, covenant increasing rate of interest payable on £22,000, registered Feb. 4, 1919.

Prices of Metals, Chemicals, &c.

		Price.	TUESDAY, OCT. 18.	
			Inc.	Dec.
Copper—	Best selected .. per ton	£67 5 0	—	£3 0 0
	Electro Wirebars	£76 0 0	—	£1 10 0
	H.C. wire, basis .. per lb.	0s. 11½d.	—	½d.
	Sheet	0s. 11½d.	—	—
	Phosphor Bronze Wire (Telephone) — Phosphor-Bronze wire, basis	1s. 3½d.	—	½d.
Brass 60 40—	Rod, basis	0s. 8d.	—	—
	Sheet, basis	0s. 10½d.	—	—
	Wire, basis	0s. 11½d.	½d.	—
	Pig Iron— Cleveland Warrants .. per ton	£6 10 0	—	—
Lead Pig—	Galvanised steel wire, basis 8 SWG ..	£23 0 0	—	—
	English	£24 15 0	15s.	—
	Foreign or Colonial ..	£23 17 6	15s.	—
Tin—	Ingot	£157 15 0	£1 15 0	—
	Wire, basis per lb.	2s. 1½d.	—	½d.
Salammoniac.—Per cwt. 65s.-60s.			Copper Sulphate.—Per ton £30.	
Sulphur (Flowers).—Ton £13.			Boric Acid (Crystals).—Per ton	
(Roll-Brimstone).—Per ton			£65.	
£13.			Sodium Dichromate.—Per lb. 7½d.	
Sulphuric Acid (Pyrites, 168°).—			Sodium Chlorate.—Per lb. 4½d.	
Per ton, £9 17s. 6d.				
Rubber.—Para fine, 1s. 1½d.; plantation 1st latex, 9½d. lb.				

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber prices by W. T. Henley's Telegraph Works Co., Ltd.

The Editor, Advertisement and Publishing Offices of "THE ELECTRICIAN" are at 8, Bouverie Street, London, E.C. 4. Telegrams: Benbroctric, Fleet, London. Telephone: City 9852 (5 lines). The subscription to "THE ELECTRICIAN" is £2 12 0 per annum in the United Kingdom, and £2 14 0 per annum abroad. Advertisement Rates can be obtained on application to the Manager. Advertisement copy and blocks should be received on the Friday preceding date of publication.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. MEMBERS, LEBES & CO., Chartered Patent Agents, 5, and 72, Chancery-lane, London, W.C.

COMPLETE SPECIFICATIONS.

- 141,705 **SHERRIN SCHUBERTHEIM GKS.** Method of making electric apparatus.
(12/20)
Relates to a cathode for metal vapour electric apparatus in which the electric arc is caused to move by a magnetic field produced in the proximity of the cathode arc, and in which the effective surface of the cathode is limited to an annular or similarly shaped surface and the magnetic field is so arranged that the cathode arc is caused to travel on the surface of the electrode in determined closed paths.
141,710 **SHERRIN SCHUBERTHEIM GKS.** Apparatus for obtaining substantially uniform electric currents from pulsating currents.
(12/20)
142,112 **ZACHAR, J. SOHNE, J.** Electro-magnetic clamps or work holders.
(12/20)
142,828 **EHRLMANN, P.** Devices for cooling electric machines. (4/4/19.)
143,122 **ARMSTRONG ELECTRIC CO. LTD.** Telephone systems. (27/1/19.)
143,123 **ZACHAR, J. SOHNE, J.** Sparking plugs. (28/8/19.)
146,204 **SOC. FRANCAISE RADIO-ELECTRIQUE.** Electro-magnetic wave receiver for transmitting telegraphical signals. (12/24/20.)
147,574 **ELDRICH SCHUCHMUTZ BERLINER TELEFON- UND TELEGRAPHEN-WERKE.** Device for strengthening telephone currents and other electrical oscillations. (30/4/17.)
147,771 **WRIGHT, C. G.** Apparatus construction for dynamo electric machines. (19/11/14.)
153,319 **LATOUR, M.** Thermionic tube relay arrangements. (27/9/15.)
156,603 **LYON, D.** Electrical heater or warming device. (23/10/20.)
156,610 **BROWN, S. G.** Electric aural apparatus, more especially for use by deaf persons. (25/10/20.)
156,613 **HACKBRIDGE CABLE CO., LTD., & KENNETT, W. C.** Electric transmitters. (11/1/20.)
156,615 **WHITE, J. C.** Junction box for electric wiring systems. (18/2/20.)
156,627 **RAILING, A. H., & ANGOLD, A. E.** Arc lamps. (14/12/20.)
156,634 **MACDONALD, K. A., ABEY, H., & MORRIS-SHEARING, G., & RANDALL, R. L.** Wireless transmitting circuits employing thermionic valves. (16/3/20.)

APPLICATIONS FOR PATENTS

May 13, 1921.

- 13,877 **WHITE.** Telephone automatic burglar and fire alarm.
13,909 **FERRITA & QUAIN.** Variable vibratory contact devices for electric circuits.
13,910 **PHIL-KAPPA SYND. & KLUITMANS.** Electric heating elements.
13,932 **ATKINSON, P. BELLE.** Indicator for electric circuits.
13,936 **MIDDLETON.** Electric generators.
13,952 **B. T. H. Co. (G. E. Co.).** Signal receiving systems.
13,953 **B. T. H. Co. (G. E. Co.).** Switches.
13,954 **CURTIS.** Commutators for electric machines.
13,955 **WALLACE.** Bell pushes, &c.
13,961 **WHITE (Elyria Iron and Steel Co.).** Electric butt welding and tubes produced thereby.
13,971 **WALL.** Means for limiting change of speed in a.c. generators.
13,977 **ROSEND.** Thermionic devices.
13,997 **HOLLIS.** Chains for electroliers, &c.
14,029 **STONE.** Electrical resistances.
14,040 **WESTERN ELECTRIC CO. & VAN RUTTEN.** Telephone transmitter mouthpieces.
14,055 **DONISTHORPE.** Thermionic valves.
14,056 **ELNEGAARD.** Single phase short-circuited motors.
14,063 **B. T. H. Co. (G. E. Co.).** Amplifying systems.
14,065 **RODGER.** Means for ploughing with electric tractor.
14,066 **METROPOLITAN-VICKERS ELECTRICAL CO.** Protective devices for electric circuits. (9/6/20, U.S.)
14,079 **SULLIVAN.** Submarine electric cables.

May 20, 1921.

- 14,068 **GOVER.** Switches.
14,135 **PRINETTI.** Arching clamp for overhead lines.
14,140 **B. T. H. Co. (G. E. Co.).** Electron discharge apparatus.
14,144 **OVERBERGER.** Incandescent lamps, &c.
14,145 **SIGNAL GKS.** Sound direction finding. (21/5/20, Germany.)
14,149 **COHEN.** Apparatus for regeneration of spent dry cells.
14,151 **GLASER.** Current regulating devices.
14,157 & 14,160 **DEARLOVE.** Submarine cables.
14,166 **GES. FÜR DEARLOVE, TELEGRAPHIE.** Regulating speed of electrical machines. (9/12/20, Germany.)

May 21, 1921.

- 14,194 **ANGOLD & RAILING.** Mineral electric hand-lamps.
14,204 **B. T. H. Co. (G. E. Co.).** Lamp sockets.
14,218 **ATKINSON.** Inductance coils for wireless telegraphy, &c.
14,220 **MACDONALD.** Electric motors.
14,222 **DORSON.** Combined electric transformer and hammer.
14,226 **LODGE FUME CO.** Electrical precipitation apparatus.
14,227 **LODGE FUME CO. & STALLARD.** Electrical precipitation apparatus.
14,232 **ROSENDAHL.** Producing perforated tape by electric current impulses.
14,272 **BROWNLOW & HADLEY.** Current-controlling arrangement.
14,288 & 14,290 **TUCKER.** Combined switches and plugs.
14,292 **MCCOMB.** Bases for trolley poles for electric vehicles.
14,293 **LYTO, LTD., BOITE & ENDOCK.** Galvanic batteries or cells.
14,312 **ALEXANDER (Iverson).** Electric flat irons.
14,314 **M. L. EXPERIMENTAL LTD., & LUCAS.** Electric ignition of signals, &c., to be dropped from the air.
14,315 **B. T. H. Co. (G. E. Co.).** Cutter Hammer Mix. Co. Low voltage protective circuit controllers.
14,316 **B. T. H. Co. (G. E. Co.).** Cutter Hammer Mix. Co. Motor

May 23, 1921.

- 14,324 **MIDGLEY.** Electric machines.
14,325 **MIDGLEY.** Control of electric machines.
14,330 **HIBERN.** Electric coding machine.
14,331 **COHEN.** Electric switches.
14,332 **GALLA O. S.** Apparatus for electric apparatus, &c.
14,333 **B. T. H. Co. (G. E. Co.).** Electron discharge apparatus.
14,334 **B. T. H. Co. (G. E. Co.).** Constant-current regulated switches.
14,352 **WATCLIFF CO. & HINCHLIFF & WATSON.** Commutators.

Arrangements for the Week.

FRIDAY, Oct. 21st (to-day).

INSTITUTION OF MECHANICAL ENGINEERS.

6 p.m. At Storey's-gate, London, S.W. Eleventh Report of the Alloys Research Committee "On Some Alloys of Aluminium," by Dr. W. Rosenhain, F.R.S., and Messrs. S. L. Archbutt and D. Hanson.

ELECTRICITY SUPPLY COMMERCIAL ASSOCIATION.

7.45 p.m. At Anderson's Hotel, Fleet-street, London, E.C. Bohemian concert.

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, London, S.W. Lecture on "Pyrometry for Boilers: Some Questions Pertinent and Impertinent," by Mr. C. E. Foster.

SATURDAY, Oct. 22nd.

BIRMINGHAM AND DISTRICT ELECTRIC CLUB.

6.30 p.m. At the Grand Hotel, Birmingham. Eleventh Annual Ladies' Night.

MONDAY, Oct. 24th.

INSTITUTION OF ELECTRICAL ENGINEERS.

(NORTH-EASTERN CENTRE.)

7.15 p.m. At Armstrong College, Newcastle-on-Tyne. Inaugural Address, "Engineering Application of Electricity in Gases," by Prof. W. M. Thornton, D.Sc.

TUESDAY, Oct. 25th.

WOMEN'S ENGINEERING SOCIETY.

6.15 p.m. At the Club Room, 26, George-street, Hanover-square, London, W. Lecture on "Stainless Steel," by Miss C. Griff, A.M.I.A.E., Birmingham Met. Soc., &c.

WEDNESDAY, Oct. 26th.

ROYAL INSTITUTE OF PUBLIC HEALTH.

4 p.m. At the Institute, 37, Russell-square, London, W.C. Lecture on "The Political Significance of Industrial Hygiene," by Mr. R. M. Wilson, M.B.

INDUSTRIAL LEAGUE AND COUNCIL.

7.30 p.m. At Caxton Hall, Caxton-street, London, S.W. Lecture on "Profit Sharing and the Coal Settlement," by Mr. E. W. Mundy, B.A.

FRIDAY, Oct. 28th.

PHYSICAL SOCIETY.

5 p.m. At the Imperial College of Science, South Kensington, London, S.W. Papers to be read: "On the Use of Anderson's Bridge for the Measurement of the Variations with Frequency of the Capacity and Effective Resistance of a Condenser," by Mr. S. Butterworth, M.Sc.; "The Elimination of Earth Capacity Effects in Alternating Current Bridges," by Mr. S. Butterworth, M.Sc.; "An Automatic Voltage Regulator," by Mr. F. G. H. Lewis; and "The Flow of Viscous Liquids through Slightly Conical Tubes," by Prof. A. S. Hemmy.

INSTITUTION OF MECHANICAL ENGINEERS.

6 p.m. At Storey's Gate, London, S.W. Discussion on the Eleventh Alloys Report.

ELECTRICAL POWER ENGINEERS' ASSOCIATION (SOUTHERN DIVISION).

7 p.m. At Central Hall, Westminster, S.W. Lecture on "Notes on Surface Condensing Plant," by Mr. J. E. Johnson.

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, Westminster, S.W. Lecture on "Water Gas Manufacture," by Mr. F. Colin Sutton.

SATURDAY, Oct. 29th.

ELECTRICAL POWER ENGINEERS' ASSOCIATION (SOUTHERN DIVISION).

5.30 p.m. At the Hotel Cecil, London. Third Annual Dinner to members of National Executive Council.

Forty Years Ago.

(THE ELECTRICIAN, OCTOBER 22, 1881.)

THE ELECTRIC LIGHT AND MILITARY OPERATIONS.—The electric light was made use of last week at some night operations carried out at Chatham. Bodies of men were discovered with ease by its aid at over 1,000 yards away.

SECONDARY BATTERY.—M. Rousse has described, in a note to the French Academy, a secondary battery in which he employs for the negative pole, a plate of palladium, and for the positive a plate of lead. The liquid employed is one of sulphuric acid to ten of water.

CITY AND GUILDS OF LONDON INSTITUTE.—The programme of technological examinations has just been issued. Among other alterations the subjects of "Electric Lighting and Transmission of Power" and "Electrical Instrument Making" have been added, and have been classed with "Telegraphy" as branches of electrical engineering. The examiners in electrical subjects are: G. Gore, F.R.S., for electro-metallurgy; W. H. Preece, F.R.S., and Professor W. E. Ayrton, F.R.S., for electrical engineering. The examination papers for last year are given at the end of the programme, which also includes a syllabus of each subject. Our young readers must not forget that they have an excellent opportunity for becoming acquainted with electrical subjects in attending the classes of Professor Ayrton, instituted by the City Guilds Institute at Cowper-street.

THE ELECTRICIAN

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Notes of the Week.

Stainless Steel.

For the past few years the chromium alloy known as stainless steel has been recognised as a useful adjunct in the relief of domestic labour. By its employment in the form of table knives much cleaning is rendered unnecessary, and the grinding action of the knife-board, with the consequent shortening of the life of the utensil, becomes a thing of the past. The same metal, for the same reasons, has found useful application for golf clubs, frying-pans, pocket knives, fenders and other articles where a high polish and a minimum of work in keeping that polish at its pristine brightness are desirable, if not necessary. In fact, there may be said to be only two things which have prevented the wide application stainless steel has already received from becoming still wider—its price and the idea that the stainlessness is due to a veneer which cleaning, polishing or grinding will gradually remove. As is obvious from the details which we give on another page of this issue, this is an entire misconception, while the former obstacle is a question of time and the operation of the laws of supply and demand.

Non-Corrodible Turbine Blades.

STAINLESS steel is now, however, available for sterner purposes than those we have just mentioned. As is well known, the nickel-steel used for the manufacture of turbine blades not only rusts, but is gradually worn away by the action of both erosion and corrosion, so leading to a loss of efficiency from leakage and the need for eventual replacement. Stainless steel, on the other hand, as the experiments at the works of its makers, THOMAS FRITH AND SONS, show, has no such disadvantages. Blades of both the polished and unpolished metal remain clean and bright and there is a complete absence of pitting after several months' running. And while the cost of the chromium steel is £168 per ton as against £60 per ton for nickel-steel, this is not a serious disadvantage, for the effect of the higher

price on the total cost of turbine is small and may well be outweighed by the advantages that are obtainable. We understand that other industrial applications are being considered and we shall await the results with interest, as they should open up a new era in many branches of the steel industry.

A Restaurant Enterprise.

It is usual in this country to mark unusual doings of both persons and corporations by more or less extended gastronomic exercises. The dinner which was held on Tuesday evening to celebrate the opening of an extension to the B. and K. Restaurant was therefore following tradition, but was at the same time singularly appropriate, for a well-cooked and thought-out dinner, cooked electrically, is the best advertisement that an electric restaurant can provide; and the satisfying results which were obtained on this occasion show that the management of the Brompton and Kensington Electricity Supply Company have reached the ideal they set themselves when they entered the catering business some seven years ago. The occasion, however, also drew attention to the enterprise of the Brompton and Kensington Company in the domestic electric field, of which this restaurant is but a part, and it indicated to those who care to examine the results that have been gained in a residential area that there is no need for electricity supply to become stagnant, for a wide-awake policy directed to the development of the domestic load is assured of success.

An Example to be Followed.

MR. H. K. BEETON, the Chairman of the Company, in reviewing the progress that has been made, was, of course, preaching largely to the converted; but there are many electricity supply undertakings which would do well to take to heart his remark, which is founded on practical experience, that cooking is a highly profitable load. Those responsible for the conduct of the B. and K. Restaurant were wise in another way. They early realised that it is impossible to design cooking apparatus which can be

employed by the ordinary domestic without becoming *cook themselves*. In developing their restaurant business they have learnt much, so much that they have more than once adopted the heroic policy of entirely scrapping their kitchen apparatus when they found that it was the only way to achieve improvement. In our next issue we shall describe in more detail the arrangements which the experience they have gained so far shows to be the best in an electric kitchen. In the meanwhile we reiterate that this is an example which might be more widely followed.

Registration of Electrical Contractors.

It appears that the Council of the Institution of Electrical Engineers have had under consideration the question of the legislative registration of electrical contractors. Although not willing to push matters to extremes, they are yet of opinion that a voluntary system of registration would prove useful, and have therefore appointed a committee representative of the Institution, the supply undertakings, the electrical contractors and the manufacturers to draw up a scheme for submission to the Council. The ultimate objects are, of course, to standardise wiring, to rule out defective work and generally to improve the installation. But we are afraid the means will not lead to that end. There is a great deal to be said for ostracising all but *bona fide* electrical contractors, but when it comes down to practical methods of effecting this it is obvious that very little effective can be done. In every town—and especially in the smaller provincial towns—there are numerous people who do wiring when it comes their way, and, as small household wiring is so simple a matter, it is difficult to see how it would help the interests of the general public or of the supply undertaking that these people, who undoubtedly work very cheaply, should be barred from such work even if they could be barred. The end that the Council have in view, like many others, can best be slowly obtained by education, both of the public and the contractors.

A Tramway Monopoly.

THE difficult situation in which tramway undertakings now find themselves owing to motor-omnibus competition is, if the proceedings at the recent conference of the Municipal Tramways Association are anything to go by, likely to lead to a demand by the London County Council and Municipal Tramway authorities for a statutory monopoly to carry passengers on tramway routes. Mr. BECKETT, the general secretary of the Municipal Tramways Association, is reported to have told a Press representative that: "Everywhere trams are exposed to a wasteful and murderous competition. A public service cannot be profitably run for the benefit of a section of the public. Like gas, water and electricity undertakings, however, a tramways monopoly would carry certain obligations in the public interest." This is a vague and somewhat misleading statement.

Neither Good nor Expedient.

WHILE we have much sympathy with tramway managers in their difficulties, we also believe there is no chance of obtaining the necessary powers and that it would not be a good thing if there were. Tramways should, on the other hand—and perhaps they may—secure exemption from some of the present roadway maintenance charges and rating obligations, which operate unfairly against them compared with other transport services. Tramways undertakings are, in fact, now in the position which the urban railways were when the electric tramway was first intro-

duced, and we believe that, like the railway managers, who, when they realised the extent of the leakage caused by the tramways, adopted electric traction, a remedy can be found without creating a new monopoly. By quicker and better service, by the use of the trolley vehicle and in other ways we believe that the tramways can obtain an improvement of their present unfortunate position.

Is the Electric Vehicle Stagnating?

FROM the electrical point of view the Commercial Motor Exhibition, which closed last Saturday at Olympia, was, frankly, a disappointment. Such an exhibition, in our opinion, has two uses—to show the present position of an industry and to indicate the advances that have taken place in a particular period, generally that since the last exhibition was held. Under the first heading, from all points of view, the exhibition fulfilled its function, for nearly all the firms engaged in the electrical vehicle business—RANSOMES, SIMS and JEFFRIES, AGRICULTURAL AND GENERAL ENGINEERS, the GENERAL VEHICLE COMPANY and NEWTON BROTHERS—showed examples of their enterprise, but with one exception they exhibited little that had not been seen before. In other circumstances the natural deduction from this would be that saturation has been reached, but, although the simplicity of the electric vehicle renders "stunts" in its design from year to year both unusual and unnecessary, surely this cannot be the case. What seems to be wanted is a branching out of manufacturers into fields other than the delivery van and light lorry, a reduction in the cost under many headings, an increase in the output of the batteries for a given weight and more encouragement from the supply undertakings in the way of charging facilities. The light van, the trolley (such as is used at railway stations) and the jib crane vehicle are all applications for the electric drive which require and should have further attention paid to both their design and manufacture.

The Electricity Commissioners' Work.

THE First Annual Report of the Electricity Commissioners, covering the period from Jan. 31, 1920, to March 31, 1921, is an unusually interesting publication of over 100 pages. Though it contains much that is ancient history, it also gives a succinct and useful survey of the present position of the electricity supply industry as well as clear and valuable indications of the present and future policy of the Commissioners.

The Report commences with a brief outline of the existing legislation governing electricity supply, a summary of the powers and duties of the Commissioners and of the steps taken to determine districts and to improve the organisation of electricity in them. Practically all that is of importance in this portion of the publication has already appeared in the columns of THE ELECTRICIAN, but it is amusing to notice the admission that, owing to restrictive legislation and to the competition of gas, "it is not surprising that the progress of electricity supply in this country has been less rapid than in other countries whose development started later." This is very nearly, if not quite, analogous to Satan reproving sin.

The Position in 1914 and 1918.

AS some indication of the position, it is mentioned that in the twenty-six years from 1888 to the outbreak of the European war the largest output in any one year from the whole of the 500 public generating stations in the United Kingdom amounted to some 2 000 million units. On the

other hand, in Sweden, where the plant is mainly hydro-electric, the output in 1914 amounted to 1 475 million units, the population of Sweden being only one-eighth of the United Kingdom. During the war there was a striking development in the application of electric power to industry, and by 1918 the output in this country had advanced to 4 628 million units, while at the end of that year the total of the generating plant installed, including 347 828 kW in London, was equal to 2 175 155 kW. The total capital expenditure on station buildings and generating plant, but excluding the distribution items, amounted to £48 293 036, or an average of £22.2 per kW installed. It is interesting to note that the average for the power companies was only £19.6 per kW, compared with £30.2 for the remainder of the authorised undertakers, though this is probably due to some extent to their later development.

Policy Adopted in Determining Districts.

There is no need to dwell here upon the urgent need for the reorganisation of the industry or of the importance of a cheap and efficient supply of electricity for power and industrial purposes. It is, however, satisfactory to note that the Commissioners realised the situation at once, for immediately after their appointment they made a preliminary survey of the present and future electrical requirements of a considerable portion of the country. In the course of this work they held numerous conferences with local electrical engineers and committees, with the result that they came to the conclusion that the existing organisation in a number of districts should be improved. At the date of the Report thirteen of these districts had been provisionally determined, and, in addition, five local inquiries had been held and preliminary surveys of other portions of England and of certain districts in Scotland had been made, so that we may anticipate the provisional determination of further electricity districts in the near future. It is not surprising to learn that the outcome of the preliminary inquiry and of the subsequent experience of the Commissioners has served to emphasise: The wastefulness and inefficiency of the present organisation for the supply of electricity; the urgent need for co-ordination among existing supply authorities; the advantages in the conservation of capital and of coal, and in increased efficiency to be derived from joint action.

Commissioners' Views on Plant Extensions.

Sec. 11 of the Electricity (Supply) Act makes it necessary to obtain the consent of the Commissioners to extensions of plant at existing generating stations or main transmission lines, and in dealing with the numerous applications made to them the Commissioners have wisely been swayed by certain broad considerations to which no exception can be taken. These include the necessity for facilitating the development of electricity supply in any district and for avoiding sterilisation in the reorganisation period, the effect of any new station or extension of an existing station upon the ultimate development of supply, the undesirability of extending a badly-placed station in one district when a better situated one in the same or an adjacent district could be extended, and the necessity for avoiding the extension or the establishment of small and uneconomical stations where bulk supply is more advantageous.

New Generating Stations.

During the period under review there were ten applications for consent to the erection of stations under statutory

powers, but only five of these were granted, viz., Belfast, Manchester, Leicester, Nottingham and Portrush, consideration of the remainder having been adjourned. Three small non-statutory undertakings were also authorised to erect new stations, one of these (at Stalham) being only of a capacity of 4 to 6 kW. The eight authorised stations represented the initial installation of generating plant of 150 000 kW.

Extensions of Existing Stations

The Commissioners dealt with applications from 120 authorised undertakers and four tramway and railway authorities for extensions of existing generating stations, consisting principally of proposals for putting in additional plant. Before coming to a decision the practicability of obtaining a bulk supply from some source or other was investigated in each case, and the sanctioned extensions represent plant of 547 000 kW, of which 415 000 kW was in respect of municipal undertakings, 113 000 kW in company undertakings and 18 740 kW in traction stations. It is worthy of notice that the Commissioners have come to the conclusion that only additions to or modifications of generating stations which involve an increase in the rated capacity of the generating plant constitute extension requiring their approval under Sec. 11 of the Act of 1919.

Municipal Borrowing Powers.

From time to time we have had occasion to comment upon the exercise of the powers of the Commissioners as the sole authority for sanctioning borrowing powers by local authorities, and it is satisfactory to learn that the general basis now adopted is the estimated life of the various assets concerned. This seems to us to be the most equitable and the most reasonable method, though it appears to us that the period allowed for h.t. trunk transmission mains is on the high side. However, before deciding upon the maximum periods allowed for the repayment of loans the Commissioners, in accordance with their usual practice, consulted the Incorporated Municipal Electrical Association on the matter. Moreover, each case is decided on its merits and the Commissioners may be trusted to insist upon the best and most economical methods being adopted in the development of electricity supply. In fact, there are complaints that they are not liberal enough in the grant of sanctions to borrow for mains and services. Of the 536 applications for loans made in the period under review, 432 were granted in full or in part and 29 were refused or withdrawn. Sanctions were issued to 204 local authorities, and the total amount sanctioned for the fourteen months was £15 181 298, of which £9 805 990, or 64.6 per cent., was for plant and £3 428 161, or 22.6 per cent., was for mains and services. These figures, which only relate to municipal undertakings, are clear evidence of the demand for electricity supply and of its importance in the industrial development of the country. In fact, the amount would have been far larger if the Commissioners had not adopted a conservative policy, as sanction to the installation of plant in small and uneconomical stations was only given to enable local authorities to meet their statutory obligations pending the availability of a bulk supply.

Special Orders and Bulk Supply.

Particulars of the results of the applications for special orders and of the arrangements made for bulk supply are given. Only where a bulk supply is not readily available and where there is a clear demand for electricity will the establishment of a generating station be sanctioned. In

six cases arrangements for mutual assistance were approved under Sec. 19 of the Act of 1919 and four applications were under consideration. In addition, two similar agreements made under Sec. 3 of the London Electric Supply Act of 1908 between London borough councils and two agreements made under private Acts have been approved by the Commissioners. This is as it should be, and no doubt we shall have many more similar agreements before long. It is, we are glad to record, a complete reversal of the old stupid policy of the non-association of supply authorities.

Systems of Supply, Regulations, &c.

In connection with the desirability of adopting one standard frequency the Commissioners, having made preliminary inquiries, called an informal conference, which was attended by the President of the I.E.E. and by representatives of the electrical associations and of the leading consulting engineers. After full consideration the Commissioners, while reluctantly abandoning the idea of a standard frequency, decided to adopt the policy of bringing about the elimination of all odd frequencies, with the ultimate object of reducing the number of frequencies to three, viz., fifty (standard), 40 and 25 cycles per second. A good deal of very useful work has also been done in standardising the existing codes of regulations for ensuring a proper and sufficient supply of electricity, for securing the safety of the public and in regard to the construction and maintenance of overhead lines. In dealing with these matters electrical associations and interests were also consulted so as to ensure the support and sympathy of those immediately concerned.

Accounts, Statistics, &c.

Other useful work done by the Commissioners include the revision of the forms of accounts and returns of undertakers and the appointment of auditors. It appears to be the opinion that there is need for an official annual return or official statistics of a more comprehensive character than those published by the electrical Press. The need for this extensive return was felt in the early part of the war, but we doubt the utility or the need for it at the present time. At all events, all authorised undertakers are now required to furnish the Commissioners every four weeks with a return of units generated, fuel consumption, stocks of fuel in hand, &c. These statistics may be useful in case of a threatened strike, but we cannot conceive any other useful purpose which they will serve.

Miscellaneous Work

We observe that the Commissioners are construing in a liberal spirit their powers under Sec. 30 of the Act of 1919 to authorise subscriptions to the funds of electrical associations, and wayleaves and overhead lines are also sanctioned without much trouble in suitable cases. Although the Commissioners have not yet initiated any experimental work, the Chairman of the Commissioners is now a member of the Advisory Council for Scientific and Industrial Research, and another commissioner, Mr. W. W. LACKIE, represents the Department of Scientific and Industrial Research on the Council of the British Electrical and Allied Industries Research Association.

Advisory Duties.

The Commissioners have also been called upon to advise the Minister of Transport on a number of matters connected with the administration of the Electricity Supply Act. Of the 200 applications to the Minister of

Transport for authority to increase the maximum charges allowed, orders were made in 195 cases. The principle of the quarterly minimum charge appears to be now settled practice, and, though it is equitable enough in theory, it is causing a good deal of discussion among consumers and is far from popular. The four applications for the construction of interim works by the Minister of Transport appear to have been unsuccessful, and, as it is doubtful if the Minister will undertake works which entail capital expenditure of any magnitude, it would be just as well if undertakers realised this and made their arrangements accordingly. The Report concludes with a group of appendices giving valuable information and statistics as to the present position of the industry, all proving that the Commissioners have had a very strenuous time during the period ending March 31, though an equally trying period is in front of them.

Palliatives and Remedies.

Two events of outstanding importance have taken place within the past few days in the industrial engineering world. These events are the Government's proposals for dealing with unemployment, and Lord WEIR's speech to the British Engineers' Association, with which may be combined the memoranda to the Prime Minister from the same body. The Government's proposals contain both palliatives and remedies, or what is hoped will be remedies. Lord WEIR's statement contains an accurate and succinct diagnosis and the real remedy for existing conditions. It is, therefore, instructive to consider these solutions not only on their merits, but from the special points of view which have influenced those who are responsible for their birth.

The Government's Proposals Analysed.

It is no secret that the Government have been forced to deal with the twin problems of unemployment and trade revival by sheer pressure from outside. For, while it is true, as the PRIME MINISTER has said, that they have had the matter long under consideration and have perhaps done more than any other Government to alleviate unemployment, it is in no carping spirit that we say that it has all been done unwillingly, and that they would much rather have left the problem to be solved by the slow operation of economic machinery than by legislation and administrative methods. But, as they have not been allowed to do this, the next best solution in their view is to provide relief work somewhere and somehow, to lighten the stress of competition in the labour market by emigration, and to extend credits at home and abroad by some means or other. But—and here we reach the reasons that lie at the foundation of all the objections to the Government's latest proposal—to do all this will require money—money, be it noted, which will eventually, and perhaps very soon, come from the taxpayers. In other words, to finance the relief of unemployment it will be necessary to ransack once more the pockets of those who are already suffering under an oppressive taxation and bearing a burden which prevents as much as anything else a true trade revival, because it makes the cheap manufacture of goods impossible.

Remunerative Work Required.

While, then, remedies of some kind or other are necessary not only to relieve unemployment, but to get industry moving again, the only work that will really give

relief to trade depression is that which can be described as both immediately essential and ultimately remunerative. And remunerative work is only possible through a reduction in the cost of production. We admit that to pledge the national credit to help industry out of its present difficulties is a policy that has much to commend it, if without undue delay that pledge is redeemed; but if it is not redeemed our last state will be worse than our first. For the Government plans will not reduce the cost of production, and may conceivably help to increase it. And it is just at this point in the analysis there becomes apparent the difference which so fundamentally distinguishes the Government's outlook on unemployment from that of Lord WEIR and others who have a right to speak for the industry of the country.

Not Relief Schemes, but Production

Lord WEIR's point of view is made clear in the speech to which we have just referred. "We do not want," he says, "relief schemes giving unproductive and inefficient employment to miners, iron workers and labourers alongside closed pits, closed iron works and harbours filled with foreign shipping bringing in foreign iron smelted with foreign coal, but something very different." Yet this tragic-Gilbertian state of affairs is just what is to be found in Scotland at the present time and is likely to continue to be found under the Government scheme unless its administration can be lifted to a higher level than our experience leads us to expect will be the case. For, as Sir PETER RYLANDS justly said, railway extensions or electrification—two of the forms of relief work which are to be put in hand, though the statement applies equally to all—is very expensive at the present time, and will not become less expensive by the mere fact of the Government lending the capital. If a scheme costs £2 000 000 when £1 000 000 is the economic price, it does not matter who guarantees the money, more capital and more interest will have to be spent, and capitalists will still feel shy of embarking on such an undertaking.

The Cost of Production Vital.

A close consideration of this matter, therefore, brings us round naturally, but nevertheless inevitably, to the cost of production. As Lord WEIR remarks, British employment will be governed by the cost of British production. That cost will continue to be high while wages are inflated by a network of conditions caused by trade union pressure. To bring relief they must be deflated, as the currency must be deflated. This is necessary if British industry is to be able to produce goods at a price at which the world can buy. Or, in other words, we must increase our production by harder work and longer hours, not because such a policy will enable us to cut down wages (which need not fall by a farthing below economic level), but to rid ourselves of the incubus of £200 000 000, which is, in his estimate, the annual cost of the present short working-week. To do this, as Lord WEIR says, would be the most direct and immediately effective help that could be given to our industries to-day. And we agree.

Set side by side with such a direct remedy, the Government proposals seem poor and ineffective enough. Criticism of them may, in fact, be summed up in the phrase that they are attempting too much to achieve too little. For, to quote Lord WEIR again, "no Government can revive trade." It can only spend traders' money in doing ineffectually what a combination of employers and workers could do much better for themselves. It is, therefore,

through co-operation of this kind that the first steps towards a real solution must be taken; and we see no reason why such co-operation should not bring about the necessary improvement.

Is Combination Possible?

On this particular question of combination, not as to whether it is good but whether it is possible, there is at present a good deal of pessimism. Both Lord WEIR and Sir JAMES KEMNAL have attacked trades unions for their lack of foresight towards industrial problems and their overbearing tyranny to their members; but, though this policy has done much harm in the past, we think it is now out of date. At any rate, the more responsible of the trades union leaders realise that this is no time for either preaching or practising strange economic doctrines. Mr. CLYNES' speech in the House of Commons last week is sufficient evidence of that. Such vapourings are becoming more and more the peculiarity of the hotheads, who more and more are losing the influence they once had. Trade Unionism is, in fact, bankrupt, not only of money, but of ideas. That being so, it would be an excellent chance for employers to extend an invitation to the leaders of the other side to discuss and find remedies for unemployment, and also to consider such other matters as may be necessary to bring into the foreground the idea that the aims of employers and employed are not antagonistic, but sympathetic, and that to stabilise conditions and develop industry without Government assistance is the duty of everyone not only for their own advantage, but for the good of the country generally.

A Useful Memorandum.

From this point of view the memorandum issued by the British Engineers Association at the end of its conference last week deserves the closest consideration. It records, among other things, the opinion of the Association that the loyal co-operation of labour in a great national effort to revitalise our industries is necessary to the country's well-being, that trades unions should repudiate the policy of rendering capitalism unworkable, that the cost of production should be reduced by amending the conditions affecting the output per pound of wages paid and that the restriction to this country of contracts involving public money, national economy, reduced taxation, productive unemployment relief work, cheaper coal and drastic measures to reduce the cost of living are all necessary stimulants to effective trade revival.

Organisation From Within.

But most important of all their proposals is the suggestion that the industry must be more and more completely organised from within. As Mr. LEWELYN ATKINSON said recently: "Manufacturers must themselves right the situation." We most heartily agree. For industry has not recovered from the devitalising effect of Government control, and there is still too great a tendency to lean rather than to push. It does not recognise that it is only convalescent, and it therefore desires to walk by itself before it is strong enough to do so. The result is that it leans on Government support at the first signs of a fall. This is natural, but it must be stopped without delay, for only by its own vitality combined with the whole-hearted co-operation of all concerned, can the necessary revival be brought about and at the same time Government interference be got rid of. And through that revival, which is to be found in lower cost, alone will unemployment be solved.

ELECTRICITY SUPPLY IN BLACKBURN.

How an Increasing Industrial Load is to be Dealt With.

The history of the Blackburn electricity undertaking is not unlike that of other concerns in the industrial areas of Lancashire, Yorkshire and the North-East Coast. Perhaps indeed its progress may be taken as typical. For though for quite natural reasons it has not expanded so rapidly as have similar undertakings in the larger towns, on the other hand it has developed more satisfactorily than can be recorded of many other cases. Of course it started as a purely lighting undertaking. That was in 1896 when a few hundred

price per unit generated, of which there were 1 159 861, was 1.32d.

We will pass lightly over the intervening years, only pausing to say that about 1912 it became evident that the generating station in Jubilee Street, near the centre of the town, and possessing neither coal nor water facilities, had seen its best days, and that a modern station would soon be required to deal efficiently with the developments. Mr. P. P. WHEELWRIGHT, engineer and manager

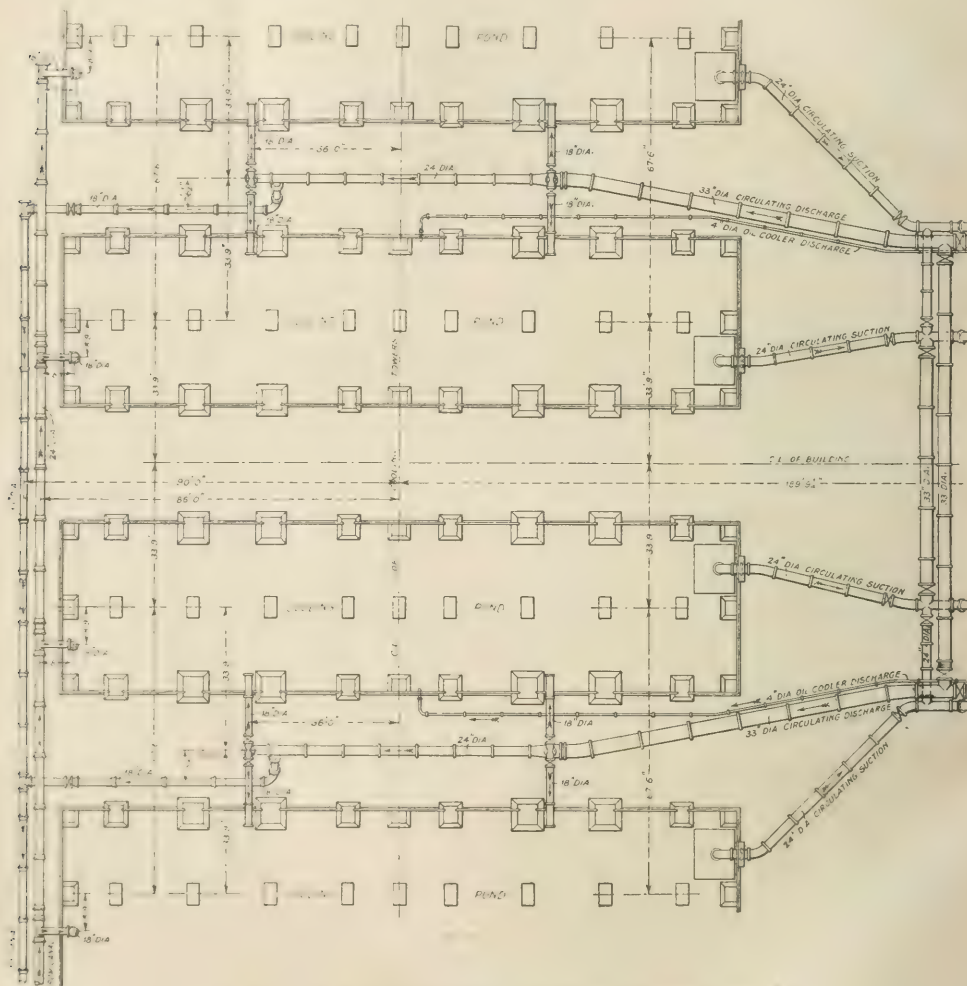


FIG. 1. PLAN SHOWING GENERAL ARRANGEMENT OF PLANT AT

units were generated, and a great discussion took place on the advantages and complications of the maximum demand system. We feel sure the latter were more prominent than the former. But soon the power load began to make itself felt, and in 1901 ninety-four motors totalling 280 H.P. were connected to the mains—nearly a 50 per cent. increase over the previous year. The capacity of the works at that time was 3 280 kW the maximum load 1 112 kW, and the

of the Electricity Department, therefore prepared plans for a new station to contain two 5 000 kW turbo-alternators, and though these plans were passed by the Board of Trade, and the necessary land was purchased, the war, of course, prevented the work being undertaken. At this time (1914) the units generated were 7 916 938, the maximum demand was 4 045 kW and the station capacity 8 000 kW.

It may be added that Blackburn started off with all the disadvantages of single phase supply, and that now this system, together with three phase and direct current, are all distributed.

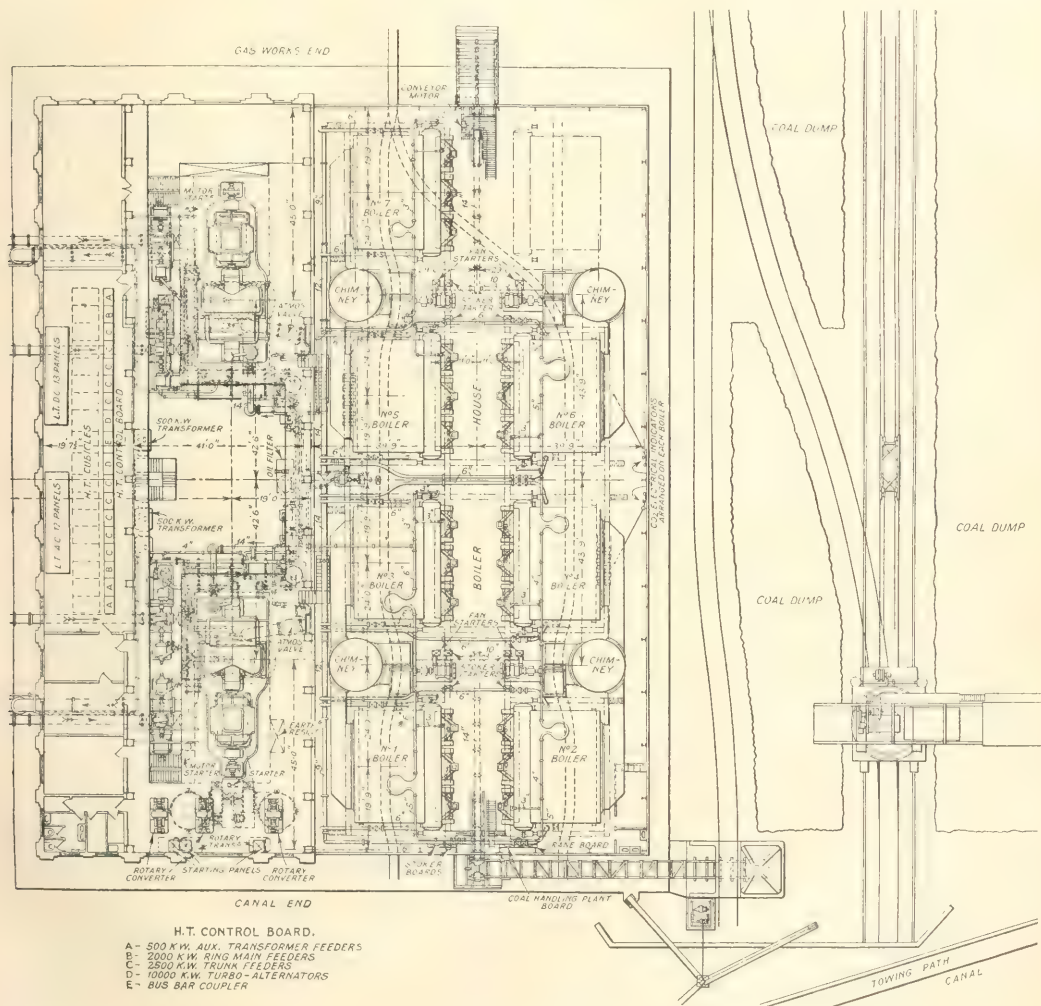
The Effect of the War.

As might be expected, the war rather worsened than improved the situation we have outlined, for by 1918 the units generated had risen to 10 318 437, and though there was a slight drop in the next two years, the output rose to the record figure of 10 561 959 in 1920-21, and it became evident that the new station was

generating station in Jubilee Street began by being a sort of annexe to the gas works, and the new station at Whitebirk is close to the modern gas works, whose sidings have been freely placed at the disposal of the Electricity Committee during construction.

Constructional Details.

We may begin our detailed description of the new station by stating that the ground forming the site is water-logged, so that some form of artificial foundation had to be employed. In preference to erecting a building on piles, it was decided to build a



—THE WHITEBIRK STATION, BLACKBURN.

urgently required. Indeed, had it not been for oil firing and trade depression it would not have been possible to carry on. In the meantime the large increase in output had led to a reconsideration of the original plans, and it was decided to equip the new station with two 10 000 kW turbo-alternators as a beginning, the contract for the whole of the work being let in August, 1919, to the ENGLISH ELECTRIC COMPANY. It may be noted that this is the first station to be erected under the auspices of the Electricity Commissioners.

An interesting human point about the undertaking is the relation of the Electricity and Gas Departments in Blackburn. The old

concrete raft, and a special line of broad-gauge railway 1 000 yds. long was laid from the gasworks sidings to the site to facilitate the bringing up of the material. The raft was completed and the foundation stone was laid on May 13th, 1920. After this the progress was rapid; two months later the steel columns were up; in another two months the steel structure was complete, while before the end of the year the whole building, both boiler house, which is constructed of bolite, and power house, which is made of brick, had reached their final stages. In the meantime the foundations for the cooling towers had been laid, well boring was progressing, the wharf was built, the canal dredged, the cranes erected both inside and

outside the building, and foundations laid for the machinery. The general lay-out of the station is given in Fig. 1.

In fact, within one year of the laying of the foundation stone the boilers, the economisers, the condensers, the feed pumps, circulating pumps, the ash-handling plant, the soot blowers, the switchgear, the cranes, the coal conveying and mechanical stoking plant, the turbine and the alternator for the first half of the station were delivered, and last Friday the first half of the station was started up by Lord Derby, with full civic pomp and municipal ceremony. This, considering the difficulties that had to be contended with, is quick work, on which Mr. Wheelwright is to be congratulated. It is expected that the station will be complete and in final running condition before the spring of next year.

Coal-Handling Plant.

The coal supply is obtainable either by canal or rail. By whatever method it comes in it is first dealt with by a 20-ton travelling crane. If it comes in by rail the full waggon is lifted by this crane,



FIG. 2. VIEW OF BLACKBURN (EAST) STATION, SHOWING COAL HANDLING EQUIPMENT

weighed by the crane operator, discharged into the coal hopper or on to the heap, and the empty waggon weighed again before being replaced on the track, so that the net weight of coal is ascertained.

This arrangement reduces the labour costs considerably, only one crane operator being necessary for discharging the waggon and weighing the coal, thus cutting out the usual weighbridge with capstans and attendants, and the shunting that is necessary when employing ancient methods. The coal is discharged direct from the truck to the heap without passing over the usual elevators and conveyors.

When the coal is not required for stock it is discharged direct by the crane into the receiving hopper of the skip hoist. The skip hoist and belt conveyor work automatically, one ton of coal being fed by weight into the skip every time it is elevated. The operations are counted, so that a correct record of the amount of coal passed up into the bunkers is kept. In addition to having low power consumption, it is found that the upkeep and general repair cost of a skip hoist are very light compared with any other form of elevating gear.

This skip hoist delivers the coal on to a Mitchell belt conveyor, which distributes it to any portion of the bunker, which has a capacity of 200 tons, or about sufficient for forty-eight hours' steaming on full load.

When unloading from barges or reclaiming coal from store, an electric grab is attached to the 20-ton crane by simply hooking it to the crane ropes. The power for closing the spades is provided by a motor inside the claw of the grab itself, which makes it possible for the same grab to be attached to any other crane that may be installed. This plant was all supplied by the MITCHELL CONVEYOR AND TRUCKING COMPANY. A view is given in Fig. 2.

Modern Ash Handling.

For taking the ashes from the boiler house, a new method has been adopted. All the usual schemes were reviewed, but this method was decided upon because of its low upkeep cost and low power consumption. It consists of using an electric battery locomotive, which hauls a specially designed truck under the ash-pit door, where it is filled. After loading, the locomotive takes the truck to a

patent distributor outside the station, whence the ashes are discharged on to a moving belt, which distributes on to the surrounding ground. By altering the position of the distributor a wide area of discharge is obtained, and the one man who drives the locomotive can also attend to the distribution of the ashes on the ground which has to be made up.

This is a great advantage in this particular case, as on the present site the amount of ground which has to be made up is considerable, so that a dump for ashes is available for many years.

A fixed radius jib crane is also provided for use in the event of the 20-ton crane being out of commission. This is fixed in position near the canal wharf, so that the path of the radius arm covers both the barges moored alongside and the underground hopper.

Steam Raising.

The boiler room plant comprises seven B. & W. cross-type marine water-tube boilers, each having a steaming capacity of 50 000 lbs. per hour as a normal duty, with a superheat of 600°F. and a pressure of 210 lbs. on the stop valve. Each unit is fitted with a super-heater and super-imposed Green's economiser of the horizontal tube type and three mechanical stokers of the underfeed self-contained forced-draught travelling grate type.

Coal is fed to the stoker hoppers from the overhead bunkers through chutes fitted with control valves. The coal burnt by the stoker is measured, as and where it passes directly into the furnace, by Lea coal meters, which are attached to each stoker. The ash and clinker from the stokers is dropped into special ash chutes built to the underside of the stokers, and is emptied into trucks running on a special track fixed in the boiler room basement, whence they are conveyed to distributor as mentioned above.

Each boiler unit is fitted with an instrument board to which are fixed the necessary instruments and apparatus to enable the operating staff to obtain at all times the most economical working of the plant under their control. These instruments consist of steam flow recorders and indicators, CO₂ indicators, draught gauge, pressure recorder, and a six-way temperature indicator for indicating the temperature of the water and flue gas at the economiser inlet and outlet and of the steam temperature in the super-heater box. The whole of this equipment was supplied by the CAMBRIDGE & PAUL SCIENTIFIC INSTRUMENT COMPANY, with the exception of the steam flow meters, which are by GEO. KENT. The CO₂ meters are connected to two four-point recorders in the superintendent's office.

The boilers are operated on the well-known balanced draught system. The stokers are provided with separate forced draught fans, and the chimneys are divided into two portions at their lower sections, and fitted with induced draught fans, which draw the gases of combustion down one section of the chimney from the outlet of the economisers and discharge them upwards through the other portion of the chimney. This arrangement ensures the maintenance of efficient combustion with fuels of varying heat values.

Each boiler unit is fitted with a soot cleaning equipment, consisting of a rotary device for directing steam at high velocity on to the tubes while the plant is in operation. These units are so situated that the whole tube area is covered by the rotary jets, which are periodically operated by hand. This is the first large power house in this country to be equipped throughout with this plant. It abolishes the necessity for hand cleaning, a costly and very often inefficient method of keeping the boilers clean. Moreover, the high state of cleanliness produced by the installation of these equipments will show a remarkable saving in fuel consumption over plants now similarly equipped. The boiler house is lighted naturally from above, white tiles are predominant, and it should therefore be easy to keep clean.

Turbo-Alternators.

The turbo-alternator plant (see Fig. 3) at present consists of two 10 000 kW ENGLISH ELECTRIC impulse turbines, each driving 6 600 V 50 period 3-phase alternators, supplied with cool, washed air from patent air filters made by PARMITER, HOPE & SUGDEN. There is room for extensions up to an ultimate capacity of 30 000 kW.

Each set is complete with surface condenser, extraction pump, circulating water pumps, &c. The condensers are of the Hicks-Breguet type. The steam from the turbines, after being condensed, is passed through pipework on the "closed feed system." The primary function of this system is to provide the boilers with pure feed water (the make-up being supplied through an evaporator), and thus to eliminate as far as possible scaling of the tubes. It also avoids the necessity of blowing down the boilers, except at rare intervals. At the same time this feed water is de-aerated as far as is reasonably practicable. Experience has shown that boilers operating with water so treated suffer considerably less from corrosion troubles. The condensed steam is fed direct to the suction of the turbine-driven boiler-feed pumps, which feed the water directly to the inlet of the economiser, where it is heated

during circulation by the combustion gases. The delivery into the boilers is regulated automatically by Cope's feed regulators. There are three turbine-driven Weir boiler feed pumps, each capable of supplying three boiler units, so that with the whole station in operation there is one spare feed pump. The alternators are of standard construction, the stators being wound on the site.

Cooling Towers.

The circulating water for the surface condensers, after passing through the condensers, is pumped into four cooling towers, supplied by FILM COOLING TOWERS LTD., where it is cooled down to a temperature of about 75°F. Ponds are constructed under each tower, from which the circulating pumps draw their supply. The only new water to be provided, therefore, after the initial starting up, is that necessary to make up the losses caused by evaporation and wastage, which will be obtained from a well sunk near the cooling ponds. Condensing water can also be taken from the canal and afterwards returned.

The pipe work between the pumps and towers is inter-connected so that it is possible for either pump to draw water from or discharge it to any one or more of the four towers. An emergency supply tank is provided, situated upon the roof. This has a capacity of about 18 000 gallons. This tank will also be used for emergency water supply for any point of the station.

Switchgear.

The high-tension switchgear comprises separate cubicles for the E.H.T. gear situated in a separate cell room immediately below the control desk, as shown in the drawing. The control board is of the desk type, and is mounted in the switch room, while the operating levers pass through the switchroom floor into the cubicle room below, the whole being mechanically operated. The gear is designed to have a breaking capacity suitable for direct connection to busbars supplied by generating plant of much larger capacity. This switchgear was supplied by the English Electric Company.

Transformers.

For supplying the auxiliary plant in the station, alternating current supply will be transformed down to 400 V by three 500 kW transformers, which are connected to the low tension A.C. switchboard. This board may also be supplied if necessary from the Jubilee Street generating station.

Rotary Converters.

For the direct current motors and station lighting, 320 kW rotary converters, which draw their incoming supply from the low tension 400 V A.C. board, and supply direct current to the d.c. 440 V switchboard, have been provided. These rotary converters are arranged so that in the event of the main generating sets not being in operation they can be worked from the feed coming from the Jubilee Street generating station.

Drainage.

The drainage is so arranged that full advantage is taken of all the rain water on the site, and a separate system provided for sewage, &c., which is taken to a small automatic sewage purification plant, built some distance away from the station buildings.

It should be added that adequate bathing accommodation is provided for all grades of the staff, and that mess rooms have also been provided. This, apart from any other reasons, is necessary owing to the great distance of the station from the town.

Distribution Arrangements.

The entire output of the Whitebirk station is transmitted to Jubilee Street, where a new switch-house has been installed for the purpose of facilitating the distribution of power. The power is fed on to the busbars of the distribution board through ten inter-connecting cables, whilst the Jubilee Street power station busbars are directly connected to those on the distribution board. From these busbars outgoing feeders radiate both for local supply purposes and for inter-connection with neighbouring stations and districts, such as Darwen. In addition, provision is made for controlling two 1 500 kW rotary converters for converting the high tension alternating current into low tension direct current for local purposes.

The high tension switchgear which carries the main current is completely enclosed in a structure consisting of moulded stone slabs fixed on an angle iron framework, the apparatus for each equipment being contained in a separate cubicle which is provided with hinged lockable doors.

Oil Switches.

The oil switches are of the three-pole electrically operated pattern fitted with closing and tripping solenoids suitable for operation from a direct current supply. Each phase forms a separate unit

actuated by cams and rollers from a common operating shaft. Each unit is designed so as to provide an expansion chamber above the surface of the oil in order to reduce the shock when the switch opens under short circuit conditions. Any gases which are formed on this operation are carried outside the cell structure by a baffled vent pipe fitted to the explosion chambers. The tanks have been specially constructed to enable them to withstand very arduous service on systems of large plant capacity. Normally the closing and tripping operations of these switches are carried out by the solenoid magnet energised from the control desk, but provision is also made for hand-operation. Isolating switches are provided on each circuit to enable the apparatus in the cubicle to be disconnected from the main busbars for cleaning or adjustment purposes. These switches are operated by an insulated operating pole, and are also fitted with locking catches to prevent them being blown open by magnetic forces on short circuit.

The busbars are in duplicate, and a busbar coupling switch is provided operated from the control board, by which the two sets of bars can be coupled together when required to meet operating conditions.

Control Desk.

The control desk has been designed to form an extension of the desk originally installed at this station by the METROPOLITAN-VICKERS ELECTRICAL COMPANY, LTD. The oil switches are operated by small drum type controllers, which operate in conjunction with a single pole contactor switch mounted in the cubicle structure. With this arrangement the breaking of heavy currents required by the large operating solenoids of the switches on the small contacts of the controller is avoided. Indicating lamps are provided to show the open or closed position of the oil switch, and, in addition, indicating lamps are provided for use in conjunction with those on the cubicle structure to indicate to which set of busbars the circuits are connected. A mimic busbar arrangement is also provided on the

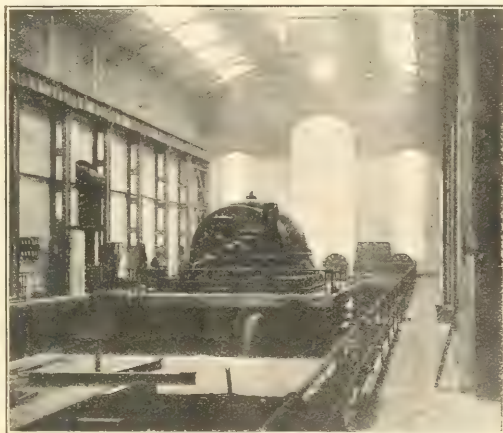


FIG. 3. VIEW IN THE TURBINE ROOM SHOWING 10,000 kW TURBO-ALTERNATOR.

sloping portion of the control desk, which enables the operators to see at a glance the connections of the distribution board at any time.

The trunk feeders are protected by means of overload time limit relays and by the Merz-Beard system of feeder protection. The indicating instruments are of a large open scale type, enabling readings to be obtained without much difficulty. All the instruments are connected to the instrument transformers in the cubicles by means of multicore cable, and as these instruments are operated from such transformers no high tension A.C. current is brought to the main control board. The total number of circuits controlled from this control board is twenty-one, including the coupling switch required for connecting the two sets of busbars together.

It is interesting to note that in the original switchgear, the cubicle structure was built on similar lines to that which has already been described, but, in this case, the main division walls were constructed of brick in place of the present day construction of moulded stone with iron framework. The oil switches were at that period of the latest design, and a comparison between these switches and those on the new section will show how great has been the progress in switch design during the intervening period.

Stainless Steel for Turbines.

An interesting example of the application of the chromium alloy, known as "stainless steel," to engineering purposes is given in a turbine which we had the opportunity of inspecting at THOMAS FIRTH & SONS' Tinsley works at Sheffield the other day. It has



FIG. 1.—COMPARISON OF POLISHED AND UNPOLISHED STAINLESS STEEL BLADES AFTER FIFTEEN MONTHS' SERVICE.

for some time been suggested that this alloy would be especially suitable for making turbine blades owing to the facts that it has successfully arrested corrosion under similar conditions and that

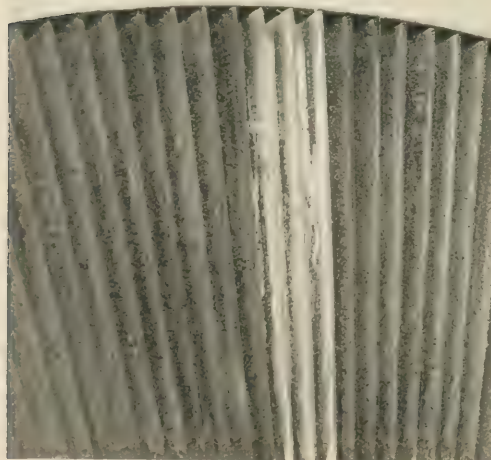


FIG. 2.—COMPARISON OF UNPOLISHED STAINLESS STEEL BLADES WITH ORDINARY BLADES.

it is not deteriorated by the working temperatures present in the turbine. That this is so is evident from the information and photographs which we give in this article, and Thomas Firth & Sons, to whom the industrial production of this metal is, of course,

due, are to be congratulated on this important widening of its applications.

Good Results from Stainless Blades.

The turbine is that of a Westinghouse turbo-generator set of 2 000 kW capacity running at 3 000 revs. per min. This set was put down in August, 1916, and since that time has been in regular use, the average load being 50 per cent. of the full output. The steam pressure is 200 lb. per sq. inch, and the steam temperature, with super-heat, about 660°F. The experimental blades were fitted on June 11th, 1920, and alongside the blades of stainless steel there were fitted, for comparison purposes, a number of new blades of the standard type supplied by the makers. These were of 5 per cent. nickel steel. The details of the experimental blades fitted are as follows:—

In wheel No. 8, situated at the low pressure end of the turbine, were fitted 12 new blades, three of highly polished stainless steel with three of stainless steel unpolished alongside them. On the opposite side of the same wheel are three more blades of unpolished stainless steel with three standard blades alongside. These blades are 7 in. long by $\frac{7}{8}$ in. wide, the diameter of the wheel being 4 ft. 1 $\frac{1}{2}$ in.

In the velocity wheel, situated at the high pressure end of the turbine, were fitted twenty-four new blades: On one side of the wheel are twelve of unpolished stainless steel, and on the opposite side six of unpolished stainless steel with three of

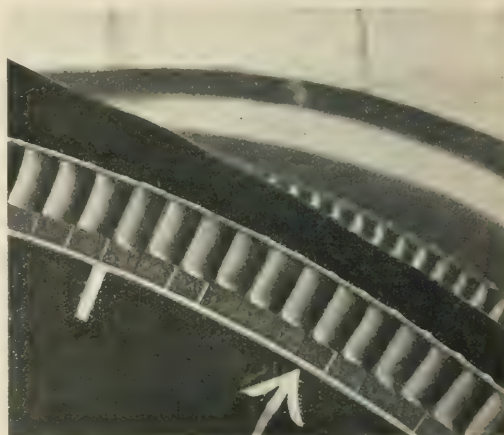


FIG. 3.—TWELVE STAINLESS STEEL BLADES SHOWING RESISTANCE TO CORROSION AND EROSION.

highly polished stainless steel and three standard blades alongside. These blades are $\frac{1}{2}$ in. long by $\frac{3}{4}$ in. wide, and the wheel is 3 ft. 7 $\frac{1}{2}$ in. in diameter.

The conditions of the velocity wheel are typical of those with dry steam at a high temperature, and the conditions at wheel No. 8 are typical of very wet steam.

No Corrosion.

The work done by this generating set since the fitting of the new blades is represented by a run of 3 471 hours, with the demand fluctuating as described above, averaging a 50 per cent. load. The appearance of the blades on opening up the turbine has to be seen in order to be properly appreciated. But it may be said whilst the standard blades have corroded in the usual way, the stainless ones, both polished and unpolished, are practically untouched and retain their original brightness. What discoloration there is is probably due to rust carried over from the other blades, as shown by the fact that it washes off with a damp rag.

In Fig. 1 will be found a photograph showing three polished and three unpolished stainless blades after fifteen months in service. Fig. 2 shows three of the unpolished stainless blades and three of ordinary composition nickel steel put in new into the turbine at the same time as the stainless blades. In Fig. 1 the blades have been

rubbed with a damp cloth prior to taking the photograph, whilst in Fig. 2 they are as opened out.

Fig. 3 is a photograph showing twelve stainless steel turbine blades as opened out, and the photograph clearly indicates the difference

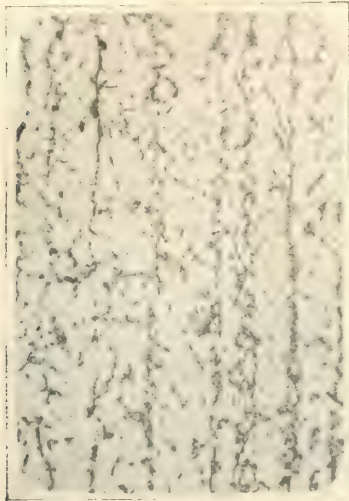


FIG. 4. MICROPHOTOGRAPH OF NICKEL BLADE $\times$ 500 DIAMS.

in the response to both corrosion and erosion when comparison is made with the adjoining nickel steel blades.

Stainless steel contains 0.30 per cent. carbon and 13.4 per cent.



FIG. 5. MICROPHOTOGRAPH OF STAINLESS BLADE $\times$ 500 DIAMS.

chromium; whilst nickel steel employed contained 0.19 per cent. carbon and 4.71 per cent. nickel.

Mechanical Properties of Stainless Steel.

The mechanical properties of the two steels as placed in the turbine are given in the following table:

	Nickel.	Stainless.
Yield-point, tons-sq. in.	25.2	44.1
TENSILE STRENGTH, tons-sq. in.	34.7	54.5
Elongation, per cent.	32.0	20.0
Reduction of Area, per cent.	61.0	59.7
Brinell hardness number.	119	255

Microstructure.

The microstructure of the blades is reproduced in the attached microphotographs, Figs. 4 and 5, which are both at 500 diameters. It will be seen that that nickel steel is in the soft condition and consists of ferrite holding nickel in solution, with a little pearlite running through it. The stainless steel is seen to consist of fine grained structure resulting from the effect of tempering upon the hardened condition.

This experimental data is rightly claimed to be sufficient to show that the introduction of stainless steel for use in turbine blading will be of great advantage, and it is quite clear that improved efficiency, due to the retention of a clean, smooth surface on the blades, and the saving of time and of awkward situations by the avoidance of shutting down for repairs, re-blading, cleaning, &c. will be of direct interest to turbine engineers.

The E.L.M.A. Publicity Campaign.

(COMMUNICATED.)

One of the most conspicuous features in recent electrical history is the growth of the Association movement. Every important section of the industry now has its representative body, and to an increasing degree the machinery of production and trade operates through incorporated associations. The prime function of these groups is to protect the common interests of their members, but to this elementary purpose they have added many others of no less value—the establishment of standards of quality, the encouragement of joint research, the equitable control of trade relations, and the promotion of electrical progress.

The ELECTRIC LAMP MANUFACTURERS' ASSOCIATION, for example, concerns itself not only with the efficiency and reliability of lamps and the stabilisation of prices, it acts also as a direct stimulus to the spread of electric lighting. The publicity work undertaken by individual lamp firms has an indirect effect upon the general popularity of electric lighting, and its success led the Association to attempt two years ago to supplement it by a combined effort to set forth, not the advantages of any particular lamp, but the broad advantages of electric light and of the lamps which bear the hall-mark of the Association. The results were so far promising that the Association has arranged for another national publicity campaign during the season upon which we have now entered.

Phases of the Campaign.

This campaign has two phases. One is to arrest the attention of the world and his wife, and to create a livelier demand for electric light and E.L.M.A. lamps in the home, the office, the factory, and the public building. The second is to invite the active co-operation of the electrical trade. In pursuit of the first phase the newspaper and general Press is being utilised; and for the second phase the trade and technical journals form the first line of approach. Series of advertisements have been arranged in London daily and evening papers, and in provincial daily and weekly newspapers. These advertisements will be supported by others in the weekly and monthly illustrated journals and magazines, thus ensuring a continuous and manifold appeal to the general reader on behalf of the electric light as afforded by E.L.M.A. lamps. The business man and the trade user will be addressed through the specialist Press, covering engineering industries, mines and collieries, textiles and soft goods, the catering and provision trades, shipping and shipbuilding, railways, breweries, building, ironmongery and hardware, and many others. The type of advertisement will, of course, be adapted to the class of user reached by each medium of publicity.

How the Demand Can be Increased.

A well-organised campaign on such an extensive scale must lead to a material increase in the demand for E.L.M.A. lamps. It is important, therefore, that the wholesale and retail electrical trade should be ready to satisfy that demand immediately it arises. In creating business for itself the Electric Lamp Manufacturers' Association creates it for every member of the lamp trade. This is the main argument for energetic co-operation by the wholesaler and retailer during the progress of the campaign. But publicity work such as E.L.M.A. is undertaking has much more extensive results. Increased sales of lamps bring an augmented demand for reflectors and fittings, for numerous accessories, and for installation work in general. Every user of electric lamps is a potential buyer of other current-consuming appliances. Electric light, as has been well said, opens the door to "other uses." With the growth of electric light and its consequent demands there comes an increase in the output of electricity supply stations and a need for more generating plant, transformers, switchgear, cables and electrical supplies in general. Thus through the interdependence of the various branches of the electrical industry, the combined publicity enterprise of the E.L.M.A. will quicken the pulse of electrical business as a whole and at a period, moreover, when encouragement is peculiarly welcome.

A Small Hydro Electric Installation.

In 1919 the NORTH WALES COUNTIES ASYLUM authorities instructed Mr. S. E. Britton, City Electrical Engineer, Chester, to report to them upon several water resources located within a few miles radius of the asylum, with a view to utilising water power in place of their existing steam plant for generating electricity. The following year the asylum authorities decided upon the development of a scheme on the River Ystrad, and applied to the Lunacy Commissioners and the Ministry of Health for sanction to proceed with the development.

The River Ystrad passes through land belonging to the asylum and the site selected for the hydro-electric installation is about 400 yds. distance from the asylum.

The area of the catchment utilised by the installation is 17 sq. miles, and the average rainfall in the district 50 in. per annum, from which it is calculated that the erection of the dam to give



FIG. 1 THE POWER HOUSE AND DAM COMPLETE, AND RESERVOIR CREATED BY THE DAM.

a fall of 15 ft., and a reservoir having an area of 3 acres would provide water power capable of producing electricity to the extent of 200 000 units per annum. The scheme involved the erection of a dam 160 ft. long across the valley of the river, a fish pass to facilitate the passage of fish over the dam, and a power station in which to instal a water turbine generator and switchgear.

A specification was prepared and sent to several contractors, but owing to the unsettled state of labour and cost of materials and the difficulty of obtaining the class of materials required, the contractors did not submit a tender. The asylum authorities then empowered Mr. Britton to make the best arrangement he could



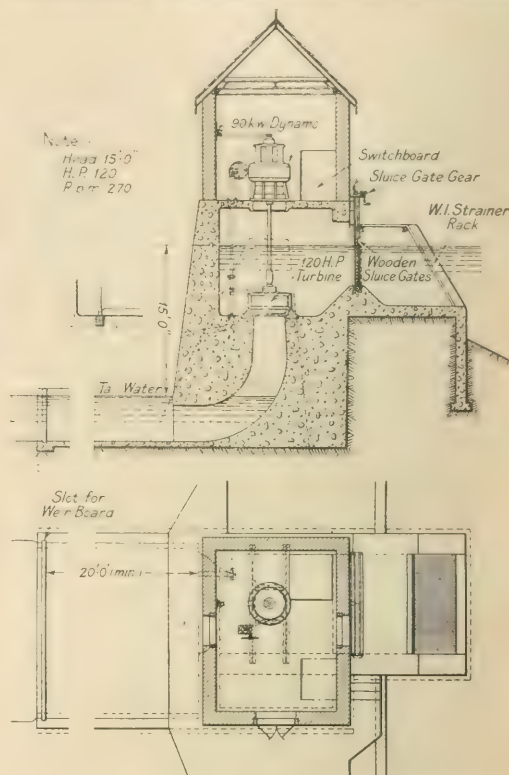
FIG. 2 AERIAL VIEW OF THE POWER STATION.

to carry out the work by direct labour or otherwise. A contractor was eventually found who was prepared to carry out the excavations and concrete work to a schedule of prices subject to fluctuations in cost of labour and materials.

Messrs. J. Gordon & Co. contracted for the supply and erection of the turbine, generator, switchboard, sluice gates, and strainer rack. The other sections of the work were carried out by direct labour.

The turbine installed is of the Francis vertical shaft type designed to develop 120 h.p. at 270 revs. per min. when working with a fall of 15 ft. The generator is also of the vertical shaft type, having an output of 700 A at 120 V, and is direct coupled to the turbine.

Two 0.75 sq. in. paper insulated lead sheathed and steel armoured cables are laid direct in the ground. These connect the generator to the main switchboard in the power house at the asylum where steam generating plant has been in use for a number of years. The power house at the asylum contains three 35 kW steam



SECTIONAL PLAN AND CROSS SECTION OF STATION.

generators, which in the past have supplied 85 000 units per annum for lighting and power purposes. The water power installation will now be used in place of the steam plant, and it is intended to instal additional electrical apparatus so as to utilise to the full the possible output of the hydro electric installation. Our illustrations show views of the reservoir, dam and power station, while the sectional drawing of the last-named makes the general arrangements clear.

Federation of British Industries.

The Grand Council of the Federation of British Industries recommended to the annual general meeting of members on the 23rd prox. the appointment of Col. O. C. Armstrong, D.S.O. (chairman of Messrs. Greenwood & Batley), to the position of president of the F.B.I., in succession to Sir W. Peter Rylands, who retires after two years' service.

Col. Armstrong has had a distinguished military career, and acted as Lord Kitchener's financial adviser during the Boer War. In 1905 he was appointed Financial Adviser, Headquarters, India. Retiring in 1909, Col. Armstrong became a managing director of Messrs. William Beardmore & Company. In 1914 he resigned to become chairman of Messrs. Greenwood & Batley. He has been vice-president of the F.B.I., chairman of the British Engineers' Association, and chairman of the Mechanical Engineering Group of the F.B.I.

The following members of the F.B.I. are also recommended for election as vice-presidents: Lord Weir and Sir John Hunter, Glasgow district; Sir Thomas Callender, electrical industry; Sir Harris Spencer, Birmingham district; Sir Wilfrid Stokes, chairman Decontrolled Firms Committee; Mr. Lennox Lee, chairman Manchester district; Mr. Peter MacGregor, chairman Sheffield district; Mr. Clive Cookson, chairman Newcastle district; and Mr. Alex. Johnston, chairman Edinburgh district.

Correspondence.

THE FOUR FUNCTIONAL PARAMETERS OF THE TRIODE AS EXTENDED TO THE "MAGNETRON."

To the Editor of THE ELECTRICIAN.

SIR: In French patent No. 512 295 of April 15th, 1916, as well as in an article which appeared in Vol. LXXVIII. of THE ELECTRICIAN (December 1, 1916, page 280), the writer introduced the four well-known functional parameters of the triode, $\frac{\partial i_p}{\partial v_p}$, $\frac{\partial i_p}{\partial v_g}$, $\frac{\partial i_p}{\partial v_a}$, $\frac{\partial i_p}{\partial i_a}$, the use of which has become classic.

It has recently occurred to the author to ascertain what became of these four parameters with reference to the vacuum tube designated by Mr. A. W. Hull under the name of "magnetron" (See "Proceedings" of the American Institute of Electrical Engineers, September, 1921) in which the electrostatic grid controlling the electron stream is replaced by an outside coil producing a magnetic field.

This particular tube, in which it is necessary to super-impose a permanent field on the controlling field in order to obtain practical results, has already been described

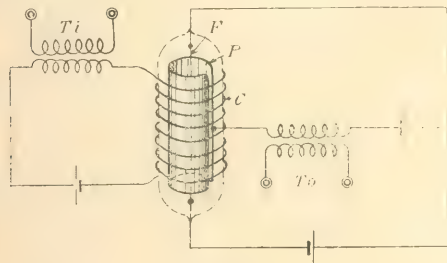


FIG. 1.

as detector, amplifier and generator in the French patent No. 503 935, 1917, of Messrs. Bouchardon and Lesage.

The magnetron, as represented in Fig. 1, comprises an axial filament, F , a cylindrical anode, P , and an outside coil, C , which is traversed by the current to be amplified and a permanent direct current. Fig. 1 illustrates the input transformer, T_i , and the output transformer, T_o .

The anode current, i_a , is a function of the anode potential, v_a , and of the total current, i , which traverses the coil, C . We have $i_a = F(v_a, i)$ whence there result two parameters for the plate current: $\frac{\partial i_a}{\partial v_p}$, $\frac{\partial i_a}{\partial i}$, similar to those of the triode.

But the method of deriving two parameters for the control circuit is not readily apparent. They nevertheless exist. If we consider the case of the triode with an electrostatic grid, the fourth parameter, $\frac{\partial i_g}{\partial v_g}$, generally approximates to zero. From a theoretical point of view, however, this parameter is of great importance, for it defines the possible reaction of the plate circuit upon the grid circuit.

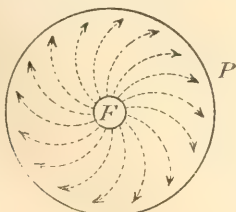


FIG. 2.

Might there not also be theoretically a similar reaction of the plate circuit upon that of the coil, C , in the case of the magnetron? There certainly might be. While the electrons are

being whirled around the filament as shown in Fig. 2, they tend to produce a magnetic field parallel to the axis of the filament and consequently that of the coil, C , and the flux embraced by the latter actually includes the flux produced by that field. In this case, the magnetic flux, ϕ , embraced by the coil, C , is at once a function of i and v_a . We have $\phi = f(v_a, i)$.

whence the two new parameters for the control circuit: $\frac{\partial \phi}{\partial i}$, $\frac{\partial \phi}{\partial v_p}$.

Let us designate the four parameters of the magnetron by symbols which recall their dimensions, as follows:

$$\begin{aligned} \frac{\partial i}{\partial v_p} &= \frac{1}{r_p} & (\text{Conductance}) \\ \frac{\partial i}{\partial v_g} &= k & (\text{Numerical coefficient}) \\ \frac{\partial i}{\partial i} &= l & (\text{Self-induction}) \\ \frac{\partial \phi}{\partial v_p} &= t & (\text{Time}). \end{aligned}$$

Let us consider the actual values of these parameters for values, v_a , i_a , ϕ , i , in the neighbourhood of which the device is supposed to work, and let us imagine that we super-impose on the continuous current, i_a , by means of the transformer, T_o , a weak current $j \sin \omega t$ to be amplified. To determine the amplified alternating electromotive forces and currents $U \sin \omega t$, $J \sin \omega t$, and the alternating flux, $\varphi \sin \omega t$, embraced by the coil, C , we shall have, when supposing that the anode circuit includes, through a transformer, T_o , of ratio 1, an external resistance, R , the following equations:

$$\begin{aligned} J &= \frac{U}{r_p + R} + k j \\ \varphi &= l j + t U \\ U + J R &= 0 \end{aligned}$$

These equations correspond to:

$$\begin{aligned} J &= \frac{k r_p j}{r_p + R} \\ U &= - \frac{k r_p R j}{r_p + R} \\ \varphi &= \left[1 - \frac{t k r_p R}{r_p + R} \right] j \end{aligned}$$

Knowing $\varphi \sin \omega t$ and the resistance r , of the coil, C , it is easy to compute the potential difference at the terminals of the coil, C , and to calculate all the deducible matter.

I am, &c.,

MARIE LATOUR.

Paris, October 21st.

THE ACCURATE MEASUREMENT OF ALTERNATING AND MULTIPHASE CURRENTS.

To the Editor of THE ELECTRICIAN.

SIR: With reference to Mr. Addenbrooke's letter in your issue of Sept. 30, I am sorry he feels he has not been fairly treated. Those of us who have used the quadrant electrometer as a wattmeter fully appreciate his pioneer work.

Part of Mr. Addenbrooke's letter suggests that he had previously published the method described by me in a recent Paper to the Physical Society. If that is so, I have no desire to take any credit that may be due to Mr. Addenbrooke. I have carefully read the article (THE ELECTRICIAN, Sept. 11, 1903) from which he has taken his abstract, but cannot find a description of the method I described, though I did find the following statement:

"I have founded a zero method of measurement on the above facts, in which, if necessary, one instrument without alteration of calibration reads directly the volts across the circuit, the apparent amperes and the true watts, &c., but there was no description of how he accomplishes this."

The only other zero method I know is described by Dr. Alexander Russell in his "Alternating Currents," Vol. I., p. 320. I am, &c.,

HUBERT PARRY.

Newcastle-on-Tyne, Oct. 19, 1921.

WATER-POWER PROBLEMS.

To the Editor of THE ELECTRICIAN.

SIR: I notice in your issue of Sept. 16 that you give a summary of the Paper on "Water-Power Development," by Prof. A. H. Gibson, read before the British Association, and it is there stated that the bearings used in connection with the 55 000 h.p. turbines now being built for the Chippawa-Queenston development of the hydro-electric Power Commission of Ontario are the single-thrust Michell bearing. Two of the 45 000 kVA vertical generators for this station have been built by the Canadian General Electric Company, Ltd., at their Peterboro, Ontario, factory. The bearings are their standard spring-thrust type, and are built to support the weight of the revolving portion of the generator, the exciter, thrust-bearing and downward thrust of the turbine under all starting, running and stopping conditions met with in operation. Each bearing is capable of sustaining and operating under a total combined weight placed on the bearings of approximately one million (1 000 000) lbs.

It might not be amiss to mention that the 16 pole, 45 000 kVA, 187½ revs. per min., 12 000 V, 25 cycle, three-phase generators now being completed are the largest water-wheel driven machines in the world, and that they are being constructed within the British Empire. I understand that a German firm is constructing a 60 000 kVA generator, but that this is for coupling to a steam turbine and for a speed of 1 000 revs. per min. Taking the speed into consideration with the capacity, it is not to be compared in size with the Queenston generator, which weighs in the neighbourhood of 1 200 000 lbs. I am, &c.,

G. N. THOMAS,

Contract Engineer, Canadian General Electric Company.
Toronto, Oct. 13.

GAS v. ELECTRICITY.

To the Editor of THE ELECTRICIAN.

SIR: We should be very pleased if any of your readers could supply us with information concerning the cost of running gas-heated furnaces for the heat-treatment of steel. What we desire to know is, what the number of cubic feet of gas amounts to per pound of steel treated. We have already some information upon this point, and so far have found that the cost of gas heating invariably exceeds the cost of heating by electricity.

There may be, however, on the market a gas furnace more economical than any that we have yet met with, in which case we should like to hear of it. We are, &c.,

AUTOMATIC AND ELECTRIC FURNACES, LTD.,

E. P. Barfield, Managing Director.

London, Oct. 21.

The Progress of Electrical Research.

THE PROGRESS REPORT of the BRITISH ELECTRICAL and ALLIED INDUSTRIES RESEARCH ASSOCIATION for the September quarter gives particulars of the several important industrial researches that have been carried out. The work of the Association is conducted by Committees under eleven sections, and the Report indicates the progress in each.

Fibrous Insulating Materials.

In Section A (Fibrous Insulating Materials) the results of the classification of users' requirements have shown that two grades of treated fabric are sufficient to meet all ordinary demands. For tubes of the higher grade, which have hitherto been purchased on a basis of price, breakdown voltage, and appearance, the Committee is developing better technical criteria. Tests under working conditions are yielding data which will define the fundamental constants of these materials. Improved test methods for untreated papers have been evolved as a result of experiments, and these are to form the basis of a specification. Researches on fibres and boards have been undertaken under three heads—press-board (including presspahn), varnish-paper products, and vulcanised fibre. Experiments on press-board have indicated the best methods for

testing, and these will form the basis of a forthcoming specification. The corresponding work on the two other classes of material is scarcely so advanced.

Composite Insulating Materials.

The experimental work on Composite Insulating Materials (Section B) has so far progressed as to enable a specification to be drafted. This embodies the results obtained on the important mechanical and electrical properties, but inflammability, machining qualities, and certain other properties are still under investigation. A comprehensive research on porcelain, with particular reference to insulation resistance, improvement of surface, and dielectric strength is being pursued, with the co-operation of the G.P.O. and of the manufacturers. Samples have been obtained from the former showing surface deposits which adversely affect the insulating properties, whilst the latter are invited to submit samples for resistivity and electric strength tests, including resistivity tests at high temperatures.

In the section dealing with mica, classification is completed, and the Committee will carry out further detail researches on the various qualities, in co-operation with the Committee of the new Section L. A report will shortly be ready on the use of mica for commutators and condensers; the experimental work on the abrasive hardness of mica is not yet completed, however.

Numerous researches on insulating oils, referred to in the last report, are still under way. The study of resistivity in relation to moisture content and dielectric strength has necessitated a comprehensive research, particularly as certain new facts arising from the investigations require further consideration. The provisional specification for insulating oils drawn up and submitted to the B.E.S.A. has called forth suggested improvements which are being dealt with.

Conductors and Control Apparatus.

In Section F (Conductors), work on buried cables at the N.P.L. and at Newcastle will shortly be reviewed. There has been some delay, due to the necessity of carrying out tests on finished cables instead of component parts, as originally intended. The work on overhead line conductors, and on the strength of wooden poles, is nearing the report stage.

The Committee of Section G (Electric Control Apparatus) has several most important researches in hand. The work on the rupturing capacity of oil circuit breakers has been mapped out, and an adaptable model switch and certain sensitive recorders have been specially designed for this programme. The Home Office at Eskmeals, and the National Physical Laboratory, still continue the research on the pressures developed in switch chambers by gaseous explosions and the rupturing of electric circuits. From the critical examination of available data on heavy-duty fusible cut-outs, a research programme on these heavy-duty fuses is being built up.

Direct current circuit breakers have been the subject of extensive inquiries, which only emphasise the lack of fundamental data on this subject. However, with such material as is available, it is hoped to make a commencement of practical tests. The Electrical Engineers of the L.C.C. and L. and N.-W. Railway, and other users and manufacturers are co-operating in this work. The extensive work on joints and contacts already done at the National Physical Laboratory and elsewhere, is being supplemented by a study of heavily loaded joints existing in various installations.

Condenser Corrosion.

The Association is participating in the research on the corrosion of condensers by the Corrosion Committee of the Institute of Metals. It is expected shortly to issue an explanatory report of the results so far obtained, and steps are being taken to bring manufacturers into closer touch with the investigators during the experimental work. In the same way, it is intended to keep manufacturers in touch close with the experimental work on turbine nozzles (under Section J) now proceeding at the College of Technology, Manchester. It is hoped to extend this work to the question of temperature distribution on turbines, and to new investigations on the properties of steam. Blading materials are already being tested under working conditions by manufacturers co-operating with the National Physical Laboratory.

A Conference of the Committee of Section K (synthetic resins) has been held with various Government Departments, through the instrumentality of the Department of Scientific and Industrial Research, and a good understanding of the requirements for different purposes arrived at. Other aspects of the use of synthetic resins, with which this Committee is dealing are—the provision of adequate supplies at all times, moulded synthetic resins, and the properties of materials of synthetic resin with a fibrous support. The work of all the Committees dealing with insulation, is being reviewed and co-ordinated by the Committee of Section L, which deals with dielectrics in general, and supersedes the old Joint Committee on Dielectric Losses and Allied Phenomena.

The B.E.A.M.A. Annual Dinner.

THE BRITISH ELECTRICAL AND ALLIED MANUFACTURERS' ASSOCIATION held their annual dinner on Thursday, the 20th Oct., at the Savoy Hotel, the Right Hon. Lord Amthill, G.C.S.I., President of the Association, being in the chair. A representative company numbered upwards of five hundred.

The toast list was short and to the point. Mr. GEORGE BALFOUR, M.P., in proposing "The Industry," said that at present the operation of agents of foreign manufacturers tended to depress prices, but the situation was to be met with confidence and courage. The Association had done good work in the standardisation of designs, in the founding of a research section and in forming the Electrical Development Association. The cure of the disease of unemployment rested with the industry and not with the Government. Wages were at present on an uneconomic basis and must be adjusted, not to a beggarly level but to the right standard to increase employment. Employers had made maximum profits when wages were at their highest. The only matter the employer could take into consideration was "Can I sell my goods?" He recommended that Lord Weir's recent advice should be followed in every way.

The Situation Analysed.

Mr. L. B. ATKINSON, in reply, said there were great difficulties in front of us. Where there had been abundance of orders and great activity, within three months we were confronted with falling credits, the drying-up of business, and the knock-out blow of the coal strike. There was nothing now to do but rebuild on the basis of high production. There was chaos in production and distribution, and the Government was blamed for the situation. The Government, however, had other duties, and after all, had only a small share in industry. Manufacturers must themselves right the situation. The fundamental facts were that margins and savings did not exist. Both were mainly absorbed in taxation and the provision of relief. Short credits were of little use to the electrical industry. Twenty years at least must be allowed. We must create export credit for the engineering trade. We were still confronted with the German difficulty. The fall in our values was greater than that of Germany, and we would not accept payment in mark paper. German people were working harder than those in England or Belgium, mainly because they were working for a unit of bread. We required not wages per week, but wages per unit of output. There would be no alternative to the closing of factories unless the unit of output rose and we got back the longer hours. It was useless to look to the Government. What was required was greater production everywhere.

The toast of "Our Guests" was briefly and aptly given by the CHAIRMAN, who remarked that the objects of the Association were essentially national and patriotic, for our national existence involved the welfare of everyone depends on trade prosperity.

Brig-General Sir H. THORNTON, in reply, remarked on the fact that everyone seemed to be complaining and no one doing anything. He confirmed the remarks of the previous speakers, that only increased production could save the situation. He approved of the eight-hours' day if eight hours' reasonable toil were given in return. There was a feeling that unless the railways could render a good account of their stewardship, nationalisation would be the only remedy. Such a course he regarded as fatal and instanced the fact that the Berlin railways were denationalised and were now being successfully administered. He thought there should be no difficulty in labour, industry and transport amicably working together. It was, however, necessary that the responsible labour leaders should be convinced that increased production was required, and that the wages paid must be commensurate with that production.

An Electric Runabout Crane Truck

Without wishing to assume the mantle of our contributor, "Electrocynic," it is not far from the truth to say that the most interesting electrical exhibit at the Commercial Motor Exhibition was not a vehicle at all, but a travelling crane. This equipment, which we illustrate herewith, was to be found on the stand of RANSOMES, SIMS & JEFFERIES. This equipment has been put on the market to supply the need for a mobile crane that can be manoeuvred in confined places, run in and out through the doorways of warehouses, and used for the speedy loading or unloading of motor lorries.

One of the difficulties that have to be faced in the design of such apparatus is to stabilise the crane in all positions. To achieve this necessitates a large base and particularly heavy construction. This is overcome by Mr. P. A. Mossay, the designer of the new truck, by fixing the crane rigidly to the vehicle and designing the latter so that it can turn on its own axis and run backward or forwards on any path of curvature.

As the crane is a fixture on the chassis, the jib is always in the same position relatively to the chassis, so that there is no variation of the stability factor as the load is slewed. As a result, we understand, the runabout crane has only about half the weight of a crane truck built for the same service according to the methods hitherto employed, and, furthermore, the pressure on the road remains constant for all positions of the crane, and is kept within low limits by its distribution between four wheels.

Driving Arrangements.

To effect this the driving wheels are each driven by an electric motor supplied by a battery carried on the truck, and the steering wheels can be rotated in either direction to positions at right angles to the running positions. Just before reaching this extreme position one of the running motors is automatically reversed, so that the truck then rotates about its own axis without any motion of translation.

Going into more detail, the truck for purposes of travelling, either forward or reverse, is operated like a lorry. The directional controller placed on the right hand side of the driver is operated by a lever working in a gate, interlocked with the left foot pedal which controls a resistance drum, and only by depressing the pedal control which breaks the circuit can the controller handle be placed in the forward or reverse positions. By releasing the pedal circuit is made through a series of resistance steps which govern the speed of the vehicle. The current can be cut off immediately by depressing the pedal.

The brake pedal actuates two compensated brake bands working



VIEW OF THE ELECTRIC RUNABOUT CRANE TRUCK

on drums keyed on the motor spindles. These brakes can be used either as a service or ratchet brakes.

Batteries supply the energy and constitute permanent counterweights.

Steering is effected by turning the steering wheel and lifting a pawl on the top of the master controller. The steering wheels, both front and rear, can be turned and locked at 90 deg. to the driving wheels. At the same time a series of contacts situated in the master controller reverse the field of one of the driving motors, which are thus connected so as to exert a couple on the whole structure.

Hoisting and Derricking.

By operating the lever and the pedal mentioned above a clockwise or anti-clockwise rotation of the crane truck may be attained.

The crane controller for hoisting and derricking, is placed on the left of the driver, and is operated by a lever working in a gate, controlling the raising or lowering of the hook. The derricking motion of the jib is controlled by the same lever, the mechanism being so arranged as to obtain an approximately horizontal movement of the load; that is to say, when lifting the jib, the hoist rope is paid out and when lowering the jib the rope is wound back on to the hoisting drum.

These cranes are made in two sizes of 15 and 35 cwt. capacity respectively. The former has a radius of 10 ft. and the latter a radius of 11 ft. 6 in. The operating space required in the first case is 6 ft. and in the second 9 ft. 6 in., while the travelling speed is about 300 ft. per min.

There is evidently a wide application of this machine for docks, railway yards and in engineering works.

Power for Irish Industries.

It is pleasant to be able to record the fact that there are still persons in Ireland who devote themselves to something more useful than to politics and religious strife. At the All-Ireland Industrial Conference, which was held in Dublin on the 19th and 20th inst., there was an interesting discussion on the economic production of power for Irish industries, in which a number of electrical engineers and industrialists took part.

Peat and Water Power.

MR. T. TOMLINSON, B.A., said that the estimated available energy in the country from water was at least five times that at present developed from imported coal, and perhaps more. The Irish Commissioners of the Fuel Research Board had reported that the peat deposits would satisfy the power requirements of the country, at the present rate of consumption, for more than 250 years. That implied that the whole present demand of Ireland for fuel, lighting, heating and cooking could be supplied for 250 years if the peat bogs were properly developed, and much longer with the aid of water power, so that the country was really in a very good position as to power possibilities. He quoted the views of Mr. G. M. Harriss, who had said that from a small water-power plant on the Liffey the cost per unit of electric energy delivered to the city boundary was 0.3225d., while the present cost of the unit delivered at the switchboard in steam stations for coal only exceeded one penny. Mr. Tomlinson suggested the installation of a modern generating plant on the best and most easily exploited fall of one of the four main water powers, and the supply therefrom of some four or five small towns willing to take bulk supply. The station would be experimental, and would familiarise their engineers with the erection, operation, prime costs and running of a water-power station.

PROF. PURCELL gave an account of recent advances in water-power development abroad, and said that he was an optimist about its use. It was, however, purely a question of supply and demand; when the demand was made an adequate supply would be forthcoming.

An Electrical Engineer's Views.

MR. L. J. KETTLE, chief electrical engineer of Dublin Corporation, said the cost of power supply depended on the use made of it. Wages were a big item in the cost. They could supply in Dublin at 1d. a unit, and they also supplied at 5d., but they considered that they made the profit on the supply at 1d. and not on the 5d. man. They did not want the 5d. man, but supplied him because they were a public supply authority. Referring to the use of Irish coal, Mr. Kettle said that Irish coal suffered from the fact that they had not been educated in the use of anthracite coal. They had been used to coal with a lot of gas in it, but anthracite coal was a coal *par excellence*. The principal trouble about water power in Ireland was the variable flow in the rivers. They had a great asset in the climate if they could only store the water that fell. Dublin Corporation were anxious to develop the Liffey, and had obtained the expert advice of Sir John Griffith. They had now decided to supplement that with the advice of a Continental expert on water power, after which they felt pretty sure they could "go ahead." The Liffey and the Bann would be the first to be exploited. Of course the Shannon and the Erne were bigger and had greater water power, but they had not the population near them.

MR. GEORGE FLETCHER, Assistant Secretary of Technical Instruction Department, said they could leave coal out of consideration, and yet the country could be made an industrial one if they wished.

MR. HAMILTON ROBB (Portadown) gave the result of his commercial use of peat gas, which he greatly favoured.

Scottish Water Power Schemes.

There is much activity at present in Scottish municipal circles in discussing and considering schemes for the development of hydro-electric power in the Highlands. Some of these are municipal projects and others are being promoted by companies. Last week the MORAY County Council were formally invited by BANFF County Council to co-operate in a joint scheme for providing electric power from the Spey and its tributaries. Another communication was read from the Town Clerk of Inverness as to the proposed hydro-electric scheme which is being promoted by the Inverness Town Council for the northern area. The Convener (Mr. J. F. Cumming) was of opinion that there was no scheme they could get from the Spey that would give them light and power that any consumer would be able to take up. Inverness put something definite before them, and thought the light could be supplied at 2d. per unit.

Ultimately a committee was appointed to report on the two schemes.

Bingley-Keighley Bulk Supply Dispute.

The Electricity Commissioners are to be congratulated upon their promptitude in issuing their findings upon the report of the Inspector who held an inquiry at BINGLEY on the 8th inst. into the complaints by Bingley Urban Council of negligence on the part of Keighley Corporation, resulting in two prolonged breakdowns (one of ten hours and the other of eighteen hours) in the supply of electricity during the first week in October.

Bingley Council alleged that the Keighley electricity department had not given proper attention to the necessity of maintaining the overhead supply lines in efficient working condition, and urged that the length of the stoppages and the inconvenience caused to con-

sumers had been increased by the fact that it was generally the case when a breakdown occurred that the ~~respective~~ supply line was also found to be out of order. The liability for the maintenance of the lines in efficient working order lies upon Keighley.

The Commissioners find that the interruptions of supply would be reduced to a minimum if the insulators on the poles carrying the lines were renewed and a regular patrol of the lines made. A recommendation is also made that the electrical engineers of the two authorities should confer together on measures to ensure a satisfactory supply of electricity being provided.

Czecho-Slovakia Industry.

In a report on the economic and industrial situation in Czecho-Slovakia, H.M. Commercial Secretary at Prague (Mr. E. H. Bruce Lockhart) states that there is at present only a small field for British commercial enterprise, but he pleads for a better understanding with, and a wider knowledge of, this, the most industrialised of the Succession States. The country is one of the richest in Europe from the point of view of natural resources and industrial development, having acquired about 80 per cent. of the whole industry of the former Austrian Empire. The richest part of the Czecho-Slovak industry is in Northern and North-western Bohemia, which is almost entirely German in population. The State lives on its export trade, and it has an industry far too large for its own needs. The crux of the situation lies in the question of transport facilities in Central Europe, but the artificial barriers created by political severances and the mutual blockade between the States also affect the economic situation.

British Capital Wanted.

The Czechs apparently desire British capital rather than goods, as Czecho-Slovakia manufactures most of the articles which form the staple export commodities of Great Britain. In Mr. Bruce Lockhart's opinion there is much to be said for British investments of capital in Czecho-Slovakia, as he considers that if the political situation in Central Europe remains stable the country should develop rapidly. Many schemes of improvements, *e.g.*, electrification, port construction and railways, are being put forward almost daily, and fail for want of capital. In present circumstances such investments must be attended by considerable risks.

The competing power of Czech manufactures in International markets was enhanced in 1919 and during the first part of 1920 by the low rate of exchange and low costs of production. More recently, however, the latter have greatly increased, and the Czech exporter has now great difficulty in competing abroad, especially in those countries which have exchanges as low as or lower than his own. His hopes are directed towards Russia and the Balkans. The country has a favourable balance as against Austria, Poland, Hungary, Rumania, France, Yugo-Slavia and Switzerland, but there is a heavy debit balance as against Germany and the United States. The largest trade has been with Germany, both in imports and exports.

Hydro-Electric Development.

There are few countries in which electric supply has reached such an advanced stage of development. In 1919 there were 390 electric power stations, including six of more than 10,000 kW, three of from 5,000 to 10,000 kW, and 28 of from 1,000 to 3,000 kW. At Prague the station has a normal output of 22,500 kW. There are several hydro-electric works, and many projects for the utilisation of water power are under consideration. In Bohemia it is estimated that the maximum output of hydro-electric power (mainly on the Elbe and Moldau) is equal 355,000 kW, in Slovakia 200,000 kW, and in Moravia 59,000 kW, or a total of over 500,000 kW for the whole of the Republic.

Nearly all plants generate three-phase current at 50 cycles, and the transmission voltages are 3,000, 22,000, and 35,000, though the Skoda works transmit power to Pilsen at 100,000 V. A law passed in July, 1919, provides for the systematic development and organisation of electricity supply throughout the country, and several supply companies have associated themselves into groups, or societies for extending supply facilities into their rural areas and for supplying energy for electric traction, &c. Like our Electricity Commissioners, a Board has been formed for supervising the work, and already a number of general principles have been laid down, including the following:—

Steam-power plants are to be erected only on a large scale and, if possible, near mines.

Hydro-electric plants are to be operated at a maximum of economy along the whole river, and should be built with a view to co-operation with other nearby plants.

All transmission lines are to be so built as to form a uniform network.

All energy generated to be three-phase at 50 cycle, except railway power stations. The standard feeder voltage is to be 22,000, except for power supply in the vicinity, for which the direct generator voltage is sufficient.

The standard trunk-line voltage to be 100,000, with permission to use temporarily 50,000 V. The consumer's voltage is to be 220-380 V, but for private enterprises 500 V with grounded neutral is permissible. In direct-current distribution systems 440 V with grounded neutral should be provided. The standard generator voltage is 6,000.

New Method of Shop-Window Lighting.

The possibilities of shop-window lighting on conventional lines are almost exhausted, and enterprising traders are constantly on the look-out for something new and attractive. They want their windows to be different from neighbouring windows, especially at night, when all the windows in a locality may be similarly lighted and individual distinction is apt to be submerged in the collective brilliance. In colour, however, lies the salvation of the lighting individualist. The judicious use of coloured illumination gives the trader almost infinite scope in regard to the treatment and effect of his displays. Coloured lighting is not merely a visual allurement of extraordinary power; it has the further advantages of novelty and variability, and the appearance of the display may be completely altered in a few seconds without moving a single article.

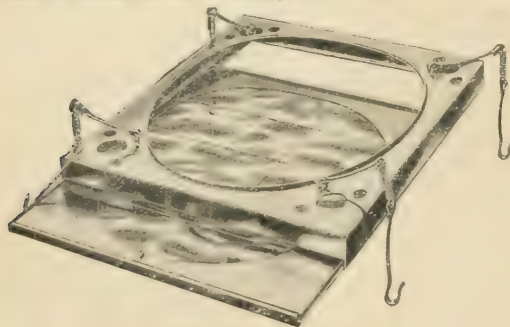
Nobody will dispute the psychological value of coloured lighting, and the only hindrance to its general adoption has been the lack of suitable apparatus. Hitherto, only makeshift methods, such as



X-RAY REFLECTOR ATTACHMENT

the tinting of bulbs, &c., have been employed. Now, however, by the enterprise of the British Thomson-Houston Company, Ltd., a device has been perfected whereby the efficient illumination of shop windows by means of colour slides may be effected. This device is the B.T.H. X-Colour-Ray attachment, which, both in design and construction, is the essence of simplicity. The attachment consists of frame, slide, and colour medium. The frame fits over a "Jove" or "Jupiter" X-ray reflector, and is attached to the reflector by four hooks, which fix in the ventilation holes. The slide is made to hold the gelatine colour medium (the only medium that does not rapidly fade), supporting it by means of fine steel wires. Red, amber, blue and green are the standard colours provided, and the insertion or withdrawal of the slides is the work of a moment.

An important feature of the attachment is that the colour of the lighting can be changed in a few seconds by substituting one slide for another, so that by keeping a few spare slides the trader



X-RAY COLOUR FRAME

is able to alter the appearance of his display as often as he likes. The contrivance can be placed in position without the aid of any tools, and the metal part of the frame in no way interferes with the lighting effect. When ordinary white light is required, it is not necessary to remove the frame; only the slide need be taken out. At least one of the largest stores has already installed the B.T.H. X-Colour-Ray attachment with complete success, and it is confidently expected that in the near future the device will be in general use in the windows of all important stores. Further information will be supplied by the Illuminating Engineering Department of the B.T.H. Company.

As a result of the long period of inactivity of the *Electrician's Technical College*, the *Electrician's Magazine* is, after a period of eighteen months, a longly period of inactivity has been mainly due to the re-organization of the *Electrician's Magazine*, which is now once more in active running order on a paying basis. As is usual in this class of magazine, the most interesting section is that dealing with old students' doings, and for contribution to this column the editor makes a pathetic appeal, which we hope will not fall on deaf

Oil Engines in Electricity Supply.

The discussion of a Paper by Mr. Geoffrey Porter on "The Function of the Heavy Oil Engine in Connection with the General Supply of Electricity," at a meeting of the DIESEL ENGINE USERS' ASSOCIATION, held at the Institution of Electrical Engineers, was particularly opportune in view of the careful consideration which is being given at the present time by the Electricity Commissioners to various schemes for extending and improving the general supply of electricity. The author submitted interesting figures of tabulated working costs, including capital charges, of undertakings using steam plant or heavy oil engines, or a combination of both, and in each case he showed the permissible purchase price payable for a bulk supply from an outside source. Curves showing total transmission losses of various mean loads and power factors, permissible purchase prices, costs per unit of alternative methods of operating, &c., accompanied the Paper. Appendices gave particulars of Diesel engine performances of actual undertakings, heavy fuel oil engine consumptions, examples of terms offered to local supply authorities for bulk supply, and estimated cost of a power station employing heavy oil engines.

Bulk Supply Conditions.

Besides the members of the Association who are users of heavy oil engines, a large number of visitors attended, including engineers interested in the design and operation of large steam-power stations, transmission lines, and transforming machinery, and in bulk supply problems generally. Although there were naturally considerable differences of opinion, it was generally admitted that there could be no case for a system of supplying in bulk throughout the country which would entirely eliminate local generating stations of comparatively small power, and that there was a strong case for the installation of heavy oil engine plant so long as a good supply of suitable liquid fuel could be ensured.

One speaker, who had experience in connection with about forty electricity supply undertakings equipped with Diesel gas and steam engines and steam turbines, and some of which were taking bulk supplies, referred to the large number of cases in which no bulk supply could compete with the local generating station. He felt, like others, that bulk supply should be used wherever possible, and even perhaps in cases in which at the moment it might not be the most economical way to meet the immediate needs of an undertaking, but every case must be considered on its own merits. No doubt the Electricity Commissioners would be willing to hear all sides of any question, and he felt certain that after the experience which the Commissioners had obtained during the past year they would now understand the difficulties and limitations of bulk supply, and that anyone with a good case for local extensions of generating plant would get a fair hearing.

Mr. PORTER's statements concerning the great development of the oil supply industry and the ample proportions of the oil reserves in the world were emphasised by several speakers. Reference was made also to the possibility of oil being distilled from coal on a larger scale in the future, and to the successful operation of Diesel engines during the war on tar oil. The consideration of the use of heavy oil engines to an increasing extent in the future was closely bound up with the development of larger units, in which so much progress had been made for marine work during the last few years.

Institution of Rubber Industry.

The inaugural meeting of the Institution of Rubber Industry took place in the Hall of the Royal Society of Arts, London, on Oct. 18, Mr. J. H. C. BROOKING, President, occupying the Chair.

Mr. BROOKING, in his Presidential Address, said the position of president might have been more suitably filled by any one of several able men whose positions in the industry were more important than his. He regretted that none of them had responded to the call to help the industry by their leadership of the new Institution, and he hoped they might yet see their honoured names on the record of its presidents. There was no cause for apology as to the need for that Institution. All other large industries had their institutions or societies, and had profited by the Papers read before them and the discussions upon them, while the members had been given the advantage of knowing one another to a more mutually beneficial extent in business than would have otherwise been the case.

This modestly-conceived Institution was an attempt to be of use to manufacturers, and, through its benefit to manufacturers, it would also benefit the growers and the distributors of rubber manufacturers. The Institution was meant to follow on the lines of the Civil, Mechanical, and Electrical Engineers, the Chemical Society, and others, which had started in a small way, and had now proved their value to their industries. The weak spot of the rubber industry was that competition was only in regard to prices and not to quality. This Institution trusted to have the sympathy and, if necessary, the collaboration of all persons and associations connected with the industry.

Subsequently Mr. HERBERT ROGERS, F.R.S. (General Manager of Messrs. James Leno Hancock, Ltd.), read a Paper on "Rubber Manufacture," in which he dealt with the history and the methods of rubber growing.

Contractors Organising Exhibitions.

With the passing of summer the exhibition season seems to have set in with unusual vigour. This is a good sign, for there is no doubt of the value of such shows for bringing before the public generally the way in which applied electricity can be used to solve their domestic problems. It is an added matter for congratulation that two of these have been organised by local contractors.

A Bournemouth Enterprise.

This thesis is well illustrated by an interesting EXHIBITION OF DOMESTIC ELECTRIC APPLIANCES held recently at St. Ambrose's Hall, Bournemouth. This Exhibition which was organised by Mr. E. BRONTMAN, an enterprising electrical engineer and contractor, of Bournemouth-road, Parkstone, aroused a good deal of local interest, and must have been of material benefit in popularising electrical methods in local household affairs. Earlier in the month there was a one-day exhibition of electrical goods at St. Peter's Hall, together with brief, but instructive lectures by experts on electric cooking, heating, washing, etc., and a large and appreciative audience manifested considerable interest in the whole of the proceedings.

After a brief explanatory speech by Mr. Brontman, there was an interesting address by Mr. F. H. HOWELL, of the Falkirk Iron Company, on the advantages of electric cooking, followed by a wireless telephone demonstration by Capt. TINGEY. An address on the A.B.C. electric washer and wringer was given by Mr. VELLAND, of the Sun Electrical Company; Mr. E. J. SMITH, of the British Thomson Houston Company, dealt lucidly with modern lighting methods; while Mr. LEEVERS of the Hotpoint Electric Appliances Company lectured on a variety of domestic electric appliances and their advantages and uses. At both exhibitions the goods of a number of electrical manufacturers were on view, and Mr. Brontman, who has adopted a system for the hire-purchase of domestic electrical apparatus, is to be congratulated upon his enterprise in giving such good public demonstrations of electrical methods.

Harrow and Progress.

Messrs. SYMPER and EVERSHED, electrical engineers and contractors, of Harrow-on-the-Hill, have also set a good example to similar firms by organising an EXHIBITION OF DOMESTIC ELECTRIC APPLIANCES at the Harrow Cinema.

The exhibition which closes to-morrow (Saturday), was opened on Monday by Lady Cynthia Mosley, who, as Mr. W. W. Symper said, has taken a great interest in the welfare of the district.

The exhibits included electric washing machines, suction cleaners, and all other kinds of domestic apparatus. The most prominent collection consists of the GENERAL ELECTRIC COMPANY'S "Magnet" specialities, including tailors' and laundry irons, soldering irons, kettles, a combined electric iron and stand with curling tongs and heater and boiler (a useful outfit, taking only 220 W. and costing £2 2s. 6d.), torches and other flash lamps, heaters which whilst ornamental when used for warming the atmosphere only, can also boil a kettle or sauce-pan or heat a frying pan. There are also shown "Magnet" cooking plates, table toasters, log fires, c., and an exhibit which claimed special attention was the "Quixup" cooking cabinet, which contains grill, toaster, kettle and frying pan, and which is recommended for flats, as the whole of the culinary outfit is hidden by the closed cabinet, and presents a most innocent appearance.

Messrs. ARTHUR LYON and CO.'S "Bungalyte" lighting set has a prominent position, and attracts much attention.

THE EVER-READY COMPANY (GREAT BRITAIN), LTD., have supplied for the show a large number of portable lamps, comprising, in addition to the usual types of pocket lamps, a new type of policeman's or watchman's lantern, for which there should be a considerable demand, and a cycle lamp showing a white light in front and a red light behind, and having the battery contained in a neat leather case, the outfit being sold at the moderate cost of 27s. 6d.

Messrs. SYMPER & EDWARDS have on view a good assortment of frosted, opal and opalescent shades, and alabaster bowls, while the correct use of electric lamps is demonstrated in "rooms" furnished by Messrs. SOPER (S. Green & Edwards), of Harrow.

BRITISH ILLUMINATING SIGN COMPANY, of 80, Queen's-road, W.2, show some signs with changing lights, one of the most effective being a reproduction of the well-known "Osram" lamp poster, which shows a muscular arm emerging from the heavens and terminating in a "hefty" hand grasping an Osram lamp.

The attraction of the show also include an accomplished ladies' orchestra and a "dry" buffet.

Public Works Congress.

The preliminary programme has been issued by the PUBLIC WORKS, ROADS AND TRANSPORT CONGRESS, which is to be opened in London on Nov. 18, and to continue till the 25th. The organisations by whom the Congress has been promoted include the County Councils Association, the Association of Municipal Corporations, the Urban and Rural District Councils Associations, the Incorporated Municipal Electrical Association, the Institution of Municipal and County Engineers, the County Surveyors' Society, and the Institute of Cleansing Superintendents.

The Conference arranged for Friday, Nov. 25, is concerned with electrical subjects only. Baillie W. B. Smith, chairman of Glasgow Corporation Electricity Committee, will preside for part of the day, and Mr. S. T. Allen, M.I.E.E., Borough Electrical Engineer, Wolverhampton, for part. At present two Papers are down for discussion in this section, one by Mr. F. Ayton, M.I.E.E., on "Electric

Vehicles for Municipal Purposes," and the other by Mr. S. J. Watson, M.I.E.E., Borough Electrical Engineer of Bury, on "The Application of Electricity to Municipal Services."

Simultaneously, and in connection with the Congress, there will be an exhibition of public service appliances at the Royal Agricultural Hall, Islington. The exhibition is being well supported by the electrical and engineering industries, and promises to be of considerable interest. The chairman of the Organising Committee of the Congress and Exhibition is Brigadier-General Sir Henry P. Maybury, K.C.M.G., C.B., of the Ministry of Transport. The programme is being issued from 9, Victoria-street, Westminster.

Legal Intelligence.

DISPUTE OVER ELECTRIC CABLES.

On Friday, Mr. Justice Branson commenced the hearing of an action by the Enfield Ediswan Cable Works, Ltd., against the A. & A. Electrical Company, Ltd., to recover £2,000, balance of account said to be owing for electric cables and wire sold and delivered for shipment; alternatively, damages for non-acceptance were asked for.

At the end of December, 1919, and the beginning of January, 1920, plaintiffs agreed to sell defendants 1,000,000 metres single wire 1.5 sq. mm. insulated cable at £8 per 1,000 metres, less 2½ per cent., cash against documents, including packing for export and delivery f.o.b. according to specifications in defendants' order of Dec. 31, 1919. Plaintiffs said that at an interview between representatives of the parties in April, 1920, it was verbally agreed that, as to 114 cases, containing 910,900 metres, of the value of £7,287, plaintiffs should make delivery to defendants' agents at Poole Wharf. That was done, and defendants had paid £6,000, part of the purchase price, but had not paid the balance for those goods.

Defendants pleaded that the goods were not fit for their purpose of a contract with Messrs. Max Weinberger & Co., and they claimed £1,087 damages for loss of profit.

MR. BARRINGTON WARD, K.C. (with Mr. Cartwright Sharp), for the plaintiffs, said property in the larger part of the cables had passed, and there he claimed for price; as to the rest he claimed damages. The dispute related to ordinary electric cable, and he suggested that if there had not been a fall in the market price that litigation would never have been begun. The balance of price claimed was £1,287. The price of the 910,900 metres delivered was £7,287, and they had received by arrangement with defendants' bankers £6,000. They had, packed at their works, another 87,000 metres, for which £696 was claimed; in the latter case the court, he submitted, must look to the difference in price between the contract price and the market price at the date of repudiation. There was a balance of £16 for a remaining lot of 2000 metres. The defence raised the question of the contract. The defendants said the contract was that plaintiffs should make the cable in all respects in accordance with the specification of the Verbandes Deutscher Elektrotechniker, but plaintiffs said that specification was to apply only in respect of thickness. Defendants urged that the cable was not merchantable, and they counter-claimed for the £6,000 and loss of profits on the sub-sale; but loss of profits on a re-sale could not be recovered except on goods sold for the express purpose of fulfilling a particular contract; only the difference was recoverable between the goods as they were and as they should be. With thickness only in question, defendants tried to place on them an impossible burden, by insisting on full accordance with the V.D.E. specification. All through the correspondence defendants were talking only of thickness. The cable (of which pieces were handed in) was of copper wire surrounded by two layers of vulcanised india-rubber, then tape, and an outer braiding. Defendants, in their particulars, suggested that the rubber was hard, brittle and unsuitable, of no elasticity, and poor mechanical quality; that the tape was of poor quality, and the braid insufficiently impregnated with black, which had not penetrated properly. They said the percentage of rubber was less than it should have been, that the percentage weight of resin was 13.8 instead of 5; and of other ingredients, including sulphur, 73.2 instead of 65.7, as required by the V.D.E. They put their loss of profit at £1 1s. 9d. per 1,000 metres, or £1,087. The early correspondence was empty of complaints, but strikes were mentioned. Mr. Barrington Ward said they were told that strikes at Amsterdam had delayed delivery, and Messrs. Weinberger & Company (defendants' customers), who complained of the quality, had refused the third delivery. He suggested Weinberger & Company did not find it convenient to take up the lot. Plaintiffs wrote: "You know the cable is equal to the sample we placed before you." Most of the invoices said "to the thickness of the V.D.E.," some "tinned copper conductor V.I.R." Defendants contracted to sell to Weinberger & Company cable "to the thickness of the V.D.E." When plaintiffs' invoices said "to V.D.E." it meant to V.D.E. thickness.

MR. ALBERT V. DOWNTON, plaintiffs' technical director, said there was a British engineering standard, and the 1910 standard was well known. As to defendants' complaint of the mechanical quality of the cable, he had to say that the Government officials made their bending and elongation tests when they inspected the cable, and the cable passed the tests. All defendants' tabulated complaints were ill-founded, except the statement as to chemical composition. Plaintiffs had supplied £80,000 worth of that cable to the Continent without complaints. The delivery was suitable for general electric wiring purposes on the Continent. It would not have been possible to supply the cable up to the V.D.E. chemical

of the price quoted. As it was not according to an 1890 contract there was no real loss to the country. A sale of scrap was made in a good case in August, 1920, might have realised £2 10s.; the scrap value of the order was under £1. The Germans had been manufacturing in 1920. The Germans officially reduced in their V.D.E. specification for 1920 the rubber percentage to 20.

Answering Mr. PATRICK HASTINGS, K.C., Mr. DOWNTON said defendants were assured, upon the contract, "the cable will be manufactured in strict accordance with the V.D.E." That was safe for house-wiring. The difference between the Continental and English requirements was that here a layer of pure rubber, or a pure separator, was required. His last report from the Continent was that cable was to be bought there for £2.

Mr. J. STUART BRANSON said he had been looking at the percentages in the defendants' table of complaints and he found they totalled 113.8. That seemed to be exacting a good deal.

Evidence was given of the present efficiency of the cable supplied for the order by Mr. GEORGE DANTA, who said he had taken several samples of the cable in question and found all above V.D.E. thickness. It retained its elasticity to a remarkable degree; the braid was properly impregnated, and the cable was open to none of the complaints defendants brought against it.

Similar evidence was given by Mr. WM. F. ADAMS, mechanical and electrical engineer, who said the wire was distinctly merchantable. Its structure under the magnifying glass was right.

Mr. FREDERICK PUGH said that he did not remember at any interview in May or June, 1920, defendants' Mr. AGAZAR having rejected the wire as useless. He said it was not in accord with the V.D.E. specification, but he never said anything against its merchantability.

The Defence.

On the question of contract, Mr. PATRICK HASTINGS suggested that the parties were never at one. Plaintiffs offered wire insulated with a layer of pure rubber. Defendants ordered high-grade vulcanised rubber. The goods must be in strict accordance with the German V.D.E. specification.

Mr. MAX WEINBERGER, whose evidence was interpreted, stated that when he saw the wire was not in order he sent to the Dutch Government Office and had it tested. He put in the written report, which showed that it was not in accordance with the V.D.E. There was, he discovered, no market for that kind of cable, though had it been in order he could easily have found a market for it.

Mr. S. C. MOFF, of the India Rubber, Gutta Percha & Telegraph Works Company, Ltd., said high-grade vulcanised indiarubber would stretch like a catapult. The rubber in the cable supplied was of low-grade quality, from his point of view.

Evidence was given by Mr. A. MORRIS, B.Sc., who examined samples of the cable in September and December, 1920. The rubber was semi-perished, and in a state that good quality rubber ought not to be in after eighteen months. Its mechanical properties were poor. The proportion of rubber was 25.4 per cent., 16 per cent. of which was resin. The rubber would only stretch one and a half times its length.

To Mr. WARD. He said he agreed that what he found 15 per cent. of resin in was a mixture, not the pure rubber. Deterioration would be greater in a dry store. Practically all the electric light cables tested at Faraday House were of vulcanised rubber, and 5 per cent. would be a usual proportion of resin in such rubber.

Mr. WM. HENRY G. SHIPMAN, manager of defendants' firm at the time of the transaction, said Mr. HASKETT at the plaintiffs' wrote to him confirming a telephone assurance that the cable would have two layers of vulcanised rubber, which was in strict accordance with the V.D.E. specification.

Mr. BRUCE R. AGAZAR, managing director of defendant company, said he had no experience before of the sale of cable, and no technical knowledge of cables. They telephoned to make it clear that the V.D.E. specification was being followed. Afterwards he said Mr. PUGH said that he thought the first reason for their customer's hesitation to accept was financial, and due to fullness of stocks; afterwards he said there were verbal complaints of the cable, and said he had encountered criticism when he offered it to other customers.

Mr. JUSTICE BRANSON, in giving judgment, said that, while defendants said the contract was for cable according to the V.D.E. specification, plaintiffs said the reference to V.D.E. was taken in this country to relate to the thickness of the insulation, and to that alone. He found some difficulty in coming to a conclusion as to which of those contentions was right. In the request for a quotation appeared the words, "and also, if possible, for Continental sizes." It was perfectly clear that the plaintiffs' quotation was not intended to bring in the V.D.E. standard, except for thickness; it was for insulated and pure rubber to the thickness specified in the V.D.E. The V.D.E. also provided for the composition of the insulating material, the quality of the copper, the conductivity, &c. He could not think it right to regard the reference to V.D.E. as a reference which would render it unnecessary to refer to those other matters at all. Letters of defendants on the face of them, and taken alone, would look as though they were asking for the complete specification. Defendants held up their order awaiting the approval of the samples and not for an assurance of manufacture in entire accordance with V.D.E. Defendants' order was subject to the same comment as plaintiffs' reference, that it did not refer to a cable of a certain size made to the German specification; it went into detail as to what the cable

was to be composed of, and how it was to be made, and the only reference to V.D.E. was "to the thickness recommended by the V.D.E." That went strongly to show that defendants could not have thought that they were going to get the full V.D.E. specification. It would be ridiculous to refer to V.D.E. as to thickness only if V.D.E. was to cover the whole manufacture. That order was accepted, and as to extensions in correspondence, which must be looked to if anywhere the contract stopped short, he did not think that subsequent letters carried the matter much further. He came to the conclusion that the contract was not a contract for the supply of V.D.E. cable, but a contract for the supply of cable to the specification stated in defendants' order of Dec. 31, 1919. The next point taken was, supposing that be so, the cable did not answer the description at all; it was not insulated with high-grade vulcanised indiarubber, but with rubber which contained so much resin as to be useless and far from merchantable, and was worth nothing but as scrap. The evidence was conflicting. Too little attention was paid to the correspondence before the parties became convinced that that material was, for one reason or another, unsaleable. After referring to the correspondence and analysing the evidence, he came to the conclusion that plaintiffs' witnesses were right when they said the material was good delivery under such a specification as that contained in the letter of Dec. 31, 1919, and that, upon his construction of the contract, was all that plaintiffs had contracted to do. He thought it was certainly not true that the wire was not merchantable; on the contrary, the evidence satisfied him that it was merchantable. His Lordship then entered judgment for plaintiffs for £1 287 claimed, with costs, with, in addition, payment for the balance at £2, the price he fixed for the purpose of calculating damages.

A stay of execution was granted with a view to appeal.

Municipal Accounts.

The accounts of BEDFORD Electricity Department for the year ended March 31 show revenue £78 705, and working expenses, including war bonuses, £54 572, leaving gross profit £24 133, and after providing for interest, instalment of loans, &c., the net profit was £2 139, which has been placed to reserve. Total maximum supply demanded was 3 190 kW. Units generated were 6 453 650, and sold 5 147 891.

The accounts of WALLASEY TRAMWAYS DEPARTMENT for the year ended March 31 show revenue £138 204, compared with £130 239 in the previous year, and working expenses, including war bonus, £115 565 (against £100 587). Interest required £6 316 (£5 959), sinking fund £5 099 (£4 723), and instalment of loans £1 725 (£1 235), and £8 000 (£14 000) has been contributed in aid of district rate. Total revenue per car mile was 23.71d. (21.32d.) and working expenses 19.85d. (16.47d.). Passengers carried were 20 806 448 (21 435 873) and car miles run 1 398 436 (1 465 595).

The accounts of HALIFAX TRAMWAYS DEPARTMENT for the year ended March 31 show revenue £230 302, compared with £189 186 in the previous year, and working expenses £208 190 against £162 892. Interest required £11 695 (£10 937), sinking fund £10 706 (£12 758), and income tax £329 (£1 122), and the net result was a deficit of £618, compared with a net profit of £1 476. Total revenue per car mile was 25.49d. (21.40d.), and working expenses, including power, were 23d. (18.48d.). Passengers carried were 23 823 406 (26 295 770) and car miles run 2 168 338 (2 115 734).

The BOLTON elective auditor's report shows that, though the tramways had an increase of £22 051 in traffic receipts for last municipal year, the gross profit was £29 750 less than in the previous year. There was an increase of £14 276 in wages of motormen and conductors and £28 008 on general repairs and maintenance, the total working expenses jumping from £157 335 to £209 890. The gross income of the electricity department was £72 961 more and the gross profit £26 859 more. Capital expenditure was £265 898, compared with £89 454.

The accounts of BRADFORD Electricity Department for the year ended March 31, which were approved by the Electricity Committee on Friday last, show income £455 692, compared with £329 233 in the previous year, working expenses £331 972 (against £245 205), and gross profit £103 720 (£84 028). Interest required £55 605 (£46 179), and sinking fund £37 512 (£41 268), leaving net profit £10 603 (against a deficit of £3 419). Income per unit sold was 1.789d. (1.531d.), working expenses were 1.242d. (1.122d.), and capital charges 0.401d. (0.425d.). The number of consumers increased from 6 429 to 7 712, and units sold were 55 683 518 (49 296 067).

The final report of Mr. A. S. BLACK (who is leaving Southport for Ipswich) on the past year's working of the SOUTHPORT ELECTRICITY DEPARTMENT states the gross profit was £20 910 and net profit £1 759, compared with £3 197 in the previous year. Interest and sinking fund charges were £19 151, compared with £15 622, the increase being mainly for new plant, which was not completed. Total cost of production also rose from £35 798 to £44 444, and running charges (coal, oil, &c., and repairs at works) from £21 403 to £26 514. Mr. Black says the scheme introduced by him in 1914 has so far been completed that the whole of the old plant has been shut down and the town entirely supplied by the new plant, which showed a better steam consumption than that guaranteed by the makers, a better coal consumption showed a greater saving than the 50 per cent. he had estimated. Mr. Black recommends that orders for additional plant should be placed this year, so as to be ready before the end of the summer of 1923, and that his scheme for substituting half-watt for arc lamps for street lighting should be proceeded with.

Electricity Supply.

The ABERYSTWYTH Special Electricity Order was laid on the table of the House of Commons on the 19th inst.

Arrangements have been made by the TALGARATH (Breconshire) Parish Council for electricity to displace gas for public lighting.

FAVERSHAM TOWN Council have applied for a loan of £1,000 to meet the cost of a Petter oil plant installed at the electricity works.

RICKMANSWORTH Urban Council has appointed a committee to consider the question of obtaining a supply of electricity for the district.

The North Somerset Electric Supply Company, Ltd., have increased their charge for electricity in PORTISHEAD AND DISTRICT to 10d. per unit.

At the forthcoming BOLTON Municipal Elections, Mr. Albert Dawson, electrical engineer, is contesting Astley Bridge Ward in the Conservative interest.

The North Wales Power & Traction Company have intimated to the LLANDUDNO Council that they hope to supply electricity in bulk to the district from Easter next.

HUDEBESFIELD Corporation have applied for sanction to a loan of £100,000 for the electric supply department. Various extensions of mains have been authorised by the Electricity Committee.

In order to provide work for the unemployed, SALFORD Electricity Committee has decided to expend £10,000 on certain clearance operations and other work in connection with the proposed new generating station.

NOTTINGHAM Corporation have received authority to borrow a further sum in connection with their super power station, and additional work will be undertaken in order to provide work for the unemployed.

In connection with the WARRINGTON Electric Supply (Extension) Order, THIELWALL Rural Council suggest that electricity be supplied in the district on the slot-meter principle. The routes of the proposed mains have been selected.

There was a deficit of £3,700 on the past year's working of WIMBLEDON electricity undertaking, and as a still greater deficit is anticipated this year, the Electricity Committee is to consider the question of increasing the charges.

SOUTHPORT Electricity Committee has decided to reduce electricity charges by 25 per cent. for the quarter ending December next. It is expected that Mr. Edgar Moxon, the new electrical engineer, will take up his duties about three weeks hence.

At a recent meeting of the DARLINGTON Electricity Committee it was reported that for the first five months of the current financial year the revenue of the electricity department fell £1,400 short of that received in the corresponding period of last year.

Progress is being made with the scheme, prepared by Dr. J. W. Purves, for establishing electric supply works in Teignmouth, at an estimated cost of £8,000. A local committee is assisting in the formation of a company for carrying out the project.

BURNLEY Electricity Committee has approved a proposed scheme for the reorganisation of electricity in the Mid-Lancs. district. An Advisory Board is to be set up to supervise the co-ordination of supply in the neighbouring areas. Nelson Council have also approved of the scheme.

Work has been commenced at the TISBURY Mill by Edmundsons Electricity Corporation, who have secured the contract for the erection of electricity works at this place. The Parish Councils of East Tisbury and Wardour have accepted the tender of the local Electric Supply Company for street lighting.

The Didcot Trades and Labour Council have asked the WALLINGFORD Rural Council to provide a public lighting scheme for Northbourne and Didcot. It is suggested that the War Office should extend the electric plant at the Ordnance Depot, and give a supply of current to the two parishes. The War Office have therefore been asked for information.

The EDINBURGH Electricity Committee has now decided to extend the area to be supplied with electricity from the Portobello station so as to include the THREE LOTHIANS. An application by Haddington for inclusion in the area led to the recommendation being made, and in due course the revised scheme will be submitted to the Electricity Commissioners.

Apparently the ABERCORN Urban Council appear to be frightened at the prospect of an early supply of electricity in the district. At the council meeting last week, Mr. J. Ganes stated that "the thin end of the wedge was already being pushed in at Newbridge with regard to the use of electricity supplied by a private company." Competition is feared, for the chairman of the Gas Committee said they were considering the question of "advertising the advantages of gas."

In addition to the joint scheme of Birmingham Corporation and the Shropshire, Worcestershire and Staffordshire Electric Power Company for the SOUTH-WEST MIDLANDS ELECTRICITY DISTRICT, Worcester Corporation have submitted a scheme designed to retain Worcester's independence as a generating station and to preserve as far as possible local control in the extension and administration of the undertaking. The joint scheme will not affect WORCESTER until after 1925, and the Corporation want to develop their undertaking as local requirements demand.

The Electricity Commissioners have submitted to the Minister of Transport, for confirmation, the Special Order authorising the MIDLAND ELECTRIC LIGHT & POWER COMPANY, LTD., to supply electricity in the parish of Bedworth, in the rural district of Foleshill and the urban district of Bulkington. Objections are to be sent to the Ministry of Transport by Nov. 5.

More cables are being laid, and the transformers in the various parts of WALLASEY are being enlarged in anticipation of the completion of the installation of the 5,000 kW set, which is on order for the Corporation. The demand for electric current has been exceptionally great, and is far more than was anticipated when the present sets were about to be installed.

RUGBY Building Trades Employers' Association have protested to the Urban Council against the practice of the Electricity Department in competing with contractors for the installation of wiring and plant on private property. The matter has been referred to the Electricity Committee, and the Association has been asked to particularise cases of alleged municipal trading.

LEOMINSTER Urban Council has consented to the following maximum charges for electricity being inserted in the Special Order of Hereford Town Council, for the rural area: Quarters ending March and December, any amount up to 15 units, 17s. 6d., and 1s. 2d. per unit over 15; quarters ending June and September, up to 10 units, 11s. 8d., and 1s. 2d. per unit over 10.

The Electricity Commissioners have submitted to the Minister of Transport for confirmation a Special Order made by them authorising the MIDLAND ELECTRIC LIGHT & POWER COMPANY, LTD., to supply electricity in WIGSTON MAGNA urban district and certain parishes in BLABY, HINCKLEY, and LUTTERWORTH rural districts. Any objections must be sent to the Minister of Transport by Nov. 12.

The Salvage Committee of BIRMINGHAM Corporation propose to construct new destructor works at Witton, where a garage for electric vehicles will be erected, and electric current will be produced from steam obtained from the burning of refuse. The proposed destructor will consist of eight cells, capable of dealing with 38,000 tons of refuse per annum, and the estimated cost is £100,000.

The WARRINGTON Electricity Committee has been informed by the electrical engineer (Mr. F. V. L. Mathias) that he hopes to be able to commence the laying of the mains for the supply of electricity to Stockton Heath in about two months, and communications are proceeding with the Manchester Ship Canal Company with reference to carrying the cable under the canal bridge. Steps are to be taken to acquire a site for the sub-station in West-avenue.

The KINGUSSIE TOWN Council have decided to act upon the advice of Mr. Newlands, engineer-in-chief of the Highland Railway, in regard to electric supply. The Council will, therefore, wait until the revised Grampian electricity scheme is before Parliament next year. Assuming that the Bill will go through, Mr. Newlands thinks it the best way of providing electric light for the town. The Council are to get in touch with the company's engineer on the subject.

Things are again assuming their normal condition in the BELFAST electric supply department. The Electricity Committee held its first meeting last week after the recent crisis, when the chairman (Councillor the Right. Hon. Sir James Johnston) presided over a large attendance of members. The business included consideration of matters relating to the 12,500 kW turbo-alternator for the new Harbour power station, and the report of the consultants on tenders for additional plant, loans for mains extensions, service mains, meters, &c.

A peculiar position has arisen at HOLSWORTHY, where, owing to a dispute with the Gas and Electric Supply Company, the Urban Council recently refused to continue the gas lighting because the charge (£5 10s. per lamp per annum) was considered excessive. In order to relieve the gloom of the winter nights the Council have now appealed to householders who have electric lights outside their houses to switch on the light every night for the next few months, and at the end of the season the Council will reimburse them for the amount of current used.

After much hesitation and many discussions, SKEGNESS Urban Council have decided not to carry out their powers to establish electricity supply. The powers should have been exercised long ago, but extensions have been granted, and recently the Electricity Commissioners intimated that the powers must lapse unless the Council could furnish reasons for not embarking upon a scheme. Mr. C. H. Worthingham, consulting engineer, reported that an outlay of £40,000 would be necessitated, and the Council, taking into consideration the heavy outstanding loan charges, felt that the further outlay was not justified, and therefore the way is now open for private enterprise to establish electric supply in the town.

Owing to the efficient working of the new generating plant, LONDONERRY Corporation propose to make substantial reductions in the charges for electric current. The reductions, which will vary from 9 per cent. to 37 per cent. for light, power and heat, cannot be made until the new scale is in operation for the shipyard. It is claimed that the new rates will be the lowest in Ireland, and lower than those charged by similar undertakings in Great Britain. The new shipyard charges come into operation next month, and if the yard avails itself of the agreement it could continue to receive power at a very low rate until February, when the Corporation would revise the scale again, so as to recover the loss which the city would incur between November and February.

Miscellaneous.

As the result of a BURGLARY at the BELFAST offices of the BRITISH INSULATED & HELSBY CABLES on the 18th inst., about £200 worth of electric wire, flexibles, &c., was stolen.

TWO of GEORGE ELLISON'S EMPLOYEES (Smith and Spate) have been selected to represent the Birmingham and Districts Works Amateur Football Association in their match against the Victoria League on Nov. 5. Mr. Smith will captain the team.

The ballot of the men employed in the ENGINEERING AND SHIP-BUILDING INDUSTRIES on the withdrawal of the war bonus closed on Wednesday, but the result will not be made known until this afternoon. It has, however, leaked out that the voting in the north shows a majority of almost two to one in favour of accepting the reductions.

A conference on COAL SAVING, more particularly as it applies to colliery and industrial works, is to take place at Cardiff on Nov. 17, under the auspices of the SOUTH WALES INSTITUTE OF ENGINEERS. In connection with it there is to be an exhibition of fuel-saving appliances, to which makers of all such devices are invited to send exhibits.

The members of the BLACKPOOL ELECTRICITY AND TRAMWAY EMPLOYEES' INSTITUTE had their annual social on the 20th inst., Mr. C. FURNESS, general manager, presiding. The Lumb silver cup for inter-departmental competition was won by E. and T. team. Several medals and awards were given in connection with the institute handicaps.

The fifth of the series of INDUSTRIAL LECTURES, organised by the INDUSTRIAL LEAGUE AND COUNCIL, will be given at Caxton Hall, S.W. 1, on Wednesday, Nov. 2, at 7.30 p.m., when Mr. E. C. de Segundo, A.M.I.C.E., will speak on "Ability as a Factor in the Production of Wealth." The gathering is to be presided over by Mr. John Ames, General Secretary of the League.

The first ARCHIBALD DAWNEY SCHOLARSHIP IN CIVIL ENGINEERING has been awarded by the London County Council to a student who, starting his studies at an elementary school, subsequently proceeded to a secondary school by means of a county scholarship. With the aid of the new scholarship he will now be able to concentrate on the study of civil engineering. The next award will be made about May, 1922, and applications should be addressed to the Education Officer (T2a), New County Hall, S.E. 1.

At Newcastle-on-Tyne on Saturday Dr. H. Stroud, Professor of Physics at the Armstrong College, delivered an interesting POPULAR LECTURE on "ELECTRICITY IN THE HOME." After referring to the wasteful use of coal and to the deleterious effects of smoke, Dr. Stroud advocated the employment of electricity on the grounds that it is cleanly, noiseless, odourless, and labour and expense saving. He praised the work of the B.E.D.A. in connection with the development of the use of electricity in modern houses.

The Board of Trade returns of advances made, and guarantees given, under the OVERSEAS TRADE (CREDITS AND INSURANCE) ACT, 1920, and the Amendment Act of 1921, states that the advances actually made from July 1 to Sept. 30, 1921, for Finland, Baltic Provinces, Poland, Czechoslovakia, Yugo-Slavia, Roumania, Bulgaria, and Austria amounted to £315 661 14s. 5d., making a total from September, 1919, to Sept. 30, 1921, of £1 276 029 12s. 6d. The applications for advances sanctioned between July and September were £65 646, making a total of £2 706 380 15s. 6d. The amount of the guarantees actually given from June to Sept. 30, 1921, for Australia, New Zealand, Cyprus, Roumania, Yugo-Slavia, and Hungary was £45 961 19s. 7d., and the applications for guarantees sanctioned totalled £221 672 11s. 2d.

What is alleged to be the arbitrary reduction in the wages of the MAINTENANCE WORKERS of the MANCHESTER CORPORATION led to a strike on Friday last, and on Monday the men employed at the Stuart-street and Dickinson-street electricity stations came out, so that nearly all the maintenance workers, who number about 800 are on strike. The men are employed in the electricity, gas and tramways departments, and are engaged largely on repair work, but they include the brakemen of the tramways department. The cause of complaint is that the reduction of 2d. an hour for skilled workers and 1½d. an hour for unskilled men was announced without any consultation with the unions whose members are affected. The Lord Mayor has been approached, and a meeting between the men's leaders and the Workmen Special Committee which recommended the reduction has been arranged.

At its meeting last week the Senate of the UNIVERSITY OF LONDON considered a letter from the London County Council suggesting that the claims of the Holland Park estate to be the future site of the University be thoroughly examined before any further steps are taken in the matter of the Bloomsbury scheme. In reply, the Senate point out that they accepted the gift of the Bloomsbury site largely on the strength of the approval of and promise of support by the Council, which had undertaken to consider a grant not exceeding one-third of a million pounds in the event of acceptance. A portion of the Bloomsbury site is already occupied by a University building, the Institute of Historical Research, and under the circumstances the question of site can hardly be reopened on the initiative of the Senate, but, should the Government wish to explore the possibilities of the Holland Park site, or any other site, in conjunction with the University, the Senate would be prepared to co-operate with the Government for that purpose.

Personal and Appointments.

MR. W. M. MINTON, of Coventry, has been appointed manager of the Wigan Corporation Tramways.

MR. A. C. MENZIES, B.A., has been appointed an assistant lecturer in physics at the University of Leeds.

MR. W. A. TOPPIN, assistant manager of the CHESTERFIELD Electricity and Tramways Department, has resigned.

Prof. A. H. BARKER will be president of the INSTITUTION OF HEATING AND VENTILATING ENGINEERS for next year.

MR. A. C. WELBOURNE, of Barton-on-Humber, has been appointed assistant engineer at Holmfirth Council's electricity works.

MR. G. T. MILNE has been appointed Senior Trade Commissioner in Canada and Newfoundland in succession to Capt. Edwards, who recently resigned.

MR. J. W. NICHOLSON, M.A., D.Sc., F.R.S., has been appointed to a War Memorial fellowship as tutor in the mathematics and physics department at Balliol College, Oxford.

We are glad to be able to announce that Sir ROBERT HADFIELD, who underwent a slight operation on the 16th inst. at a nursing home in London, is making satisfactory progress.

MAJOR A. A. JAYNE, D.S.O., O.B.E., M.C., Assistant Inspector of Telegraph and Telephone Traffic at the G.P.O., London, has been promoted to Controller of the Edinburgh Telegraph Office.

MR. F. M. NICHOLL, deputy general manager of the Tasmanian Government's Hydro-Electric Department, has been appointed to the newly-created post of business manager to Launceston Council.

MR. THOMAS R. WHITEHEAD, manager of the Coventry Corporation Tramways, who has completed twenty-five years' service, has been presented by the Tramways Committee with an inscribed silver fruit dish.

The Finance Committee of the Federation of British Industries report with regret that Mr. EDMUND L. HILL has resigned his position as general secretary. The work of the general secretary will be divided among various departments of the Federation, and Mr. B. L. WALKER has been appointed secretary.

MR. R. W. HAYMAN, A.M.I.E.E., manager of the export department of SIMPLEX CONDUTS, LTD., paid a visit to South Africa in the early part of the year to investigate the possibility of increased business. So satisfactory were the results that Mr. Hayman is returning in charge of the Simplex permanent interests throughout the Union.

The following appointments have been made at the VICTORIA UNIVERSITY OF MANCHESTER:—MR. J. S. WRIGLEY, B.Sc., Assistant Lecturer in Engineering; MR. J. H. BLACKBAY, B.Sc., Assistant Lecturer in Physics; MR. ARTHUR ADAMSON, M.Sc. Tech., A.R.C.S., Lecturer in Physics; MR. H. N. MERCER, B.Sc., M.A., Assistant Lecturer in Physics in the Faculty of Technology.

MR. J. HOLLINGSWORTH has resigned his lectureship in electrical engineering, and Mr. A. FERGUSON has taken his lectureship in physics.

MR. G. W. SPENCER HAWES informs us that there are several errors in a note which has appeared in the Press in regard to the personnel of the staff at the Guildford Corporation Electricity Works, which have been taken over recently from the Guildford Electricity Supply Company, Ltd. Mr. Hawes personally (and not the firm of May & Hawes) is consulting engineer to the Corporation. MR. W. E. AFFLECK, on Mr. Hawes' recommendation, has been appointed Corporation electrical engineer. Mr. Affleck was not assistant to Mr. Alderton up to the time of his (Mr. Affleck's) appointment, but had left some time previously. Mr. Hawes has not taken the place of either Mr. Alderton or Mr. Affleck as manager, but Mr. Affleck is at present working under his direction.

Telegraph and Telephone Notes.

THE BELGIAN NORD RAILWAY COMPANY is experimenting with a new signal system by which the chief of the train service organisation communicates with the signal cabins by wireless telephone.

Since the opening of the "TOLL" TELEPHONE EXCHANGE on Sept. 17, the records show that only about 5 per cent. of the total calls made throughout the day in London fail to secure immediate connection and have to be booked for completion later. The average number of outgoing calls is 5 000 daily, and the incoming traffic reaches about 6 000 calls per day. Some 5 000 calls are still being passed daily by telephone users to "Trunks," whereas the wanted numbers are within the "Toll" area. It is announced that Edgware is henceforth within the London telephone area, and London subscribers can secure connection to Edgware subscribers direct from their own exchange.

THE P. & O. steamer "BARADINE," which is reported from Cape Town to have received Press bulletins throughout her entire voyage from England, is fitted with receiving apparatus employing a single MARCONI FOUR-ELECTRODE VALVE, and not with gear using three-electrode valves as suggested by the widely-published cablegram. The Marconi four-electrode valve, as employed in the new type of marine receiver, performs all the functions hitherto associated with the use of at least three valves of earlier type, and has also a degree of sensitiveness to distant signals similar to that secured by the employment of three or more three-electrode valves. This sensitiveness is combined with the advantages of operation and maintenance which naturally follow a reduction in the number of essential parts.

Companies' Reports, &c.

Maple Coal Mining has been appointed a director of **SIR W. G. ARMSTRONG, WHITEWORTH & COMPANY, LTD.**

THE CANTON ELECTRIC SUPPLY CORPORATION, LTD., has declared a half-yearly dividend of 8 per cent., less tax, payable Nov. 16.

The directors of **MARSHALL, SONS & COMPANY, LTD.**, announce that they have decided not to pay an interim dividend on the ordinary shares.

An interim dividend of 1s per share has been declared by the directors of **CALLENDER'S CABLE & CONSTRUCTION COMPANY, LTD.**, payable Nov. 2.

The directors of **BARKER & WILSON, LTD.**, have declared a dividend of 7 per cent. (tax free) for the half-year ended June 30, the same as in 1920.

The directors of the **AUCKLAND ELECTRIC TRAMWAYS COMPANY, LTD.**, have declared a dividend of 5½ per cent. (tax free) on the ordinary shares for the past year, carrying forward £8 491.

The directors of the **MONTVEDIO TELEPHONE COMPANY, LTD.**, have declared a final dividend of 5 per cent. (tax free) for the year ended July 31, making 8 per cent. for the year, as in the previous year.

THE MONTREAL LIGHT, HEAT AND POWER CONSOLIDATED COMPANY has declared a dividend of £1.25 per share, payable Nov. 15. The **MONTREAL LIGHT, HEAT AND POWER COMPANY** has also declared a dividend of 82 per share.

The directors of the **WEST AFRICAN TELEGRAPH COMPANY, LTD.**, for the year 1920 was £73 451, and total expenses were £101 088, showing a loss of £27 636. After providing £181 for income tax and allowing for £1 039 brought forward, the debit balance is £26 777, which has been charged against general reserve.

The profit of **HERBERT MORRIS, LTD.**, for the year ended July 30 was £70 878 (against £121 266 in previous year), to which is added £8 675, being dividends from investments, &c., and £19 663 brought forward, making £99 216. A final dividend of 6½ per cent. on the ordinary shares is proposed, making 10 per cent. (tax free) for the year (as in 1920). The sum of £25 000 (against £100 000) has been placed to reserve, and £20 294 carried forward.

The directors' report of the **ELECTRIC SUPPLY COMPANY OF VICTORIA, LTD.**, for the year ended March 31, 1921, states that the lamps connected were 312 520, compared with 268 544 in 1920; the passengers carried on the tramways were 6 096 269 (against 5 316 136); the revenue was £124 994 (against £105 053), the expenditure was £85 295 (against £69 712), and the gross profit £39 699 (against £35 341), leaving £35 825, with £32 604 brought forward, and after deducting debenture interest, redemption, &c. (£14 343), the balance is £54 085. The directors propose to pay on account of arrears of preference dividend £10 500, and to carry forward £43 585.

At the recent annual meeting of the **ALUMINIUM CORPORATION, LTD.**, the chairman (Mr. K. M. Clark) reported that the company had been able to secure sufficient orders to keep the rolling mill working full time. Their company, with the North Wales Power and Traction Company, had been intensified during the year, and to that undertaking a large portion of the electricity produced would ultimately be sold. In that way the board believed that an arrangement had been made which would place the Corporation in a position of independence as regards the aluminium market and insure a more profitable use of the energy. The North Wales Company were the authorised distributors of electric energy in the North Wales and Chester district, and the joint working of the two companies would have satisfactory results. The directors were satisfied that the profits for 1920 justified the payment of the preference dividend. The meeting was adjourned until the board are in a position to submit accounts.

New Companies.

The following list is compiled from information supplied by Messrs. Jordan & Sons, Ltd., company registration agents, 116 and 117, Chancery-lane, London, W.C. 2.

ALLEN'S (RESILIENT) WHEEL, LTD. (177 184). 43, James-street, Cardiff. Registered October 8. To acquire patents and turn same to account. Nominal capital £100, in £1 shares. Private company.

"A. O." REFLECTOR COMPANY, LTD. (177 345). 18A, Leinster-terrace, W. Registered October 19. Manufacturers of light reflectors and diffusers. Nominal capital, £3 000, in £1 shares. Directors: C. H. Keane, F. W. Stevenson and S. J. Frost. Private company.

BROADBENTS PATENTS COMPANY (SOUTHPORT), LTD. (177 273). 7B, King-street, Southport. Registered October 14. Electricians. Nominal capital, £2 000, in 1 000 preference and 1 000 ordinary shares of £1 each. Directors: D. L. J. Broadbent and G. W. Tongue. Private company.

BURNERS (1921) LTD. (177 353). Registered October 18. Manufacturers of gas burners, gas fittings, electric fittings, &c. Nominal capital, £3 000 in £1 shares. Directors: J. S. Burgovne and A. J. Kingston (Suffolk House, Laurence Pountney-hill, E.C. 4). Private company.

CESCO, LTD. (177 314). Registered October 17. To acquire business of the Commercial Electrical Supplies Company and carry on business of electricians. Nominal capital, £6 000, in £1 shares. Directors: A. H. Smith (13, Station-road, Penarth) and G. W. Matthew. Private company.

DAVIS ELECTRICAL COMPANY LTD. (177 301). 6, Warwick-court, Gray's Inn, W.C. Registered October 15. Dealers in and manufacturers of gas and electric light and heating and other apparatus. Nominal capital, £1 000, in £1 shares. Directors: J. Davis and Madge Davis. Private company.

EDWARD DEWHURST, LTD. (177 199). 16, Mount-street, Preston, Lancashire. Registered October 10. To acquire and carry on business of electrician and mechanical engineer, being the business lately carried on by the late Edward Dewhurst, at 14 to 26, Mount-street, and Theatrical-street, Preston. Nominal capital, £20 000, in £1 shares. Directors: E. G. Rhodes, E. G. Dewhurst, R. A. Dewhurst, A. A. S. Roscoe, and J. E. Eaves. Private company.

HAMPSTEAD ELECTRICAL COMPANY, LTD. (177 252). 355, Finchley-road, Hampstead, N.W. Registered October 13. Electrical and general engineers. Nominal capital, £1 000, in £1 shares. Private company.

MOORE & BARKER, LTD. (177 243). Registered October 13. To acquire business of dealers in electrical goods, now carried on at 13, North John-street, Liverpool. Nominal capital, £1 500, in 1 300 preference and 200 ordinary shares of £1 each. Private company.

TECHNICAL AND ELECTROTECHNICAL WHOLESALE TRADE, AMSTERDAM, LTD. (TELGA LTD.) (2 017f). 4, Union-place, Wells-street, Oxford-street, W. 1. Registered October 15. Incorporated in Holland. To trade in electrotechnical machinery and requisites in metal goods, and in all the products of technical industry. Nominal capital, £100 000, in shares of £1 000 each. Name of person authorised to accept service, Eugene Cecil Beman, 4, Union-place, Wells-street, Oxford-street, W. 1. (Sales Manager). Private company.

COMPANY LIMITED BY GUARANTEE.

INDUSTRIAL LEAGUE AND COUNCIL. (177 151). 82, Victoria-street, Westminster, S.W. Registered October 6. To promote British Home and Overseas Dominions and foreign trade and commerce. Every member to contribute a sum not exceeding 5s. each. Directors: Viscount Burnham, G. H. Roberts, M.P., Sir W. J. Peckemason, Bart., H. Hirst, R. Young, M.P., H. Choley, and G. Latham.

Obituary.

The death occurred suddenly, at Aden wireless station, on the 16th inst., of **LIEUT.-COMMANDER RICHARD W. UNIAKKE BAYLY**.

The death is announced of **ALD. JAS. FIELDING**, joint managing director of Messrs. Fielding & Platt, Ltd., engineers, Gloucester. Mr. Fielding, who was seventy-five years of age, served on the Gloucester City Council for many years.

We regret to record the death on the 25th inst. of **SENATOR FREDERIC NICHOLLS**, president of the Canadian General Electric Company. He was born in England in 1856, and received some of his education at Stuttgart, but he went to Canada before he was eighteen years of age. For seven years he was secretary of the Canadian Manufacturers' Association, and he also owned and edited the "Canadian Manufacturer." When the Canadian General Electric Company was established he became associated with it, but before that time he had organised the first electric supply company in Canada, the Toronto Incandescent Electric Light Company. In 1896 he was elected president of the National Electric Light Association of America, and in 1917 he was appointed to the Senate. Mr. Nicholls was also associated with the Canadian Foundry Company, Allis-Chalmers Company, Dominion Iron and Steel Company, Toronto and Niagara Power Company, Toronto Railway Company, the Great North-Western Telegraph Company, as well as various other commercial and industrial enterprises.

Business Items, &c.

MR. THOMAS LLOYD has commenced business as an electrical engineer at 9, Lumley-street, Grangemouth, Scotland.

The offices of the **NORTHWOOD ELECTRIC LIGHT & POWER COMPANY, LTD.**, are now at 2, Eastbury-road, Northwood, Middlesex.

Messrs. T. Twist & Son, electrical engineers and contractors, have removed to Britannia-chambers, George-street, St. Helens.

An order for the compulsory winding up of the **MAXIM LAMP WORKS, LTD.**, has been made by Mr. Justice Astbury, on the petition of Carl Quittman.

The **SALICORBE MOTOR & ENGINEERING COMPANY, LTD.**, have opened a branch of their electrical department in Rock-road, Torquay, with Mr. W. Lawrence as manager.

The address of the Newcastle branch of **SIMPLEX CONDUITS, LTD.**, is now at 72, St. Mary's-place, and the branch remains under the management of Mr. A. G. Robson. The telephone number and telegraphic address also remain the same, i.e., Central 2 615 and Simplex, Newcastle-on-Tyne, respectively.

The business of the **HOTPOINT ELECTRIC APPLIANCE COMPANY, LTD.**, has been transferred to more commodious premises at 21, Berners-street, Oxford-street, London, W. 1. Extensive show-rooms have been designed, which permit of the exhibition and demonstration, under comfortable conditions, of the complete range of Hotpoint electric appliances, including lamp-socket heating and cooking devices, electric ranges, suction cleaners, dish and clothes washing machines, &c. There are also a model kitchen and dining-room for the better display of the company's various electrical specialities.

Tenders Invited and Accepted.

UNITED KINGDOM.

LOUGHBOROUGH CORPORATION. OCTOBER 31.—Steam-raising plant. Particulars from Mr. C. H. Wordingham, at 7, Victoria-street, Westminster, S.W. 1; or 11, Moseley-street, Manchester.

CWM, MON. OCTOBER 31.—Re-wiring the Cwm and Tallstown Institute.

FALKIRK PARISH COUNCIL. NOVEMBER 5.—Six months' supply of electric lamps to Blinkbonny Home. Forms of tender from the Governor.

WARRINGTON ELECTRICITY AND TRAMWAYS COMMITTEE. NOVEMBER 15 (noon).—Motors and transformers. Specifications from the Borough Electrical and Tramways Engineer, and tenders to the Chairman of the Committee.

MANCHESTER EDUCATION COMMITTEE. NOVEMBER 2.—Wiring and fitting Hague-street and Lloyd-street municipal schools. Specifications can be obtained at the Education Offices, Deansgate, Manchester.

AUSTRALIA.

VICTORIAN GOVERNMENT RAILWAYS. NOVEMBER 9 (extension of time).—The date for receiving tenders for armature banding machinery, with motor and starting gear (contract 34 378).

VICTORIAN GOVERNMENT RAILWAY COMMISSIONERS. JANUARY 4, 1922.—60 tons galvanised telegraph wires (contract No. 34 706); 23 steam meters and accessories for Newport power house (No. 34 611); and 150 electric train stops for power signalling (No. 33 546). Tenders must be accompanied by a preliminary deposit of half per cent. of total amount of tender, and local representation is essential.

NEW ZEALAND.

WELLINGTON. CONTROLLER OF STORES, POST AND TELEGRAPH DEPARTMENT. NOVEMBER 21.—* 750 red and 750 white switchboard cords (three conductor), to specification No. 87.

WELLINGTON. PUBLIC WORKS DEPARTMENT. NOVEMBER 29.—In connection with Mangahao electric power scheme. * Section 12: Three water-wheels of 6 450 B.H.P., and two water-wheels of 3 225 B.H.P., complete with governors, couplings, and accessories; Section 13: Three 6 000 kVA and two 3 000 kVA alternating-current generators; Section 14: two three-unit exciter sets, each consisting of one 375 B.H.P. Pelton wheel, one 250 kW direct-current generator, and one 350 H.P. asynchronous motor; Section 15: seven 4 000 kVA single-phase transformers and accessories; Section 17: insulators for 110 000 V 50 cycle transmission lines; Section 18: lightning arresters for operation on two 110 000 V three-phase transmission lines; Section 19: switchboard, switches, and accessories.

INDIA.

CALCUTTA ELECTRIC SUPPLY CORPORATION, LTD. NOVEMBER 9.—One 15 000 kW turbo-alternator and condensing plant, and two water-tube boilers, each of 60 000 lb. evaporative capacity. Specifications from the consulting engineers, Messrs. Kennedy & Donkin, 17, Victoria-street, S.W. 1.

SOUTH AFRICA.

JOHANNESBURG MUNICIPAL COUNCIL.—Nov. 18.—*One water-tube boiler with superheater, economiser, mechanical stokers, &c. Tenders to Town Clerk. Local representation is desirable.

* Particulars from the Department of Overseas Trade.

RAND WATER BOARD'S MAIN PUMPING STATION, VEREENICING. NOVEMBER 7.—Two steam-driven electrical generating sets of 350 kW capacity, each complete with switchboards and all accessories. Tenders to the Secretary of the Board, Central House, P.O. Box 1 703, Johannesburg.

ADMINISTRATION OF THE SOUTH AFRICAN RAILWAYS AND HARBOURS. NOVEMBER 7.—* For twelve months, from December 31, of 85 560 incandescent train lighting lamps (tungsten filament) for 24 V, 8 to 10 c.p.; 8 125 engine head lamps, 150 W, 32 V (gasfilled $\frac{1}{2}$ W type, with concentrated filament); 50 472 incandescent lamps (tungsten filament); 5 545 incandescent lamps (carbon filament).

MUNICIPAL CORPORATION OF HUMANSDORP, CAPE PROVINCE. NOVEMBER 30.—Machinery and plant. Section A: one water turbine and dynamo, switchboard with connections, battery of accumulators, and accessories for same; Section B: electricity supply main and public lighting; aerial distributing lines, street lamps, fittings and accessories, section boxes, service cut-outs, meters, &c.; Section C: ferro-concrete pipe line; Section D: reinforced-concrete tank; Section E: buildings and foundations. Further particulars from the Town Clerk, Humansdorp.

SOUTH AMERICA.

ARGENTINE NATIONAL DEPARTMENT OF PUBLIC HEALTH, BUENOS AYRES. JANUARY 19, 1922.—Electrical plant for the southern district of the City of Buenos Ayres.

GREECE.

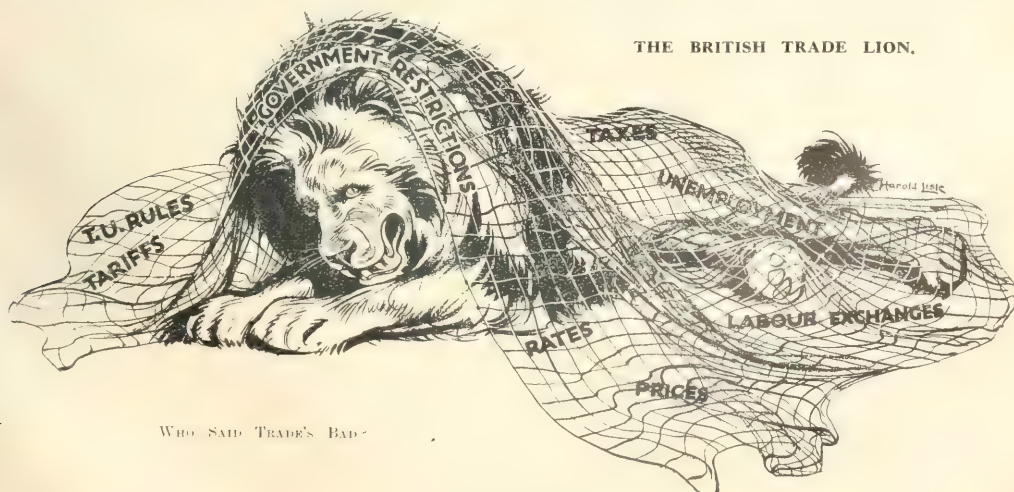
ATHENS.—Nov. 14.—*New telephone installation of central battery type and of an approximate capacity of 5 000 local lines, forty inter-urban lines, and at least fifty special lines connecting Athens with the Piræus.

NEWQUAY Urban Council have accepted the tender of T. Tremain for wiring the Council-chamber.

HAMMERSMITH (London) Electricity Committee recommend the acceptance of the tender of the Hackbridge Electric Construction Company (lowest tender received) for the supply of two 200 kW oil-cooled transformers at £494. Six tenders were received, the highest being £629 0s. 6d.

SALFORD Corporation has accepted the tenders of the Rail Welding Company for welding and re-reading 500 joints on Bury New-road tramway (£575); Brighton Lighting and Electrical Engineering Company, for swan-necks for attachment to lamp pillars; Mather & Platt, for spare armature for canal water-pumping plant; Metropolitan-Vickers Electrical Company, repair parts for No. 2 turbo-alternator (£3 370), and switch-tripping batteries for Blackfriars and Trafford sub-stations (£276 5s.); Doulton & Company, 250 yds. 3 in. stoneware pipes (5s. 0½d. per yard), and 500 yds. 3½ in. stoneware pipes (6s. 10 4-5d. per yard).

MANCHESTER Corporation have accepted the following tenders: Brush Electrical Engineering Company, for tramcar trucks; Aiton & Company, for low-pressure water, steam and other pipes, supports, &c.; Connolly's (Blackley), for cable; J. Blakeborough & Sons, for valves, &c., and the Saint George's Engineers, Ltd., for transformer oil-storage tank for Barton power station; Lancashire Dynamo and Motor Company, for motor and switchgear (as sub-contractors under Peter Brotherhood's contract for ammonia compressor); Keith, Blackman, & Company, ventilating fan; Lancashire Dynamo and Motor Company, for duplicate brine cooler (under the Lightfoot Refrigeration Company's contract).



WHO SAID TRADE'S BAD?

Imperial Notes.

M. F. C. STOKES, who has been appointed consulting electrical engineer to the MAN. & N.S.W. Council.

The Electric Light and Power system in PORT OF SPAIN is being extended by the Electric Light and Power Company.

The Victoria Institute has appointed a committee to examine and report on the working of the INSTITUTE, SINGAPORE at BANGALORE.

It is reported that glance pitch (bitumen) has been found in NORTH-EAST KIMBERLEY, West Australia, and there are also definite indications of mineral oil.

Mr. H. E. Macdonnell, town engineer, has intimated that he intends to submit to the CARRIS (Queensland) Council a full report on an improved water supply combined with an electric supply for the town.

According to the report of the general managers of the Standard Bank of SOUTH AFRICA, business conditions remain unchanged. There is, however, some improvement in the demand for electrical goods, and prices are unchanged. Mining material and machinery business is restricted, and prices tend downward.

The Oakley Park Colliery Company has commenced the installation of a thermal generating plant capable of supplying the whole of the town of LITHGOW (N.S.W.), and if necessary, also Bathurst and Orange. The scheme will cost from £25 000 to £30 000, and is expected to be completed by the end of this year. Lithgow Municipal Council are under a contract to take current for the centre of the town from the Hoskins Company for the next two years at 1½d. per unit, and the Oakley Park Company offer a supply at 1d.

SYDNEY (N.S.W.) City Council recently decided to accept the offer of the Thompson Company (Castlemaine) Proprietary for the supply of a 17 000 kW turbo-alternator, at £125 000, including erection. Amendments proposing to reject the offer, on the grounds that the machine offered was not the one asked for, and that the General Electric Company of Australia had not quoted on the basis of a 3 000 r.p.m. machine, were defeated, as was a further amendment that the matter be referred back to permit the opinion of counsel being obtained on the accuracy of the City Solicitor's view that the acceptance of Messrs. Thompson's contract would involve an action against the Council for breach of contract.

Catalogues, Price Lists, &c.

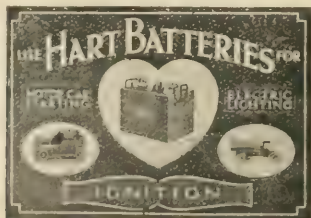
Bulletins 37 S and 40 S have been issued by MESSRS. WATSON & SONS (ELECTRO-MEDICAL), LTD. The former deals with a new diathermy apparatus of the portable type, and the latter contains a list of secondhand X-ray and electro-medical apparatus.

We have received from Messrs. Cassell & Company the first part of their latest serial entitled "The Practical Metalworker." This work, which will be completed in twenty-four fortnightly parts, published at 1s. net per part, will be a comprehensive, complete and up-to-date guide to the working of metal.

An effective showcard of "COSMOS" RADIANT FIRES is being circulated by the Metropolitan-Vickers Electrical Company, Ltd., Trafford Park, Manchester. A revised envelope enclosure price list (4 150/4) of these fires is also available, and retailers can obtain supplies of both, overprinted with their names and addresses.

In a pamphlet issued by the FALKIRK IRON COMPANY, LTD., of Falkirk and London, illustrated particulars and prices are given of the company's 1921 models of "Falco" electric fires. These fires embody practically a complete set of new designs in electric fires in a variety of finishes and periods to suit all classes and conditions. The fire-bar is of a new refractory material, which has been subjected to prolonged tests, resulting in a radiant heat of high efficiency. The firm have also issued a leaflet giving details of the "FALCO" ELECTRIC COOKER, which has been designed to comply with the requirements of the modern electric house. Glasgow Corporation have already placed orders with the company for over 100 of these in connection with their hiring-out scheme, and we understand that a second order for a further 100 is to be placed by the Corporation. The cooker, which is suitable for families of four to ten persons, is evidently destined to become very popular.

A neat and effective showcard is being issued by the HART ACCUMULATOR COMPANY, LTD., of Marshgate-lane, Stratford, E. The showcard, which is in white, is very bold, and shows up prominently



on a grey ground. The showcard, a view of which is given above, will form a useful and permanent reminder to motor-car users of the Hart batteries for starting, lighting, and ignition purposes.

Arrangements for the Week.

FRIDAY, Oct. 28th (to-day).

PHYSICAL SOCIETY.

7 p.m. At the Imperial College of Science, S. Kensington, London, S.W. Papers to be read: "On the Use of Anderson's Bridge for the Measurement of the Variations of the Capacity and Effective Resistance of a Condenser with Frequency," by Mr. S. Butterworth, M.Sc.; "Notes on Earth Capacity Effects in Alternating Current Bridges," by Mr. S. Butterworth, M.Sc.; "An Automatic Voltage Regulator," by Mr. F. G. H. Lewis; and "The Flow of Viscous Liquids through Slightly Conical Tubes," by Prof. A. S. Henny.

INSTITUTION OF MECHANICAL ENGINEERS.

6 p.m. At Storey's Gate, Westminster, London, S.W. Resumed discussion on "The Eleventh Alloys Report."

ELECTRICAL POWER ENGINEERS' ASSOCIATION.

7 p.m. At Central Hall, Westminster, London, S.W. Lecture on "Notes on Surface Condensing Steam," by Mr. J. E. Johnson.

INSTITUTE OF ELECTRICAL ENGINEERS.

8 p.m. At Caxton Hall, Westminster, London, S.W. Lecture on "Water Gas Manufacture," by Mr. F. Colin Sutton.

SATURDAY, Oct. 29th.

SHROPSHIRE PHILOSOPHICAL SOCIETY.

8 p.m. At the Borough Technical School, Shrewsbury. Paper on "Thermionic Valves as Used in Long-distance Telephony," by Mr. T. Plummer.

TUESDAY, Nov. 1st.

INSTITUTION OF ELECTRICAL ENGINEERS.

(NORTH-WESTERN STUDENTS' CENTRE.)

7.30 p.m. At Houldsworth Hall, Deansgate, Manchester. Address by Mr. W. Walker.

ROSTON SOCIETY.

8.15 p.m. At the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. Presidential address.

INSTITUTION OF CIVIL ENGINEERS.

6 p.m. At Great George-street, London, S.W. Address by Mr. W. B. Worthington.

WEDNESDAY, Nov. 2nd.

ROYAL INSTITUTE OF PUBLIC HEALTH.

7 p.m. At 37, Russell-square, London, W.C. Lecture on "The Influence of Atmospheric Conditions on Industrial Efficiency," by Dr. H. M. Vernon.

INSTITUTION OF RAILWAY SIGNAL ENGINEERS.

6 p.m. At the Midland Grand Hotel, St. Pancras, London, N.W. Paper on "Three-Position Signalling," by Mr. A. E. Tattersall.

INDUSTRIAL LEAGUE AND COUNCIL.

7.30 p.m. At Caxton Hall, Westminster, London, S.W. Lecture on "Ability as a Factor in the Production of Wealth," by Mr. E. C. de Segundo.

ROYAL SOCIETY OF ARTS.

8 p.m. At John-street, Adelphi, London, W.C. Experimental address on "Wireless Telegraphy," by Mr. A. A. Campbell Swinton, F.R.S.

LIVERPOOL ENGINEERING SOCIETY.

8 p.m. At the Royal Institution, Colquitt-street, Liverpool. Paper on "Water-Tube Boilers for Merchant Steamers," by Mr. A. Forster.

THURSDAY, Nov. 3rd.

INSTITUTION OF ELECTRICAL ENGINEERS.

6 p.m. At Savoy-place, Victoria Embankment, London, W.C. Inaugural address by Mr. J. S. Highfield.

FRIDAY, Nov. 4th.

INSTITUTION OF MECHANICAL ENGINEERS.

6 p.m. At Storey's Gate, London, S.W. Thomas Hawksley Lecture on "Power Transmission by Oil," by Dr. H. S. Hele-Shaw, F.R.S.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

7.30 p.m. At the Literary and Philosophical Society, Westgate-road, Newcastle-on-Tyne. Paper on "Sea Casualties and Loss of Life," by Sir Westcott S. Abell, K.B.E.

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, London, S.W. Lecture on "Timber Trees of Commerce," by Mr. T. H. Ivey.

Forty Years Ago.

(THE ELECTRICIAN, OCTOBER 29, 1881.)

ELECTRIC LIGHTING AT GREENOCK.—The Greenock Police Board have resolved to promote a Bill in the approaching Parliamentary session to obtain powers for lighting the town by electricity.

S.S. "GREAT EASTERN."—This vessel was offered for sale last week at Lloyd's. The bidding began at £20 000 and went up to £30 000. As no higher bid than this was received she was not sold.

ELECTRIC BREAKS FOR RAILWAY TRAINS.—The French Eastern Railway Company lately made trial of the Achard electric break fitted to a train running between Chateau-Thierry and Chalons. It is stated that the average speed was 90 kilometres per hour. When running 96 kilometres per hour the break brought the train to a standstill in a distance of 270 metres, and once, it is stated, that the distance run after application of the break was only 190 metres.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Partnerships Dissolved.

FOWLER, Samuel, 50, Victoria-road, Halifax; HOYLE, Arthur, 3, Lombard-street, Halifax; and CROWTHER, Frank Ewart, 44, Prospect terrace, Queensbury, Halifax, electric block makers, carrying on business at Gaol-lane, Halifax, under the style of the Electric Block Company, as from Oct. 13, 1921, by mutual consent. Debts received and paid by F. E. Crowther.

PENGILLY, Harry William, and BURGESS, George Frederick, electrical engineers, 6, Ormonde-buildings, Station-road, Epsom, under the style of Pengilly & Burgess, as from Oct. 23, 1920, by mutual consent.

Notice of Dividend.

DRYSDALE, William, 24, Paxton-street, Barrow-in-Furness, electrician. Amount per £, 1s., second, payable Oct. 28, 4, Ramsden-square, Barrow.

Company Winding-up.

THE MAXIM LAMP WORKS, LTD. Winding-up order, Oct. 18.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors, we do not report subsequent county court judgments against him.]

BROOK-VOS, Mr. E. C., 147, Corporation-street, Birmingham, electrical goods factor. £65. Sept. 14.

CLAYTON, Aubrey C., Park-lane Mills, Chorley-lane, Leeds, electrical engineer. £11 1s. 4d. Sept. 19.

GURLLIAM, Mr. C., 42, Conewood-street, Highbury, electrician. £11 1s. Sept. 20.

REEVES, Albert, 34, Archer-street, W. 11, electrician. £13 14s. 6d. Sept. 13.

SPIVEY, Fred., Low Mills, Heckmondwike, electrical engineer. £14 11s. 8d. Sept. 15.

WHEELER, G., & SON, 190, Harwoods-road, Watford, electrical engineers. £20 6s. 2d. Sept. 19.

Bills of Sale.

[The undermentioned information is from the Official Registry. It includes Bills of Sale registered under the Act of 1882 and under the Act of 1878. Both kinds require registration every five years. Up to the date the information was obtained it was registered as given below; but payment may have been made in some of the cases, although no notice had been entered on the Register.]

GOLLAND, Leonard, 42, Litherland-park, Litherland, electrical engineer. Oct. 18. £42 10s.

TYSON, Joseph, 24, Lonsdale-street, Gorse-hill, Stretford, electric motor fitter. Oct. 22. £40 5s.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

BASTIAN ELECTRIC COMPANY, LTD. (late Bastian Electric Heating Syndicate Ltd.), London, E.C. Registered Oct. 13. £1 500 debts.; general charge. *£1 400. Nov. 7, 1919.

THREADGILL ELECTRO DEPOSITS, LTD., Tipton. Registered Oct. 17. £3 000 debts.; general charge. *Nil. Dec. 31, 1920.

WIMBLEDON ELECTRICAL COMPANY, LTD. Registered Oct. 17. £800 debts.; general charge.

Bankruptcy Proceedings.

BLOWER, Arthur Ernest, lately trading as Blower & Cooper, electrical engineers' merchants, 1, Paul's Bakehouse-court, Godliam-street, E.C. Creditors interested under a receiving order made against this debtor met on Tuesday at the London

Bankruptcy Court before Mr. W. P. Bowyer, Senior Official Receiver, presiding. The debtor, in a preliminary examination, had stated that in September, 1917, Mr. Ashley Cooper joined him in the purchase of an electrical supplies business at the above address for £780, in instalments. He and Mr. Cooper started in partnership and traded successfully until December, 1920, when Mr. Cooper, being unable to devote his whole time to the business, retired from the partnership. At the time of the dissolution £400 was still outstanding on account of the purchase price. The debtor continued alone until last August, when, owing to bad trade and general depression, he closed down. The partnership assets, which he held as trustee for the partnership, had depreciated in value, and he doubted whether they would realise more than £120, while £300 was still owing to the vendor of the business. His own debts incurred since the dissolution amounted to £345, against assets estimated at £102. The case was left in the hands of the Official Receiver for administration in bankruptcy.

DOWNIE, Charles Philip Manners, trading as and described in the receiving order as Philip Downie, 355A, Westborough-road, and 88, Ronald Park-avenue, Southend-on-Sea, Essex, electrical engineer and factor. The application for discharge of this debtor was heard on Oct. 17 at the Shire Hall, Chelmsford. The Deputy Official Receiver stated that a first and final dividend of about 4s. 9d. in the pound was expected to be paid on liabilities of £520. The receiving order had been made in May last. Debtor had traded in a small way at first, and then became associated with a company formed by his father, and he had been later pressed by the creditors of the company. The discharge was granted, subject to a suspension of two years.

MATHERS, Ernest Edward, 10c, High-street, Doncaster, Yorkshire, electrical engineer. The public examination of this debtor was held on Oct. 20 at the County Court Hall, Bank-street, Sheffield. The ranking liabilities were returned at £581 18s. 5d., while the assets were estimated to realise £84 6s. 1d. Debtor stated that he started business in April, 1921, with £150 capital borrowed from his mother. He had never been successful. The examination was closed.

In Voluntary Liquidation.

T.B.S. ELECTRICAL CONSTRUCTION COMPANY LTD. (in voluntary liquidation), 68, Victoria-street, Westminster, London, S.W. At the statutory meeting of creditors held recently at Winchester House, E.C., Mr. F. C. Goodman, the liquidator of the company, reported that the liabilities to the trade amounted to £1 595, while £2 494 was owing to the bank. The latter had been guaranteed by one of the directors of the company. The assets were estimated to realise £1 289, and consisted of book debts, £79; stock, machinery and fittings, £925; and furniture, £285. The company was formed in August, 1919, with a nominal capital of £1 000, which was later increased to £20 000. During the thirteen months to Sept. 30 last the business was carried on at a gross profit of £2 573, but there was a net loss of £2 457. During the same period the purchases were £5 597 against sales of £8 806. The liquidator stated that he intended to advertise the business for sale as a going concern, and something might then be obtained for the goodwill and certain other assets, on which no value was now placed. The present position of the company had been brought about by the state of trade. The creditors confirmed the voluntary liquidation of the company, with Mr. Goodman as liquidator, and an informal committee of the representatives of the three principal trade creditors was appointed. The following are creditors: The Alliance Electrical Company, £10; B.E. Transformer Company, £13; Scholley & Company, Ltd., £38; Edison, Swan & Co., Ltd., £45; English Electric and Siemens Supplies, Ltd., £171; B.T.H. Company, Ltd., £19; Siemens Bros., £353; D.B. Battery, £50; Venner Time Switches, £23; J. W. B. Smith, £25; De Martins Accumulators, £88; F. S. Bennett, £154; W. Norris & Company, £34.

Benn Brothers' Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"The Cabinet Maker" (Annual High Wycombe Number); "The Making of a Wycombe Chair"; "The Wycombe Furniture Industry"; and "Treatment of the Floor and Frame of a Furnishing Shop Window."

"Chemical Age" (Special Mining Annual): "Mining and Metallurgy in South Africa," by Lieut.-Col. W. Cullen; "America-Sulphur Mining" (illustrated); and "Industrial Future of Electro-Deposited Iron," by W. E. Hughes, B.A.

"Farm and Home": Full report of the London Dairy Show; "The Harvest of 1921," by Prof. James Long; and "Research at Reading."

"Fruit Grower" (Imperial Fruit Show Number): Full details of Competitive and Trade Exhibits, with list of Judges and Special Message from the Minister of Agriculture.

"Gardening Illustrated": "Some of the Older Fuchsias"; "Some Newer Apples"; and "The Japan Anemone." "Hardware Trade Journal": "Drill Chucks"; "Electrical Cooking on a Dining Car Train"; and "Some Alloys of Aluminium."

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by **MESSRS. MARRIS, FRANK & CO., Chartered Patent Agents, 7 and 72, Chancery Lane, London, W.C.**

COMPLETE SPECIFICATIONS.

- 141778 **BELLING, O. H.**, Frequency alternator. (21/1/21. Patent of Application not granted.)
- 141829 **SCHMIDT, H. & FRANK, G.**, Magneto for internal combustion engines. (1/2/21.)
- 1416129 **PARSONS METAL RADIATOR CO.**, Radiator construction, covers applicable generally to electric transformers. (22/1/21.)
- 141724 **SCHMIDT, H. & FRANK, G.**, Electric condenser unit, having an internal combustion engine for the prime mover. (2/2/21.)
- 1417429 **GES. FÜR DRYTHLOSE TELEGRAPHIE**, Telegraphic transmitters employing thermionic generators. (15/7/15.)
- 1417422 **GES. FÜR DRYTHLOSE TELEGRAPHIE**, Method for directing wireless telegrams with semi-separated antennas. (11/8/18.)
- Notes: In a method of directional wireless telegraphy whereby low frequency alternating currents displaced in phase and produced at a central point are supplied to spaced antennae, and there brought to sequences, the antenna system is so designed that high frequency, in which alternating currents of only small intensity are produced at the central point and are brought to the requisite intensity at the antennae by means of amplifying devices.
- 1417658 **GES. FÜR DRYTHLOSE TELEGRAPHIE**, Wireless telegraph transmitters. (12/9/18.)
- 1416640 **MACDONALD, A. J., & SHEARING, G.**, Thermionic valve circuits, for vacuum and heated cathodes. (15/4/20.)
- 1416641 **JONASON, G. L.**, Telephone apparatus for deaf persons. (6/4/20.)
- 1416649 **WILSON, F. E., SHEPHERD, W. A., & POWELL & HANMER, LTD.**, Combined electric switch and meter for use on motor cycles and on other electrical apparatus. (8/4/20.)
- 1416650 **WILSON, F. E., SHEPHERD, W. A., & POWELL & HANMER, LTD.**, Electro-magnetic cut-out. (8/4/20.)
- 1416651 **HARR & STODOL, LTD., & FRENCH, J. W.**, Electric step by step motor of the Woodward type. (9/4/20.)
- 1416653 **HAMILTON & CO., LTD., R. F., PIRE, F. J. S., HAMILTON, R. F., & SMITH, H.**, Electrical measuring instruments of the moving coil type. (10/4/20.)
- 1416654 **HYMANSON, J. F. G. P.**, Electrical switching apparatus of the kind comprising a conducting liquid jet. (10/4/20.)
- 1416656 **GOODMAN, J. W.**, Electrical energy distributing systems. (13/4/20.)
- 1416659 **AUTOMATIC & ELECTRIC FURNACES, LTD., WILD, L. W., & BARFIELD, E. P.**, Electric muffle furnaces. (13/4/20.)
- 1416662 **WESTERN ELECTRIC CO., LTD. (Western Electric Co., Inc.)**, Multiple high-frequency electric signalling systems. (14/4/20.)
- A pair of transmitting lines inter-connect two points, one line being adapted for transmission in one direction and the other line for transmission in the opposite direction and a plurality of pairs of receiving stations connected thereto by means so arranged that simultaneous transmission may take place between each pair of stations over one of said lines in one direction, and over the other line in the opposite direction.
- 1416667 **ASQUITH, LTD., & FEATHER, G.**, Mounting of electric motors on machines. (15/4/20.)
- 1416675 **BULLMORE, W. R.**, Electric lamps. (16/4/20.)
- 1416684 **GREENESS, K. E. L.**, Sparking machine. (17/4/20.)
- 1416700 **PALMER, H. J., & TELEPHONE MANUFACTURING CO., LTD.**, Inter-communication telephones. (20/4/20.)
- 1416707 **LAW, J. A. (Smith, A. P.)**, Storage batteries. (21/4/20.)
- 1416708 **IONIC ELECTRIC CO., LTD., & BERGMANN, F.**, Electrical relays. (21/4/20.)
- 1416715 **BRITISH THOMSON-HOUSTON CO., LTD., & MARTIN, J., & CLOUGH, F. H.**, Systems of electric ship propulsion. (22/4/20.)
- 1416760 **BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.)**, Means for providing alternating currents. (11/5/20.)
- 1416780 **ROBINSON, J., & SMITH, R. T.**, Wireless directional systems. (21/5/20.)
- 1416805 **JACKSON, H.**, Electric arc lamps. (24/6/20.)
- 1416853 **MARTY, T. W.**, Drawing in tape for threading electrical wires in conduits. (17/11/20.)

APPLICATIONS FOR PATENTS

May 24, 1921.

- 141380 **WHITEHEAD**, Accumulator.
- 141404 **HILL & MAUDSLONE**, Electro-magnetic wave signalling apparatus. (24/5/20, U.S.)
- 141442 **MATT**, Electro-magnetic long-distance switch.
- 141445 **COOPER & MCILROY**, Battery indicator systems.
- 141453 **B. T.-H. Co. (G. E. Co.)**, Wireless signalling systems.
- May 25, 1921.
- 141482 **WALKER**, Electric controlling devices.
- 141490 **HOUNBY & WATSON**, Contact starters for motors.
- 141518 **MOODY**, Interchangeable parts for wireless and electrical apparatus.
- 141535 **AUTOMATIC TELEPHONE MFG. Co.**, Automatic telephone systems.
- 141543 **PHILIPPAUD**, Accumulators. (31/5/20, France.)
- 141545 **TRICHARD**, Frequency multipliers for alternating currents. (26/5/20, France.)
- 141550 **IONIC ELECTRIC CO. (Cutler-Hammer Mfg. Co.)**, Motor controllers.
- 141555 **TAYLOR**, Electric transmission over long distances.
- 141561 **B. T.-H. Co. (G. E. Co.)**, Electric discharge devices.
- 141562 **B. T.-H. Co. (G. E. Co.)**, Electric heating units.
- 141563 **B. T.-H. Co. (G. E. Co.)**, X-ray apparatus.
- 141571 **CHLORIDE ELECTRIC STORAGE CO. & HEAP**, Secondary batteries.
- 141573 **ECKERSLEY & FRANKLIN**, Wireless signalling.
- 141574 **GES. FÜR DRYTHLOSE TELEGRAPHIE**, Means for actuating electric relays. (23/4/20, Germany.)
- 141575 **GES. FÜR DRYTHLOSE TELEGRAPHIE**, Circuits for electrical oscillations. (30/7/20, Germany.)

May 26, 1921.

- 141604 **SALMON**, Suspension device for electric light reflector bowls.
- 141637 **GRIEST**, Coupling for electric conduit.
- 141655 **CLARK**, Means for operating electric bells.
- 141656 **M. & P. Electric Co., Ltd., & MORRISON**, Electric heaters.
- 141663 **LOW**, Electric speedometer.
- 141672 **LORAND**, Switches.
- 141675 **ANDERSON, G. B. & CO.**, Apparatus for diminishing the number of open or closed circuits. (2/6/20, Switzerland.)
- 141675 **WELCH**, Contacts for switches.
- 141681 **METROPOLITAN STEAM ENGINE CO.**, Governing mechanism for steam turbines.

- 141695 **DIDIER**, Electric safety lamp for miners. (17/8/20, France.)
- 141702 **KENNERFELT**, Electric fuses. (2/6/20, Sweden.)

May 27, 1921.

- 141709 **RICHARDSON**, Magneto contact breaker spring guard and conductor.
- 141713 **BOWIE & HENDERSON**, Definite time limit relay or time lag device.
- 141777 & 141778 **BRITISH LIGHTING & IGNITION CO. & TURNER**, Magneto.
- 141787 **LUCAS & MILLER**, Electricity measuring instruments.
- 141790 **AWT, GRS. HOBBS, ROBERT JT. (CZ)**, Change over apparatus for operating vehicles with different voltages. (28/5/20, Germany.)
- 141795 **GILL (Zandler & Co.)**, Switches.
- 141801 **B. T.-H. Co. & TAYLOR**, Windings of a.c. machines.
- 141814 **LOKE**, Electric, &c., furnaces.
- 141816 **PERNOT**, Means for receiving a.c. signals.
- 141822 **DRURY**, Terminal connection for electric cable, &c.

May 28, 1921.

- 141836 **EFANDEM & CO., CUTLER & EATON**, Rotary magnetic separators.
- 141849 **BANKS**, Electric connections or couplings.
- 141872 **WESTERN ELECTRIC CO. & DEAKIN**, Telephone call distribution system.
- 141895 **ROSE**, Electric horns, &c., for motor vehicles.
- May 30.
- 141918 **WOOSNAM**, Glow lamps.
- 141954 **COMPAGNIE GENERALE ELECTRIQUE**, Synchronized non-synchronous machines. (27/10/20, France.)
- 141966 **PHILLIPS**, Thermionic valves.
- 141975 **WESTERN ELECTRIC CO.**, Disconnecting electric cable joint box fittings.
- 141977 **COMPAGNIE GENERALE ELECTRIQUE**, Synchronized non-synchronous machines. (23/3/21, France.)
- 141979 **B.T.-H. Co. (G.E. Co.)**, Wireless signalling systems.
- 141986 **KRAWINKEL**, Dynamo electric machinery.
- 141996 **KRAWINKEL**, High-frequency generators.
- 141999 **AUSTEN & YOUNG**, Electric water heating attachments.
- 142028 **WALKER**, Induction motors and electric controlling devices.

- May 31.
- 141947 **THOMPSON (AIKEN'S)**, Electrolytic refining of tin.
- 141962 **LATOUR**, Electro-magnetic wave signalling systems. (8/12/15, France.)

- 141975 **ELL & SHOTTER**, Alternating current instruments.
- 141980 **ROBINSON**, Guard devices for conductor rails of railways.
- 141985 **PETERSEN**, Copying telegraphs. (17/6/20, Norway.)
- 141987 **SIEMENS-SCHUCKERTWERKE**, Synchronous motors. (26/7/20, Germany.)
- 141988 **B. T.-H. Co. (G.E. Co.)**, Arc welding machines.

- June 1.
- 141964 **CURZONS**, Electric ignition systems.
- 141965 **KAMPFELD & BEAP**, Electric, &c., motors.
- 141982 **JOHNSON**, Quick make and break switch.
- 141989 **GLEASON**, Semi-automatic electric signalling.
- 141993 **KNABEN**, Magneto.
- 141996 **B. T.-H. Co. (G.E. Co.)**, Dash-pots.
- 142005 **RIST**, Commutators for ignition systems.
- 142006 **AUTOMATIC TELEPHONE MANUFACTURING CO.**, Telephone systems. (18/6/20, U.S.)

- June 2.
- 141961 **MICHELWRIGHT**, Resistance units.
- 141965 **HYNES**, Electric burglar alarm.
- 141994 **PELLETIER & PELLIN**, Electric resistances. (22/6/20, France.)
- 142000 **SVES**, Electrical means for transmitting or reproducing sound.
- 142016 **MORRIS-AREY, SHEARER & PRESTON**, Valve transmission circuits.
- 142024 **SIEMENS-SCHUCKERTWERKE**, Apparatus for propelling conveyor trucks with electric drive. (2/6/20, Germany.)
- 142041 **AMOS & LLOYD**, Electric alarms.
- 142055 **NYE, DRAPER & GOODMAN**, Medical battery.
- 142062 **NAALMOOZE VENOOTS ELEC. MAATSCHAPPIJ**, Electro-stroom. Joining insulated conductors. (5/6/20, Holland.)

Prices of Metals, Chemicals, &c.

		TUESDAY, OCT. 25.		
Copper—		Price.	Inc.	Dec.
Best selected	per ton	£74 0 0	—	5 0
Electro Wirebars	..	£74 10 0	—	£1 10 0
H.C. wire, basis	per lb.	0s. 11½d.	—	½d.
Sheet	.....	0s. 10½d.	—	½d.
Phosphor Bronze Wire (Telephone)—				
Phosphor-bronze				
wire, basis	.....	1s. 3½d.	—	½d.
Brass 60/40—				
Rod, basis	.....	0s. 8d.	—	—
Sheet, basis	.....	0s. 10½d.	—	—
Wire, basis	.....	0s. 11½d.	—	½d.
Pig Iron—				
Cleveland Warrants	per ton	£6 10 0	—	—
Galvanised steel				
wire, basis 8 SWG	..	£23 0 0	—	—
Lead Pig—				
English	.....	£25 0 0	5s.	—
Foreign or Colonial	..	£24 2 6	5s.	—
Tin—				
Ingot	.....	£158 5 0	10s.	—
Wire, basis	.....	2s. 1½d.	—	—
Salammoniac.—Per cwt. 65s.-60s.				
Sulphur (Flowers).—Ton £13.				
..... (Roll-Brimstone).—Per ton				
£13.				
Sulphuric Acid (Pyrites, 168°).—				
Per ton, £9 17s. 6d.				
Rubber.—Para fine, 1s. 2d.; plantation 1st latex, 9½d. to 10d. lb.				
The metal prices are supplied by British Insulated & Helsby Cables, Ltd.				

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FRIDAY, NOVEMBER 4, 1921.

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Notes of the Week.

Commercial Electric Cooking.

THE extension of the B. and K. Restaurant at Kensington, which we describe in this issue, and the installation on one of the Great Northern Railway dining cars of an electric cooking equipment, mark the progress which is being made in the use of electricity for culinary purposes by those whose first object is commercial rather than technical success. The Great Northern installation, it is true, is not absolutely the first application of electric cooking on railway trains, but it is sufficiently novel to be worthy of note, and at the same time is a recognition of the fact that by using electricity it is possible to provide meals under the arduous conditions of restaurant car working. We may go further, and say that electric cooking is especially suitable for this class of work, for it enables palatable meals to be prepared in a pure atmosphere, and allows the temperature of the car itself to be kept at a comfortable level—a point which is not without its importance both to the staff and to the passengers. We are therefore not surprised to hear that the cooks are enthusiastic about it. It will also enable the possibilities of electric cooking to be explored by those who are not electrical experts, but are sufficiently well versed in the culinary arts to make their experience worth having.

Cooking and Measurement.

THE B. and K. Restaurant is interesting in another way. In it cooking will be carried out under ideal conditions by those who have been educated in the possibilities of electricity for some considerable time. It will show both the frequenters of the restaurant itself and that increasing number of Kensingtonians who purchase cakes and other confectionery for home consumption the pastry it will be possible for everyone to make when the all-electric home becomes a universal experience rather than a too infrequent dream. The restaurant will do something else.

The results obtained, both electrical and culinary, will be carefully measured and analysed by Mr. DOWNE and his assistants, not only to find out weaknesses in the equipment, but to obtain figures of the actual cost of electric cooking and of the energy consumption of the various apparatus. These figures cannot fail to be of the greatest use, and we hope they will be made public for the confounding of critics. It is almost a proverb that science is measurement, and we may admit that cooking is a science. It therefore logically follows that cooking is measurement, and this opens a new area of the greatest possibilities. The whole enterprise is one that reflects the greatest credit not only on the directors of the company, but on Mr. R. S. DOWNE for his indefatigability and enthusiasm.

Distribution Problems.

IN listening to after-dinner speeches by official personages, such as Electricity Commissioners, it is well to remember that there is a difference between their unofficial aspirations and their official enactments. With this reservation we may describe Mr. ARCHIBALD PAGE's recent pronouncements at the B. and K. Restaurant as being a most stimulating contribution to the solution of certain problems of electricity distribution. These problems, as we have recently pointed out, are among the most important, if not the most important, of those troubling the electrical industry at the present time. It is in many areas exceedingly difficult to know how best to provide for an increasing domestic load without spending a very large amount of money on expanding the distribution system. The difficulty is heightened by the lack of experience as to how best this development should be carried out in detail. Happy, therefore, is the engineer who manages a three-phase or single-phase system, or is able, as has been done at Newcastle, to introduce an alternating supply into the middle of a direct-current network. Mr. PAGE apparently would take this heroic course in every case, but whether that is economically the best system universally to employ is a little open to

doubt. It is certain that many of the distributing systems in our small towns will have to be strengthened, whatever system is employed, if they are to deal with any domestic load at all, and it may be that when this has been accomplished the use of mercury vapour rectifiers will provide an adequate solution of the difficulty.

Auxiliary Features in Automatic Telephony.

IN this issue of *THE ELECTRICIAN* we begin a series of articles on "Auxiliary Features in Automatic Telephone Systems," by Mr. W. AITKEN. The subject of automatic telephony is one of a very special character. Its practical ramifications are understood by few, and its complications make it a subject which cannot easily be dealt with in a descriptive article. The inherent difficulties of the subject from the latter point of view are increased by the limitations imposed on the pages of a weekly journal in matters of large folder diagrams (the only way in which the systems can properly be illustrated), and of giving a lengthy description, continued from week to week, necessitating frequent reference back to previous numbers. For such information the reader may be referred to Mr. AITKEN's recent book on the subject of "Automatic Telephone Systems," to which these articles may be considered as appendixes, which will describe features which are integral parts of the automatic system and by forming short articles, complete in themselves, will, we hope, help to increase the general knowledge of electrical engineers on telephone subjects. The subject matter will be mainly new, will be descriptive of fresh developments as they are introduced, and of inventions and designs as they are disclosed. Some of the latter class, even if they are never introduced into practice, are interesting as indicating how experts working in this most intricate of all fields are attempting to perfect automatic telephony.

South-East Lancashire Electricity District.

THE technical scheme for the reorganisation of electricity supply in the important district of South-East Lancashire is now available, and is one of the most complete that we have yet seen. Judging by the general agreement of the authorised undertakers in its favour, the extra time taken for its preparation was well spent, and the result reflects credit upon the tact and diplomacy of the engineering sub-committee presided over by Mr. S. L. PEARCE, C.B.E. The situation was almost as difficult as in the London area, owing to the numerous undertakers and the various interests involved, but apparently practical unanimity has now been reached.

Technical Details.

WE gave an outline of the administrative and financial features of the scheme in our issue of September 30th, and it only remains to add that the supply will be on the three-phase alternating current system. The standard frequency will be 50 cycles per second, but in the initial stages of development there will be no interference with other frequencies. The main transmission pressure will be 33 000 V and the local secondary transmission pressures 11 000 and 6 000 V, so as to coincide with existing practice. Eight stations are scheduled as being unsuitable for extension, and special arrangements are to be made for the Alderley and Wilmslow and the Altrincham Electric Supply Companies. It is to be regretted that the cost of changing the Stalybridge Board's system, which operates at 40 cycles per second, is considered too high to justify the expenditure involved—about £400 000—and for a similar reason it is

not proposed to alter the three-phase power station of the Lancashire and Yorkshire Railway Company at Clifton, which has a frequency of 25 cycles per second. This station may, however, be called upon to supply an increased load for traction purposes, and when extensions of plant are made later on the necessary change may be effected.

Progressive Bradford.

THE Bradford Corporation electricity department is not only one of the pioneer municipal electricity supply undertakings, but has always maintained itself in the vanguard of progress. It was the first to introduce the principle of hiring motors and apparatus, Mr. ROLES was an early "Point Five," it has developed an excellent domestic load and in other ways has encouraged the use of electrical energy, with the result that the undertaking is, as it deserves to be, in a prosperous and flourishing condition—this in spite of the fact that the woollen trade, the staple industry of the city, has recently been suffering from a period of unexampled depression. Nevertheless, the department for the year ending March 31 last is able to boast of a record output, over 55 680 000 units, or an increase of 143 520 units above 1918, the previous best year, and nearly 6½ million units more than in 1920. The gross profit amounted to £103 720, and after meeting interest and sinking fund charges there was a net surplus of £10 603, compared with a deficit of £3 419 in the preceding twelve months. These figures reflect great credit on Mr. ROLES and his staff and show that the department is both stable and managed on sound business lines. Not only was the output greater, but there was an increase in all classes of supply and there was also a record number of new consumers connected, viz., 1 283, compared with 1 052 in the previous year. This increase brings the total number of consumers up to 7 712. This is a clear indication of the increasing popularity of electricity for power, lighting and heating, and, what is equally satisfactory, the intimation that notwithstanding the depressed, though improving, condition of the wool industry, the demands for supply continue to come in at a good rate.

Extensions of Plant and Mains.

A good deal of the Committee's Report is devoted to an outline of the extensions of plant and mains that will be necessary to keep pace with customers' requirements. Various extensions of the e.h.t. feeders and transformer chambers have already been made, and at present there are over 81 miles of underground feeders with three miles of overhead e.h.t. transmission lines and 74 transformer chambers in commission, aggregating in output 19 464 kVA. There was also unprecedented activity in connection with the general supply network, the number of extensions made being 133.

Motor Hiring.

BRADFORD has also the distinction of being the first municipal undertaking to introduce and develop the system of letting motors and apparatus on hire. In consequence of the great increase in the prices of new motors and starters, the higher rate of interest on money and the extra cost of inspection and maintenance, the Committee have been compelled to make substantial advances in the hire charges which have been in operation for over twenty years. Nevertheless, as a proof of the success and popularity of the hiring department, we may add there are at present about 1 850 consumers who use hired motors with a total output of over 10 000 H.P.

Business Development.

ANOTHER branch of the Committee's activities is exemplified in the organisation of a Business Development Department. This is designed to deal with manufacturers who use other forms of power than electricity, and the past year's record shows that several special agreements have been made for large supplies of electricity for power, as well as supplementary agreements with existing consumers for substantial increases in their demands. In addition, steps are being taken to extend the supply system to Idle and Thackley, and it is instructive to notice the steps taken by the department to ascertain the nature of the demand in these districts. In the first place, a canvass was of such an encouraging nature that the Committee authorised the opening of an auxiliary showroom and information bureau in Idle. A fairly comprehensive display of electrical fittings and apparatus was made, and announcements relative thereto appeared in the Press, on the screen at the local picture house, &c. The result of this campaign was so satisfactory that it has now been decided to give a general supply of electricity in the district in question. It is obvious that the Committee have an adequate appreciation of the value of modern showrooms in advertising the use of electricity for domestic purposes, for application has been made for authority to borrow £42 225 for the purchase of new premises for offices and large showrooms in the Sunbridge Road. In short, the administration of the Bradford electricity department may be looked upon as a model, and its example might well be copied by other supply authorities.

Electricity Supply in the United States.

SOME interesting statistics have recently been collected by the "Electrical World" to show the development of electric light and power undertakings in the United States. The most striking point revealed is the relative stability of shares in such undertakings during the recent depression. During the present year in particular the average price has varied little, whereas shares of industrial concerns and railway companies have fluctuated considerably and, on the whole, have shown a decided downward movement. Generally speaking, we believe that a similar condition would be found to exist in this country, and in view of the very great economic difficulties companies have had to meet this must be considered a tribute to the prudent policy adopted in the past.

Operating Rules.

A FEATURE of interest in connection with these American statistics is the course of the "operating ratio," i.e., the ratio between operating and maintenance expenses and the gross revenue from the sale of energy. During the present year the ratio for steam plants was almost the same in June as in January, namely, 56.2 per cent. During 1920, on the other hand, there was a rise in the corresponding period from 55.3 per cent. in January to 62.5 per cent. in June, mainly owing to the exceptionally high prices for fuel in 1920, which have since become stabilised. Generating companies operating only hydro-electric plants have naturally a smaller ratio. The operating ratios of companies having both steam and water power follows the high and low-water periods of the country. Comparing June, 1921, with June, 1920, it appears that the ratio for steam plants decreased from 62.5 to 56.2 per cent.; for combined steam and hydro plants from 50.9 to 45.0 per cent.; and for hydro plants alone from 21.6 to 20.4 per cent. Gross revenues were about

10 per cent. greater, and if the operating expenses had increased proportionally no improvement in the operating ratio would have been seen. It is evident, however, owing to the introduction of more efficient methods and probably also to lower fuel costs, the position has become substantially better.

Organisation of Benevolence.

THE speeches at the festival dinner of the Electrical Trades Benevolent Institution last week directed attention to the need of further contributions to this deserving fund by elusive rather than by the direct methods. Sir TOM CALLENDER briefly stated the amount that had been collected, and it was left for Sir WILLIAM NOBLE and Mr. LLEWELYN ATKINSON to rub in the lesson that the electrical industry lags very much behind the Post Office in generosity and that an unexpected change in the prosperity of an industry is a good example of what may happen to the prosperity of the individual. We have never concealed from readers of THE ELECTRICIAN our opinion that this fund should be very much larger than it is, and that this increase could best be obtained by making a change in the method of collection. Those responsible for the conduct of the Institution, and especially its indefatigable secretary, Mr. F. B. O. HAWES, will no doubt agree with us. At present the collection is effected by a system of concentration, and takes place largely at the annual dinner, which certainly is no better attended as time goes on. This system should be replaced by one more centrifugal in character, so that not only are more persons engaged in the industry actually collecting, but that collection should be made by means of small sums throughout the year. This could either be done in the form of a weekly or monthly subscription and by local entertainments got up for the purpose. It is only by some such means that the fund can be made really worthy of the electrical industry and be competent to do the work for which it is designed—the relief of the deserving unfortunate.

The Electrification Boom.

IN last week's ELECTRICIAN we pointed out certain financial disadvantages in the Government scheme for relieving unemployment by advancing capital for constructional work such as railway electrification—work, that is, which requires doing, but cannot be economically undertaken at present time owing to its high cost. But if such Government-aided work is to be undertaken at all—and it certainly seems among the most satisfactory ways of immediately dealing with unemployment—it could not take a better form than the conversion of our suburban railways to electric traction, and the extension of those lines that are already electrically worked into districts that at present have no railway facilities. For railway electrification will give immediate and prolonged employment to a large number of men in the majority of the engineering and closely allied trades. This is emphasised in an article in the current issue of "The English Electric Journal," in port electrification, it would do much to remove those scheme, which would cost £6 000 000, absorbs, when every allowance is made for imported material, no less than £4 800 000 for direct British labour. Moreover, by ultimately increasing the facilities for communication and transport, electrification would do much to remove those economic difficulties of which unemployment is the outward and visible sign. We must therefore commend the promptness with which the railway companies, especially the South-Eastern and Chatham Railway and the Underground

Group, have put forward proposals upon which we hope work, with Government assistance, will be started without delay.

Electrification Relieves Congestion.

It is an open secret that Mr. A. RAWORTH, electrical engineer of the South-Eastern and Chatham Railways, some time ago made a close study of the electrification question as applied to that system, that as a result very careful financial and operating data were prepared, even before the war, and that the chief, if not the only, obstacle to the adoption of electric working has been the monetary one.

It is equally common knowledge that saturation is reached at business hours on the sections of the South-Eastern Railway within a short distance of the London terminal stations. This knowledge is confirmed by a letter from Mr. P. C. TEMPEST, general manager of the Company, which appeared recently in "The Times" in reply to a complaint about the late running of the morning boat train from Dover. It appears that owing to the dates of the change from summer time to Greenwich time not corresponding in England and France, passengers for a period of three weeks were kept waiting an hour at Dover. But, as Mr. TEMPEST points out, to have obviated this would also have entailed altering the running of no less than thirty-one London suburban trains with an average loading of 500 passengers, and that it was better to delay one train than alter thirty-one for so short a time. This sort of difficulty experience has shown will be overcome by electrification, while at the same time both the average speed of the journey, the headway and the "off-peak" service can be improved, and revenue thereby increased.

Details of the Scheme.

As a beginning it is proposed to electrify a route mileage of 94 miles, *i.e.*, a single-line mileage (including sidings) of 210 miles. This part of the scheme will take in an area of about 20 miles from Charing Cross, and comprise the North Kent and Greenwich lines, the Bexley Heath line, the Dartford loop line, the main line to Orpington and the Bromley North branch, the Mid Kent and Hayes branch, the main line to Bickley and Orpington, the Crystal Palace and Greenwich Park branches and the Catford loop lines. Subsequently a further 140 route miles, representing 438 miles of single line and sidings, will be converted. This will bring such towns as Strood, Chatham, Gillingham, Sevenoaks, Tonbridge and Dorking within the electrified area. Electric operations will begin with the suburban passenger trains, followed by through passenger and goods trains. It is estimated that electrification will allow a 30 per cent. average increase in speed and frequency of the service to stations in Section A, while in Section B the increase in speed will be 40 per cent. and in frequency of service 60 per cent. There seems no reason why these figures should not be obtained, and the advantages in rapid and easy communication that will ensue are therefore obvious.

First Use of the Standard System.

As regards the systems to be employed, it is stated that the "standard" system will be used with rail collection. "Multiple-unit" trains will, of course, be employed for the suburban services and locomotives for the fast passenger and goods trains. In the former case the motor car will be equipped with two 200 H.P. motors, which should give plenty of margin, even with the somewhat severe gradients that have to be traversed on certain

portions of the line. We are not told whether Mr. RAWORTH's interesting three-wire system is to be employed, but, in any event, the technical details so far published are meagre. And we rather wonder what "working in" arrangements will be adopted where the line traverses the Brighton Company's system, as it does in several places. This is one of the cases where standardisation would be a real benefit.

The Underground Scheme.

The Underground scheme, though less spectacular than that of the South-Eastern and Chatham Railway, should not be less useful in providing better facilities for inter-communication between city and suburbs. It may be described as a combination of consolidation and extension. The City and South London Railway is to be widened circumferentially and connected to the London Electric Railway at Camden Town. The Hampstead and Highgate Railway is to be extended to Edgware, and the Central London Railway is to be connected to the London and South-Western Railway at Shepherds Bush, so that through trains can be run from Liverpool Street to Kew, Richmond and Hammersmith. These are all useful projects, and will correspondingly reduce the number of "missing links" which are still found in unexpected places in tube travel. They will provide extra communication for the travelling public and stimulate traffic on certain sections of the Underground which are not already saturated.

A "Bottle Neck" Problem.

But the same testimonial cannot be given to the proposed extension of the District Railway from Wimbledon to Sutton. Or, rather, this useful extension must wait for something else. It is one of the schemes that has long been talked about and almost as long has been awaiting inauguration. Before, however, the London Electric Railway Company undertake this work Lord ASHFIELD and his co-directors must give urgent study to the problem of relieving the congestion between South Kensington and the Mansion House. This section of the system is a bottleneck so narrow that we wonder how it has stood until now without bursting the pressure that is every night and morning put upon it. To improve the conditions in this section is a problem so difficult that we do not wonder it is shelved, but it is obvious that it must be dealt with somehow. Extensions, linking up, and longer and quicker trains will all fail of their full effect as long as this section continues to cause delay and overcrowding, as it inevitably must do. Whether widening of any sort is possible, or whether the solution lies in building further tracks under those now used, is not for us to decide, but these are alternative solutions, which must be carefully examined and the solution adopted put in hand at once.

Other Schemes.

Similar schemes to those we have just dealt with have been put forward definitely by the London, Brighton, and South Coast Railway, and indefinitely by the Great Eastern Railway. As we anticipated, the improved methods of steam working recently adopted on the latter system have done little to improve the congestion, and now the electrification of lines between Liverpool Street and Enfield, Palace Gates, Chingford, Ongar, Woolwich and the main lines to Broxbourne and Gidea Park has, it is hinted, been determined upon. This, it is said, will necessitate a large amount of reconstruction work near the terminus, which we can well believe, and the erection of a generating station at Tidal Basin—a point which is not mentioned in the South-Eastern scheme, though we believe

a site at Erith has been provisionally surveyed. We hope, however, that the undue erection of generating stations will be avoided, though the Commissioners can be trusted to keep this point in view. Powers have long been possessed by the Midland Railway Company for the conversion to electric traction of the line between Fenchurch Street and Southend-on-Sea. It is to be hoped that work on this will also not long be delayed.

The Magnification of the Unessential.

Now here are a number of schemes which, as we have said above, will not only relieve unemployment, but benefit the public generally. For that reason we hope that they will go forward as speedily as possible under a Government financial guarantee or otherwise. Beneficial as these schemes are, however, yet it is characteristic of British mentality, as represented perhaps, we should add, by the daily Press, that the real advantages of the plans suggested have been almost wholly ignored in order to discuss a minor political point in the scheme put forward by Lord ASHFIELD on behalf of the Underground Group.

We shall not fall into the same error. No doubt the question of monopoly as applied to road traffic is a wide matter upon which it is possible to hold a number of different high-temperature opinions. It is possible that Lord ASHFIELD and his colleagues are asking for too much, even when it is remembered that the London Tube Railways give but a small return on the capital expended on them, it is possible that to grant to the Company on paper what they already virtually have in reality would be detrimental to the public interest, though it is quite usual in nearly every town but London, and it is probably quite true that some competition with the tramways is most unfair. But all these things and more like them will happen so long as we have no London Traffic Authority. And, in any event, they have little to do with the electrification of railways as a means of relieving unemployment.

Electrical Progress in India.

THE discussion on hydro-electric development in India during the past two or three years has been just as interesting and equally justified as in this country. But, though some progress has been made with surveys and other preliminary work, the actual advance has not been so great or so rapid as was anticipated. We learn that there are distinct signs of a revival, and it is confidently expected that as a result the electricity supply industry will show increasing prosperity in future.

Statistically, we note that at present there are forty-eight licences in force for the generation and supply of electricity, and in the majority of the cases the powers have been exercised. Twelve of the licences relate to schemes in the Bengal Province, ten to Bombay, six to the United Provinces, and four each to Madras, Burma, the Punjab and the Central Provinces. The leeway caused by the war is, therefore, now being satisfactorily made up, though some companies are still short of plant. For instance, at Lahore, where there is a steam-driven plant, connections have had to be refused, while Simla has exhausted the capacity of its existing water power, and new developments are under consideration.

Increased Costs and Charges

Like other countries, India has not escaped the effect of the high prices of materials and increases in wages, and consequently a few licencees have found it necessary to increase their charges on account of the advance in fuel

and establishment expenses. From the annual supplement to the "List of Electrical Undertakings in India" we learn that of the steam-driven plants Bombay had the lowest works costs, viz., 0.694 anna per unit generated in 1919, while the figure for the Tata Hydro-Electric Company, supplying an industrial load, was only 0.113 anna. The units sold in the two cases were 34 and 87.5 millions respectively. The Calcutta undertaking comes next in order of magnitude with 32 million units and works costs of 0.921 anna, but the Simla hydro-electric works have the second lowest costs, viz., 0.303 anna. An anna is now equal to one penny.

Hydro-Electric Developments

As the result of the universal rise in the cost of coal and an equal rise in the price of oil, it is not surprising to find there is a general desire for greater hydro-electric development. It is, however, unfortunate that the rainfall of India is confined to the few months of the monsoon period, so that storage on a large scale is generally essential if a source is to be employed to anything like its maximum development. Along the whole of the North of India, at the foot of the Himalayas, a chain of possible sites has been located by the Hydro-Electric Survey of India and by independent prospectors. Similarly there is immense water power down the whole chain of the Western Ghats and throughout most of Burma. In Southern India there are but few areas outside the radius of the prospected schemes, though these are for the most part smaller in scale than elsewhere. Assam also has large undeveloped power both in the Cherrapunji area (where the rainfall averages some 400 in.) and in the remote Hukong Valley to the far north.

Electro-Chemical Enterprise.

The largest individual scheme examined in India is that of the Koyna Valley. This was found by Mr. A. T. ARNALL, and is capable of giving some 300 000 H.P. continuously. Proposals have been submitted for developing this important source of latent wealth, but it is essential that electro-chemical industries should be started *pari passu* with the power scheme. In the Punjab the great bend in the Sutlej River above Rupar has been fully investigated under the direction of Col. B. C. BATTYE. The possibilities of this site were known thirty years ago, as, by short-circuiting the bend with a tunnel, some 400 ft. of fall is obtainable with a minimum flow of 3 000 cubic ft. per second. The greater part of the industrial needs of the province could be supplied from this source, which is certain to be developed sooner or later. Permission was given many years ago to develop two similar but smaller loops on the Jumna River near Mussorie, but so far nothing definite has been doing. The Jumna and Sutlej projects are within interlinking distance.

British Standards Adopted.

It is satisfactory to learn that there is general agreement in India as to the necessity of adopting British standard pressures and frequencies for all future schemes, so that interlinking may be effected without difficulty. Already the Punjab Government has passed a resolution to this effect, and, as the Institution of Engineers of India has taken up the question of the adoption of British engineering standards at the instance of the Government of India, it is probable that British pressures and frequencies will be adopted throughout the Indian Empire. We certainly hope that this will be the case, as the importance of this form of standardisation in the early stages cannot be over-emphasised.

AUXILIARY FEATURES OF AUTOMATIC TELEPHONE SYSTEMS.*

Laidlaw's Relay Device to Repeat Sender Impulses to Switches.

B. W. AITKEN, M.I.E.E.

The permissible speed at which a sending device may be operated is limited by the time required for the positive working of the switching apparatus. For this purpose the make and break periods of the impulse are of unequal duration, the movement of the switch wipers being usually effected during the longer of these periods.

The subscriber's dial-sender is arranged to run at a constant speed and to control mechanically the duration of each complete period, but the relative durations of the make and break periods vary in practice between wide limits by the distortion of the current impulses due to the capacity, inductance and imperfect insulation of the lines over which the impulses are transmitted and the apparatus associated with the lines.

which in one position connects a condenser to a suitable source of electricity, and in another position disconnects it from the source and discharges it through a relay controlling the switching apparatus.

The diagram shows circuits for the control of a first selector with means for retransmitting the impulses, free from distortion, to the other selecting devices used in the setting up of the wanted connection between two subscribers' stations.

The circuit shown is suitable for number impulses in which each impulse comprises a short break and a long make period, the condenser being charged during the break period, and the motor magnet during the make period. In systems in which the impulses comprise long break and short make periods the

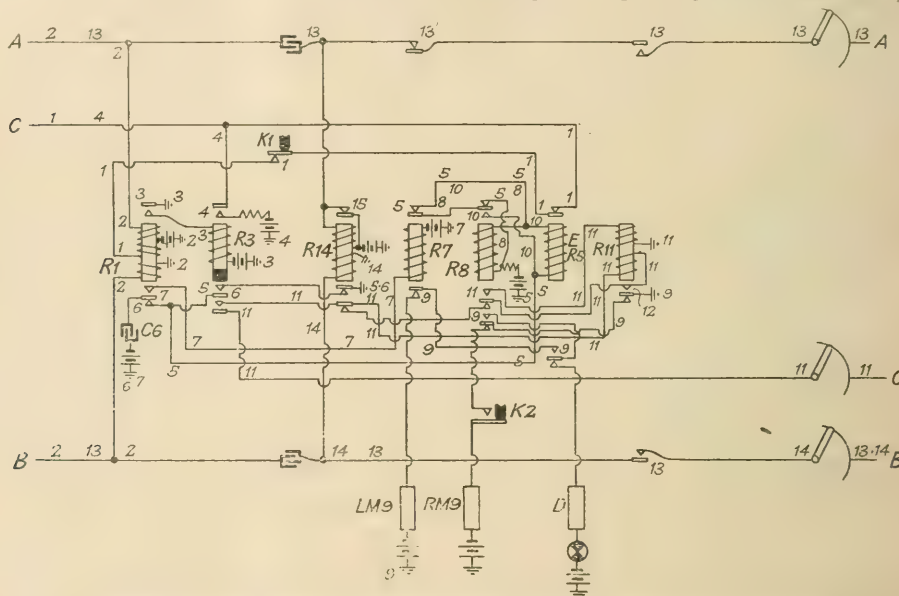


DIAGRAM OF A RELAY DEVICE FOR REPEATING SENDER IMPULSES TO SWITCHES (E. A. LAIDLAW).

The actual speed attained in practice is considerably reduced by the effects mentioned. The arrangement shown in the diagram is a method of increasing the permissible range of speed and the certainty of action of the switching apparatus by means which render its operation independent to a large extent of any adverse conditions of the line.

The Application of the Condenser.

The arrangement makes use of the property by which a condenser can be charged almost instantaneously, and the energy stored up can be afterwards discharged in the circuit of a relay during a period depending upon the constants of the circuit. The time during which the relay can be energised by the discharge of the condenser, and can consequently retain its armature in an operated condition, is determined by the electric constants of the discharge circuit, and is independent of the distortion of the impulses due to the line conditions, so long as this distortion does not mutilate the impulse to such an extent that the charging circuit of the condenser is never closed.

The current impulses transmitted from the sender are received by a relay, for example, the line relay, the armature of

circuit would be arranged so that the condenser was charged during the make period.

It is assumed that a subscriber has called and that the loop has been extended to the first selector in a known manner.

Arrangement of Circuits.

The circuits are numbered in the order of operation and are as follows:—

1. When the receiver is lifted, relay R' is energised over the C wire.
2. Circuit over loop.
3. Relay R3 energises, slow to de-energise.
4. New holding circuit for the C wire.
5. Relay R5 energised and opens circuit 1. First digit impulses.
- At the first break of the line by the dial, circuit 2 is opened and relay R de-energises.
6. Condenser C6 in charging circuit.
7. On completion of the impulse, circuit 2 is completed and relay R' re-energises, and connects the charged condenser to relay R7, which is energised by the discharge of the condenser for an adjustable and predetermined period of time.
8. Short-circuit about relay R8, which is now opened by relay R7. Relay R8 energises in series with relay R5.

When the condenser has been discharged, relay R7 de-energises independently of the condition of circuit 7.

9. Magnet LM9 energises to lift the shaft one step. Shaft contact K' is then opened.

10. Short-circuit of relay R5, which is thereby made slow to release and therefore remains energised during a train of impulses.

As relay R' de-energises and re-energises for each impulse, the above action is repeated and the shaft raised to the level required.

Relay R7 is adjusted to hold its armature in the attracted position only for a time sufficient to assure that the armature of relay R5 will be retained during the period in which the relay is short-circuited, and that the armature of magnet LM9 can be fully released and prepared for another step.

When the last impulse of the train has been sent, relay R' remains energised and relay R5 short-circuited, so that it de-energises and opens circuit 9 to cut off magnet LM9 and join up the rotary magnet RM9.

The wipers then search for an idle trunk in the group.

11. When an idle line is found, relay R11 energises and opens circuit 9 to cut off magnet RM9.

12. The lower winding of relay R11 is connected directly to earth, thereby engaging the called line.

13. The loop is extended to the next selector or connector, and relays corresponding to R' and R3 are energised.

At the next train of impulses, relay R7 operates as described. Each time relay R7 is energised it opens contact 13' to repeat the impulses to relay R' of the selected switch.

14. When the called subscriber answers, relay R14 is energised over the B wire.

15. The short-circuit about the second winding of relay R14 is opened to balance the circuit.

Relay R14 opens circuits 5 and 6 to release relay R8, which prepares the release to be effected in known manner.

Electrical Trades' Benevolent Institution.

The festival dinner of the ELECTRICAL TRADES' BENEVOLENT INSTITUTION was held at the Trocadero Restaurant on Wednesday, October 26th, Sir Tom Callender being in the chair. The company present included several ladies and numbered about 120.

SIR TOM CALLENDER in proposing the toast of the "Institution" said that it had started its operations in 1905. So far it had been singularly fortunate in having had no call on its funds. Nevertheless, those responsible were endeavouring to get together money for a rainy day, and had collected the sum of £15,700. This sum brought in an income of about £700 a year, which income after expenses had been deducted went to swell the capital fund. Grants to necessitous people during the present year had only amounted to £52.

SIR WILLIAM NOBLE in supporting the toast said although he was not connected with the electrical trade himself he was head of the department which was one of the trade's best customers. It was commonly thought that the civil servant had not to provide for his old age as he received a pension, but a pension was not granted until the age of sixty years was reached or after about forty years service. In the meantime provision had to be made for accidents, for sickness, and for maintenance in the case of need. A scheme for this purpose had therefore been started in the London district in 1907, and since that date many thousands of pounds had been distributed from the fund, which was now in an exceedingly flourishing condition.

Sir William also gave details of the Post Office relief fund which was started late in 1914. In four years this had collected £450,000, had endowed two hospitals and maintained three convalescent homes. It also provided funds for the support of widows and orphans of Post Office servants killed during the war, and had sent parcels every week to those in the service who had been taken prisoners. It had now on its books 3,000 widows and 5,000 children, and was devoting itself among other things to the education and maintenance of orphans.

Mr. LLEWELYN ATKINSON, who also spoke, said that last year the difficulty in the electrical industry was to make anyone believe it was necessary to provide for such a flourishing undertaking. They all knew that since that time a most unexpected change had taken place, and such unexpected changes affected persons equally with industries. Workers in the electrical industry therefore must now use every effort to build up a benevolent fund from that point of view. It was a good thing that ladies were present, as their presence was likely to stimulate a home interest in the fund, as every woman would thereby be brought to realise that the fund was a buffer between the hard strokes of fate and the existence of her home.

It was announced that the sum collected during the evening was £1,280.

Electricity in Gases as a Branch of Engineering.*

By Prof. W. M. THORNTON, O.B.E., D.Sc.

Fifty years ago Maxwell indicated research on electricity in gases as a probable avenue for the penetration of the constitution of matter. The prediction has been amply justified, but there is still a long way to be penetrated. Present knowledge recognises two kinds of electricity, viz., permanent right and left handed strains in ether, of which all atoms are composed. A loosely charged molecule is a possible ion or carrier of electricity. Ionisation in gases is in general of a simpler nature than in liquids, thus the production and behaviour of positive and negative gaseous ions in various fields may be a consideration.

Radiation and Ignition.

Radiation from a flame is highly important. At least 25 per cent. of the energy of the coal burning in a boiler furnace, which reaches the water, is transmitted by electrical radiation from the atoms in the flame and incandescent coal. Taking the boiler power of the world as 50 million H.P., at least 12 million H.P. are transmitted by short ether waves to furnace walls in this way. The total power received in full sunlight, and arising from the vibration of atoms in the sun, is far greater—no less than 200 billion kW.

The negative electron is easily moved as compared with the positive electrons. The latter form nuclei of atoms and radiation is set up by oscillations of the negative electron only. Electrical ignition comes next to radiation in engineering importance. Ignition proper is not primarily a thermal process, but involves ionisation of the explosive mixture. Electric action in gases may cause ignition (1) through direct ionisation, (2) by collision of the electrons with the molecules in a jump spark or by ionic emission from arcs, and (3) by thermionic emission from hot wires. Even in the Diesel engine, where there is no direct electrical ignition but only the attainment of a certain temperature of compression, electrical phenomena probably play some part. Ignition from hot wires occurs at temperatures above 200°C. (far below red heat), when a discharge of electrons from the wire commences. The theory of the arc is incomplete, and has little influence on design. The oscillations are more important in relation to radio-work than in connection with the arc as a source of light.

Electric Discharges through Mercury.

The operation of electric discharges through mercury vapour was discussed, and the application in the mercury rectifier (now built to transmit 1,000 kW) explained. The rectifier is an example of discharge in gases at low pressures. Discharges in high vacuum form the origin of the X-ray tube and triode valve. The latter is a modification of the vacuum tube by the insertion of a grid between the electrodes. When electric discharges occur in air intense ionisation by collision is produced. At low temperatures the effect is almost confined to oxygen, which is converted to ozone. The derivation, by electrical discharge, of nitrogen compounds from the air has been actively developed in Germany and Scandinavia, the products being of great value, both as explosives and for fertilisers.

Just as rain, when electrified, coalesces in large drops characteristic of a thunder shower, so clouds of smoke can be caused to deposit by electrical treatment. The essential is a strong electric field sufficient to produce clouds of ions, electrons or charged molecules, which are swept into collision with the smoke particles. In such discharges it is probable that the negative ionic discharge plays the greater part.

Atmospheric Electricity.

Atmospheric electricity is of interest chiefly in its bearing on radial telegraphy and telephony. Electrical phenomena on or near the earth's surface are rarely beneficial in the engineering sense. Electric storms are the bane of telegraphists, and may even be of such violence as to shut down large overhead power systems. When a strong wind blows through a mist, or over a sandy or dusty plain, electrification, and ultimately lightning discharges, may occur.

"Atmospherics" in wireless occasion many difficulties. Means are now being devised of working through ethereal disturbances of this nature, but their presence near the earth gives rise to much trouble.

The subject of electricity in gases may be divided roughly into four branches: (1) Ions produced by collision between electrons and molecules of intense electric fields. (2) Ions produced by thermionic discharge. (3) Electrical effects of collision, and (4) electrical effects of separation of charges. The subject constitutes a branch of applied electricity which may be termed "Ionic" engineering and affords great opportunity for experiment, research, mathematical reasoning, and judgment in the use of materials which are essential to engineering.

* Abstract of an address delivered before the North Eastern Centre of the Institution of Electrical Engineers.

ELECTRICITY SUPPLY IN SHEFFIELD.

Details of the New Blackburn Meadows Station.

The history of public electricity supply in Sheffield dates back to the dark ages of 1878, when Mr. John Tasker and, subsequently, the Sheffield Electric Light & Power Company, ran a small station in the centre of the town. The Corporation came on the scene in 1898, at which time a single phase supply at 100 cycles was being given, and besides changing over to 50 cycles and two phase, soon found it necessary to construct a station at Neepsend, of which a full description was given in *THE ELECTRICIAN* of March 13th, 1914. Neepsend started with a capacity of 1 500 kW. in 1914 it had 13 500 kW, and now its capacity is 59 500 kW, this enormous increase being, of course, due to the war load. But though the end has been reached as far as Neepsend is concerned, the good work will be carried out at the new Blackburn Meadows Station.

The Site.

The site of the Blackburn Meadows station, of which a view is given in Fig. 1, is near the eastern boundary of the city, close to many of the large works, and so suitable in every way for the erection of an up-to-date generating station. Moreover, it adjoins

steel, has had to be made in reinforced concrete. Thus the overhead coal bunkers are supported on a special concrete foundation. This is made up of two reinforced concrete beams 5 ft. wide at the bottom and 7 ft. deep, and running the whole length of the boiler house, that is 225 ft. These beams carry eighteen vertical pillars, each 2 ft. 6 in. by 1 ft. 6 in., of a similar construction. The centre feet of the roof principals of each of the bays on either side of the coal bunkers, and the bunkers themselves, are carried on further continuous reinforced concrete beams, 5 ft. deep, which are themselves carried on the vertical pillars already referred to.

The boiler house basement, where the ash-handling plant is installed, is on the ground level, and has been designed so that the men employed there are working under conditions as ideal as it could be hoped to obtain. So spacious is this basement that a portion can also be utilised for storing heavy materials.

The boiler firing floor, 12 ft. above, is carried on 180 reinforced concrete pillars. The total breadth of this floor is 130 ft., and the height to the top of the coal bunkers 70 ft. These bunkers have a capacity of 1 200 tons of coal. At the east side of the boiler house

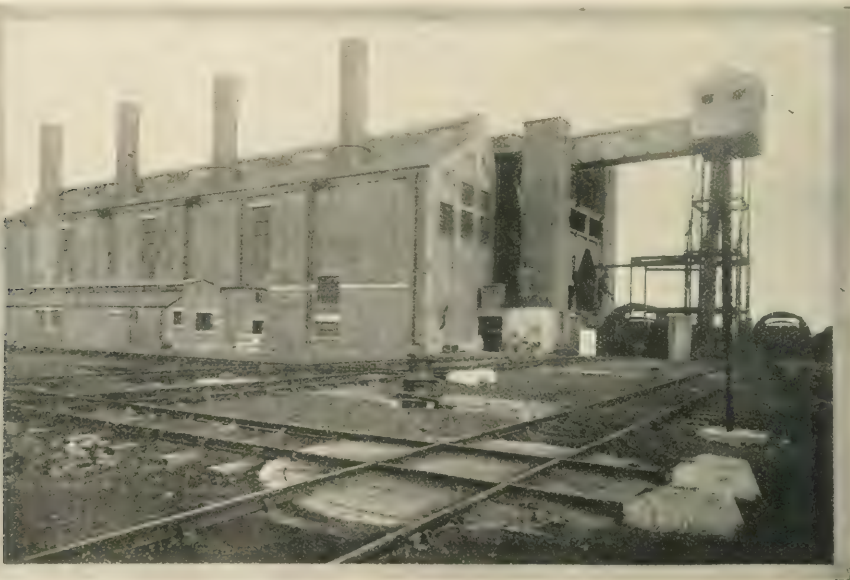


FIG. 1.—WEST VIEW OF THE BLACKBURN MEADOWS STATION, SHEFFIELD.

the city sewage works, runs up to the river Don on the east, and has an area of about 27 acres. Also the site was substantially level and had a good subsoil, so possessing many advantages and few disadvantages.

Despite the overwhelming evidence of shortage of power the Ministry of Munitions, in the first instance, would not give permission for the work on the site to proceed. In consequence of this the original proposals for the station had to be abandoned, and when work did eventually commence in November, 1917, any plant available had to be employed. Moreover, the increased cost of wages, material, and cost of plant made a considerable difference in the wrong direction in the necessary capital outlay.

On the other hand it must be noted that the Corporation were very fortunate in obtaining plant which was nearing completion in manufacture and at a lower price than was obtainable in the market generally. This was due to the fact that they were enabled to take over contracts made by the Government for plant for the Henbury Explosive Factory. At the same time the plant so obtained was not that which would ordinarily be installed had the scheme gone through when first decided on. The station was started to work during the early part of last winter, and is being formally opened by the Duke of York to-day.

General Arrangement of Buildings.

Owing to the difficulty of obtaining constructional steel work, much of what in normal times would have been carried out in

is the turbine room, with the condensers in the basement at the ground level. It is 145 ft. long, 70 ft. wide, and has a total height of 77 ft. The turbine floor level is 19 ft. above the condenser floor level. The ventilation for both the boiler house and turbine room has been carefully studied, so that the central portion between the two lines of boilers in which the stokers are working is kept as cool as possible.

Staff Accommodation.

On each side of the main buildings is an annexe—that by the side of the boiler house being 132 ft. long, 36 ft. wide, and 19 ft. high. This has been fitted up as mess rooms for the use of the boiler house employees. The annexe on the side of the turbine house is 102 ft. long and 26 ft. wide. It is three storeys high, and contains on the ground floor a completely equipped fitting and repair shop, on the first floor the necessary offices for the operating staff and engineer in charge, together with mess rooms for the turbine house and switchboard staff. The top storey, which comes directly behind the switchboard, contains the high-tension switchgear. The total height of this building is 38 ft., and the roof, which is of concrete, is flat.

Coal Handling.

The existing sidings, which were put down for the Sewage Department, are used for coal delivery. At right angles to these are two sets of lines laid at ground level of the site, connected to the sidings by 12 ft. steel turntables. Each set of rails is

provided with a tippler of the circular ring revolving type. Each tippler has a 2 h.p. motor for the clamping device and an 8 h.p. motor for revolving it. The wagons are hauled on to the sidings by electric capstans situated at suitable points. They tip into a pit below ground level, from which the coal is elevated to the level of the bunkers by two bucket elevators, one to each tippler driven by 15 h.p. motors. Each of these elevators can deal with 40 tons of coal per hour.

The bucket elevators deposit the coal on a push plate conveyor (driven by a 15 h.p. motor) extending the length of the boiler house and running over the tops of the bunkers. This conveyor has a capacity of 60 tons of coal per hour. The base-plate of the conveyor is fitted with shutter doors, which permit the coal being fed to the bunkers at any point. The overhead bunkers have a capacity of 1 200 tons of coal.

Steel chutes fitted with mixing vanes deliver the coal from the overhead bunkers to the stoker hoppers.

Boiler House.

In the boiler house (Fig. 2) are installed fourteen water-tube boilers. Eleven of these, of the five-drum Stirling type, have each a heating surface of 8 282 sq. ft. and a grate area of 196 sq. ft. They are rated to evaporate 30 000 lb. of water per hour from feed at 212°F, with a working pressure of 190 lb. per

sq. in. The super-heaters to these boilers have a surface of 1 120 sq. ft. and give a super-heat of 200°F.

The other three boilers are of the Woodeson type, with Clarke Chapman super-heaters. They have a heating surface of 8 800 sq. ft. and a grate area of 196 sq. ft. Two chain-grate stokers of the Bennis type are fitted to each boiler. These are each provided with



FIG. 2.—VIEW THROUGH THE BOILER HOUSE.

a six-speed gear and are belt-driven from a central line of shafting running the whole length of the boiler house.

A motor drive is provided for the main line driving shaft at three positions, each end and the centre. The motors are of 45 h.p. each, and the drive is by chain reducing gear. Hans Renolds block type chains are used, totally enclosed in dust-proof steel cases.

The whole of the central line shafting can be driven from any one motor.

Ash-Handling Plant.

The ashes from each boiler fall into a receiving pit at the back end, and are thence delivered through a valve to an ash crusher. The ash crusher (Fig. 3) is driven by a 10 h.p. motor. It can be moved, by hand, to deal with the ashes from any boiler, as required, being mounted on a line of rails running the length of the bank of boilers.

The ashes then pass through cast-iron suction pipes into the ash-receiving tanks at the south end of the boiler house. Each bank of boilers has a separate ash-handling plant operating in the above manner. The receivers are fixed at a height of 55 ft., and sprays are fitted at the ash entry to slake and precipitate the dust and prevent it being drawn into the exhausters, which are of the Roots' blower type, each driven by a 70 h.p. motor. The air drawn in is taken through filters into the exhausters and discharged through silencers.

The spaces between the bottom drums of the boilers, and also the spaces in the bottom of the economisers, are connected by means

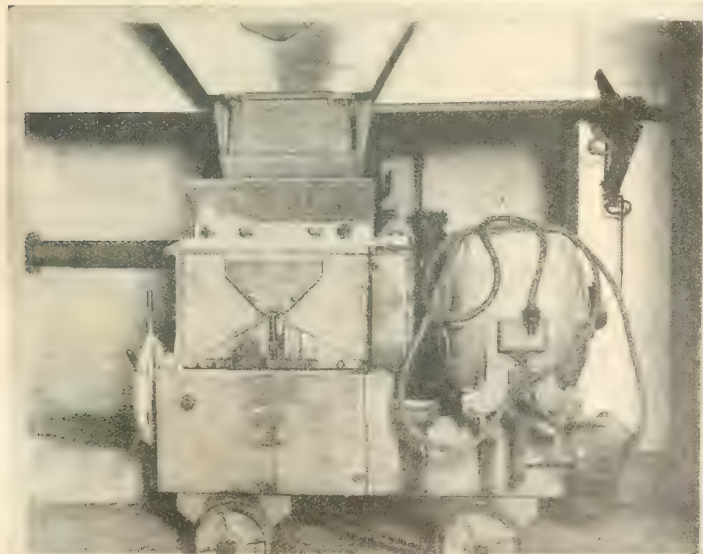


FIG. 3. VIEW OF THE ASH CRUSHER.

of 6 in. cast-iron exhausting pipes to the same suction plant. By this means the soot, grit and flue dust, which ordinarily deposit, are removed whilst the boiler is in service. This obviates the necessity for the old-fashioned boiler cleaning which had to take place at frequent intervals.

The ash receivers are capable of holding about 14 tons of ashes and dirt, and are fitted with valves which discharge into bins. These in turn discharge through chutes to the railway trucks on the siding running along the south end of the building. The sprays for slaking the dust and ashes fitted at the head of each receiver are supplied by pumps drawing from the circulating water inlet. Steel tippler wagons running upon the same rails as the ash crusher are provided. These form the necessary standby should the suction plant be at any time out of commission.

Electric hoists are installed by means of which these wagons can be made to tip into the ash hoppers for distribution of the ashes to railway trucks as before.

Economisers, Flues and Chimneys.

Each boiler and economiser is a separate unit. The economisers are of the Green type, fitted with the usual scraper-gear, which is driven by a 3 h.p. motor. Each economiser is fitted with a circu-

Boiler Water Supply.

The town water service is brought into the boiler-house through a 9 in. service main. It is metered directly at the position where the main enters the building and also at the point where it is tapped off the town main. The incoming supply is carried to the storage tank by a 6 in. ring main, and branches are taken from this, fitted with connections for fire-hose and also for supplies to the various canteens. The storage tank, which forms the roof of the pump house, is divided into two sections, either or both of which can be used. These feed tanks are arranged to take all returns from boiler, steam-pipe, and turbine drains, for the purpose of feed heating.

Generating Plant.

The main generating units are four in number. The whole length of one side of the turbine room (Fig. 4) housing them is occupied by the switchboard gallery, which is raised about 2 ft. above the engine-room floor level. The total capacity of turbine plant at present installed is 35 500 kVA. This is made up as follows:—One horizontal type Curtis turbine, manufactured by the British Thomson-Houston Company, direct coupled to a 7 500 kVA alternator, running at a speed of 1 500 revs. per min. One Parsons single cylinder reaction turbine, coupled to a 12 500 kVA

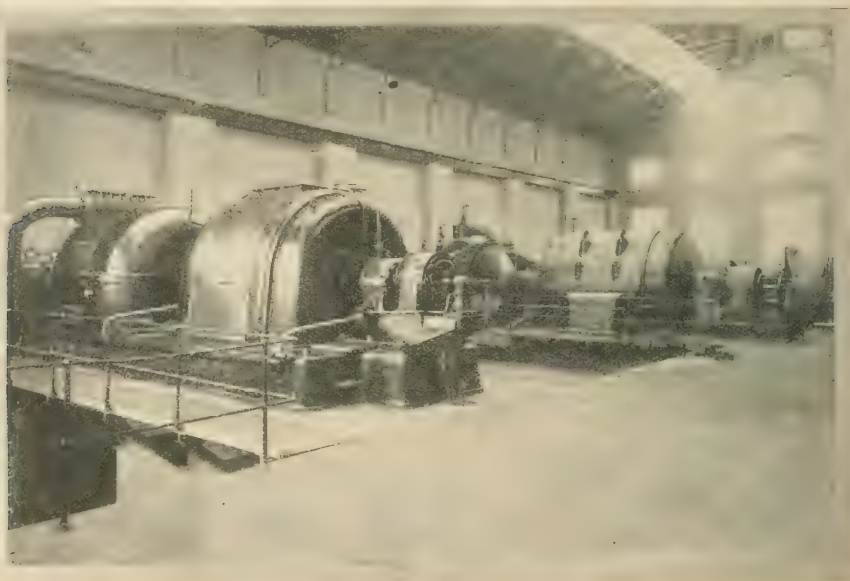


FIG. 4. GENERAL VIEW IN THE TURBINE ROOM.

lator. This supplies partially heated water at the inlet side, and so prevents sweating taking place in the first bank of tubes. Each pair of boilers is provided with a chimney 60 ft. high, the diameter tapering from 12 ft. at the base to 8 ft. at the top. Two 45 in. induced draft fans, each driven by a 40 h.p. motor, are installed.

Feed Main and Boiler Feed Pumps.

Steel mains 8 in. in diameter and in duplicate are installed with separate branches to each economiser. These mains are supplied from the pump house, which contains six pumps. Three are six-stage centrifugal pumps with a rated capacity of 20 000 gallons of water per hour against a head of 555 ft. These pumps are each driven by a 100 h.p. motor.

The other three pumps are of the direct acting Weir type, and are steam driven. They have a capacity of 17 000 gallons per hour against the working boiler pressure of 190 lb. per square inch. Two Lea recorders are provided, through which all water supplied to the pumps passes on its way from the main water tank. These can, however, be by-passed, so that water can be drawn direct, if necessitated by the recorders being out of commission.

The water required for boiler or condenser tube cleaning is arranged to be supplied from a special five-stage centrifugal pump, and this can also be used in case of emergency as a special fire pump.

alternator, running at a speed of 1 500 revs. per min. One pure Zoelly type turbine with eight single stages running at 3 000 revs. per min. This turbine is designed to give its most economical consumption at 4 800 kW, with a stop valve pressure of 180 lb. per square inch, 180°F. superheat, and 28 in. vacuum. The fourth turbine is also of the Zoelly type of the same output as the one just mentioned.

Condenser Plant and Air Pumps.

Each turbine has its condenser and air pumps directly below it. The condenser for the Parsons machine has a cooling surface of 14 000 sq. ft., and is capable of dealing with 120 000 lb. of steam per hour. The B.T.H. machine has a condenser with a cooling surface of 12 000 sq. ft., which can deal with 90 000 lb. of steam per hour. Each of the Zoelly type turbines has a condenser containing 10 500 sq. ft. of cooling surface, and each is capable of dealing with 90 000 lb. of steam per hour.

The air pumps for all these machines are of the three-throw Edwards type, and are all motor driven through reduction gears. On the Parsons set these auxiliaries can also be driven from a small steam turbine provided.

After condensation the steam from each turbine is passed through an integrating water meter of the Lea recorder type, of which there are four, one for each turbine. From these records a continual check can be kept on the steam consumption of each unit for al

loads. A small force pump is connected to the crank shaft of the air pumps, and this returns the condensed steam direct to the boiler feed water tank.

Generators.

The four generators are all three-phase 50 cycle machines, generating at 6 600 V. Two of them run at 1 500 revs. per min., and two

fan. This is direct driven from a 110 h.p. motor. Although the generating pressure is 6 600 V, the busbar pressure is 11 400 V, and each generator is connected direct to three single-phase transformers, for stepping up to the required pressure on the main switchboard. These transformers are delta-connected on the generating side and star-connected on the switchboard side.

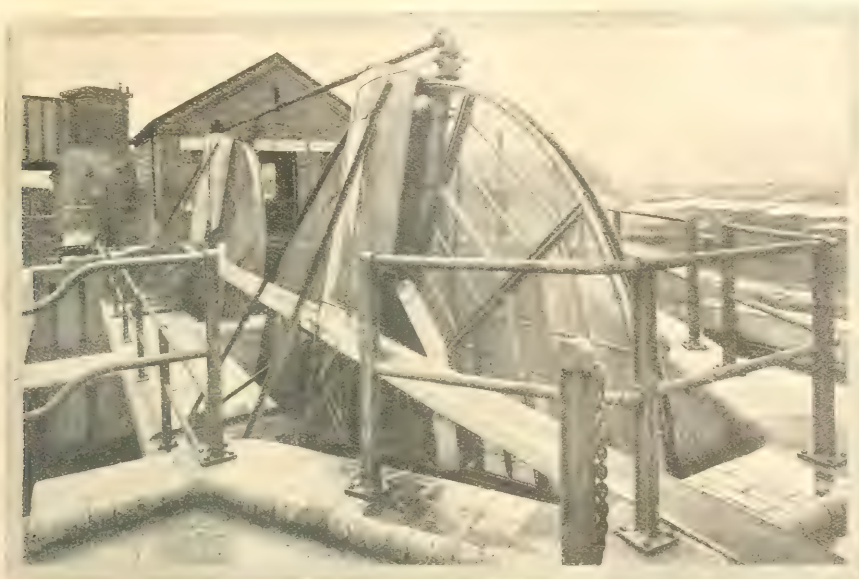


FIG. 5. THE REVOLVING CIRCULATING WATER SCREENS IN THE UPPER POSITION.

at 3 000 revs. per min. The three smaller machines have fans fitted on their rotors for ventilation purposes, and these pass approximately 33 000 cubic ft. of free air per minute through each generator. The Parsons machine has its ventilating air supplied by an external

Circulating Water.

The circulating water for the condenser is taken from the River Don just below its junction with the South Yorkshire Navigation Canal. It flows by gravity through two revolving screens, each



FIG. 6.—GENERAL VIEW AND SPRAY COOLING POND.

about 20 ft. in diameter, into a bay 33 ft. wide by 9 ft. deep. Each of these revolving screens (Fig. 5) is continuously cleaned by means of a jet of water spraying outwards through the top of the screen, which washes off all deposits which the incoming water has left on the mesh in passing through. The screens are kept continuously revolving by a 6 h.p. motor and can be driven at different speeds. The water spray for washing is supplied from a pump driven by a 12 h.p. motor. A brick-work culvert 4 ft. 6 in. in diameter and 290 yds. long conveys the water to the power station itself. Behind the screen at the entrance to the culvert is a circular penstock, 54 in. diameter. The power station end of the culvert is provided with a similar penstock. This allows the culvert being entirely shut off both ends for the purposes of repair or cleaning. On the station side of the second penstock is the suction culvert, 7 ft. in diameter, from which the circulating pumps, one for each machine, draw their water. These pumps are sunk in separate pits to the level of the suction culvert. The three circulating pumps for the British Thomson-Houston and the two Zoelly machines are of

mechanism, with the meters and exciters, is mounted on the front of a wall, the other side of which are the actual switch units.

The centre of the board is taken up by the four generator panels, together with their exciter switchgear. From this position the switchboard attendant has a full view of all four generating units. Ten split conductor feeder panels, three transformer panels and one inter-connector panel comprise the remainder of the board.

Synchrosopes and voltmeters are mounted, on swing panels hanging from the wall in full view of the operator. Indicators are fitted to all switches to show whether they are in or out. Overload relays with time-limits are fitted to feeder and generator switches, and each generator is provided with balanced protective gear of the Merz Price pattern.

Auxiliary Switchboard.

In the turbine room itself are Reyrolle ironclad type boards controlling the motor driven auxiliary plant. An automatic



FIG. 7. BACK VIEW OF THE MAIN SWITCHGEAR AT BLACKBURN MEADOWS.

centrifugal type with a diameter of 24 in. The first has a duty of 576 000 gallons per hour against a head of 53 ft., and each of the others is capable of delivering 438 000 gallons against the same head. Each of these pumps is driven by a motor, the first of 200 h.p., and each of the others approximately 175 h.p.

The Parsons machine has a 30 in. centrifugal pump of Gwynne's twin type, capable of giving 978 000 gallons against the same head. It is coupled to the motor that drives the air pumps. The discharge from the condensers can be either turned back into the river, which it then enters about 100 yds. below the inlet, through a culvert 4 ft. 6 in. in diameter, or to a spray-cooling pond, through a 40 in. cast-iron discharge main.

Cooling Plant.

The cooling pond (Fig. 6) has a superficial area of 61 500 sq. ft., and with an atmosphere of 60°F., and a humidity of 75 per cent., will cool 1 111 000 gallons of water per hour through 20°F. with a top temperature of 100°F. The 40 in. discharge main delivers to thirty distributor pipes extending over the pond, each fitted with twenty-six spray nozzles. After being sprayed the water falls into the pond and is led to a centre main channel. Flowing by gravity over a sill it returns into the return culvert. This spray-cooling plant can be used either independently or in conjunction with the river, or entirely cut out of the circulating water circuit. Any section of the distributor pipes can be isolated as a unit and the system is capable of easy extension.

Switchboard.

The main switchboard (Fig. 7) is made up of units of totally enclosed Reyrolle ironclad gear. The whole of the operating

throw-over switch provides for any auxiliary to be run from any machine.

Separate lighting and power distribution boards are placed at convenient points in the station, and these are supplied from the auxiliary boards, and in turn supply to the motor and lighting circuits.

We have to thank Mr. S. E. Feilden, general manager Sheffield Electric Supply Department, for giving us facilities for describing this station and for the loan of the blocks illustrating the articles.

Institution of Electrical Engineers.

A Special General Meeting of Corporate Members and Associates of the Institution of Electrical Engineers will be held in the Lecture Theatre of the Institution, Savoy-place, Victoria Embankment, London, W.C. 2, on Thursday, November 17, at 5.45 p.m., for the purpose of considering and if thought fit passing the following resolutions:

1. That the Institution be wound up voluntarily and that Sir James Devenshire, K.B.E., of Electric Railway House, Westminster, S.W.1, and Percy FitzPatrick Rowell, of Savoy Place, Victoria Embankment, W.C.2, be appointed liquidators for the purposes of such winding-up.
2. That the property of the Institution remaining after the satisfaction of all its debts and liabilities be given or transferred to the Institution of Electrical Engineers incorporated by Royal Charter dated August 15, 1921.

Should the above resolutions be passed by the requisite majority they will be submitted for confirmation as Special Resolutions to a further Special General Meeting of Corporate Members and Associates of the Institution which will be held at the same place on Friday, December 2, at 5 p.m.

ELECTRIC COOKING AT KENSINGTON.

Details of the Latest B. & K. Enterprise.

Since May, 1912, the B. & K. restaurant, owned by the BROMFON and KENSINGTON ACCESSORIES COMPANY, has been a bright spot in the development of electric cooking. It has provided in an area some what disapproved in that respect a meeting point where families, friends and business men may lunch and dine in comfort, and has been the means of collecting a wealth of experience for those who are responsible for conducting its affairs. We assume that in both these fields its establishment has been justified, for as we saw on Tuesday evening last week an extension to the restaurant accommodation has become necessary, and the Company have taken advantage of this development to modernise the electrical equipment installed, and to provide further facilities for what in another industry would be called the "off-licence" trade, i.e., to sell cakes and other electrically cooked comestibles to people who will take them away in paper bags. This enterprising policy has, in fact, been a characteristic of the Company's activities since the very start, and they have never hesitated to scrap equipment when it has failed to fulfil its purpose, or when something else has been designed that rendered old methods out of date.

designed that may be said that in the B. & K. restaurant electric cooking has been, and will continue to be, conducted in spotlessly clean kitchens under the exacting conditions of daily commercial practice, and so will provide a revelation of any weakness in design or need for improvement in construction, a policy that in the past has enabled the makers to claim for the B. & K. cookers that they approach the ideal of an apparatus which will carry out continuously and without risk of mechanical or electrical failure the work for which it is intended. Or, put in another way, it is claimed that the B. & K. electric cookers have been perfected by the direct experience of their makers and not as a result of complaints by users.

Details of the Extension

The extension to the kitchens and restaurant which has now been opened consists in converting the original kitchen into a further dining-room, as shown on the plan in Fig. 1, thus giving an additional seating accommodation of 25 per cent., in providing a pastry counter in what was the main restaurant on the ground floor, and in building extensive additional kitchens, sculleries, and stores for meeting the demands of the increased accommodation. How this has been carried out in detail will be gathered from the description which we give below.

Starting with the servery which forms the distribution base for the whole restaurant here we find electrical apparatus with a total loading of 15.3 kW, and consisting of a three dish carving table, a hot cupboard which will accommodate 800 plates, and a heated serving shelf. A unique arrangement of counterweights for the dish covers has been fitted to allow the maximum lift in a low-ceilinged service room. The hot cupboard is mounted on rollers to

ensure cleanliness. Here are also aluminium soup tureens, with domed bottoms and detachable hinged lids. These are let in to a slate serving table, under which a water bath is constructed at a

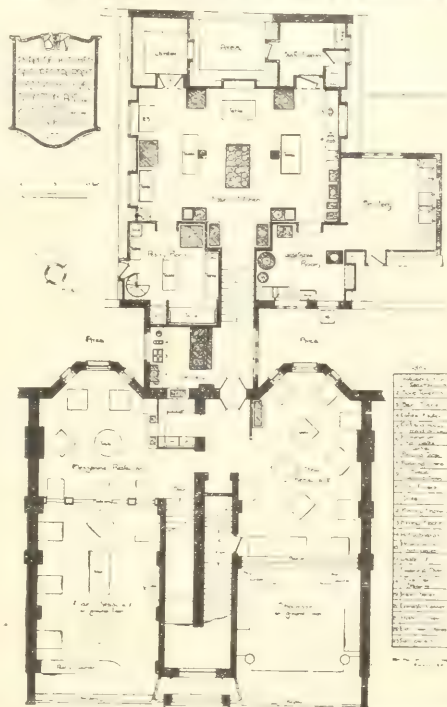


FIG. 1. PLAN OF THE NEW B. & K. RESTAURANT AND KITCHENS.

temperature of 210°F. The capacity of each tureen is 3½ gallons. Other useful apparatus is a vegetable bain marie, which has been

bain marie, which has been specially designed with four compartments, so that steam only can come in contact with the vegetables thus maintaining them without drying, at a high temperature until required, and a coffee bain marie consisting of two four-pint porcelain coffee jugs and one porcelain milk jug. It may be noted that water is supplied to all the above bain maries and water baths from the hot water system at a temperature of 150° F., and is quickly brought up to simmering temperature, about 210° F., and maintained there by means of immersion heaters of low rating. Tumblers, jugs and vegetable compartments are refilled from the kitchen as and when necessary.

Grilling and Toasting.

The grill in the servery is complete with a small hot cupboard and is supported by wall brackets fixed at such a height that all grilling and toasting operations can be carried out at the most



FIG. 2. THE NEW MAIN KITCHEN AT THE B. & K. RESTAURANT, NO. 15, A MONASTERY.

and a convenient view point without stooping. Two three-heat switches are provided so that when the grill is being used intermittently, the switch may be turned to "low," "medium," or "quarter heat." This will maintain sufficient heat in the fire bars to allow them to regain their maximum working temperature within a few seconds of switching on to "high."

An aluminium plate warmer is fitted in the service counter

of meat at once. In order to adapt this oven to the peculiar requirements of the restaurant, it has been sub-divided into four compartments by means of a series of thermally insulated baffle plates and detachable drop doors so that the oven can be used as a 1, 2, 3 or 4 compartment oven of varying sizes at will. As each compartment is separately controlled a very wide range of totally different classes of cooking can be carried on simultaneously.

The temperatures ranging from as low as 120°F. in the bottom oven, for proving or drying meringues, through the varying higher temperatures required for casseroles and roasting, up to the temperature of between 450 and 500°F. for French pastry in the top oven.

The equipment of the main kitchen is complete with fish fryers, grills, mincing machines, Hobart pastry mixer, two small hot cupboard with vegetable bain-maries and two aluminium platewarmers.

The Vegetable Kitchen and Scullery.

Leading off the main kitchen on the right is the vegetable kitchen and scullery, where the boiling and steaming of vegetables, together with all other steaming operations, are kept entirely separate from the main kitchen for the sake of convenience and cleanliness. The garbage and litter unavoidable in the preparation of vegetables is thus central-

ised and quickly disposed of by means of the waste lift which carries all refuse from the vegetable kitchen direct to the bins in the area below. Hence the reason for the complete absence of flies in any of these model kitchens during the exceptionally hot summer we have just experienced.

supplying the downstairs room. These plate warmers are also fitted in each room of the restaurant so that during the heavy rush hours food is kept at a high temperature until it reaches the customers.

The following food temperature figures showing the small loss of heat that takes place between the servery and the tables in the various dining rooms may prove of interest.

	In Servery.	At Table.
Soup	160 F.	135 F.
Vegetables	155 F.	130 F.
Coffee and milk	160 F.	140 F.
Blanchette of veal	Not taken	140 F.
Roast beef	120 F.	120 F.

The maximum temperature of liquids and solids for convenient consumption is 140°F.

The Main Kitchen.

Leading from the servery up a broad flight of stairs are the main kitchen (Fig. 2) and the vegetable and pastry kitchens. These kitchens are clean, bright, and well-ventilated. There are no fumes, the layout being well balanced and convenient with the apparatus well above the floor level. No stooping or bending is called for. All the controlling devices are placed at a lower level than that required for cooking. All tables and cupboards are mounted on rollers. No wires or cables are visible anywhere, and the fuses are conveniently placed but unobtrusive. There is an indicating lamp to every switch. The lighting is effective and diffused from a hidden source. There is also a plentiful supply of hot and cold water. All floor corners are rounded, and there is no possible hiding place for dirt or vermin. There, we may add, are no flies either in or on the "B. & K." kitchens.

Kitchen Equipment.

Turning to the equipment of the kitchen, the central boiling table comprises two model "F" boiling tables, each fitted with six 2 000 W "Universal" boiling plates. This boiling plate is claimed to be the best on the market, because it is simple in design, efficient in operation, and reliable in practice. Other points about this range are—free approach from all four sides, and the employment of strong cast aluminium utensils with machined bottoms and corners externally square and internally rounded to insure efficiency and cleanliness.

The roasting ovens are of the model "F" construction and are each of 12 cub. ft. capacity. The model "G" oven is of a gargantuan character and has a capacity of 28 cub. ft., or in other nomenclature will accommodate about 2 cwt.

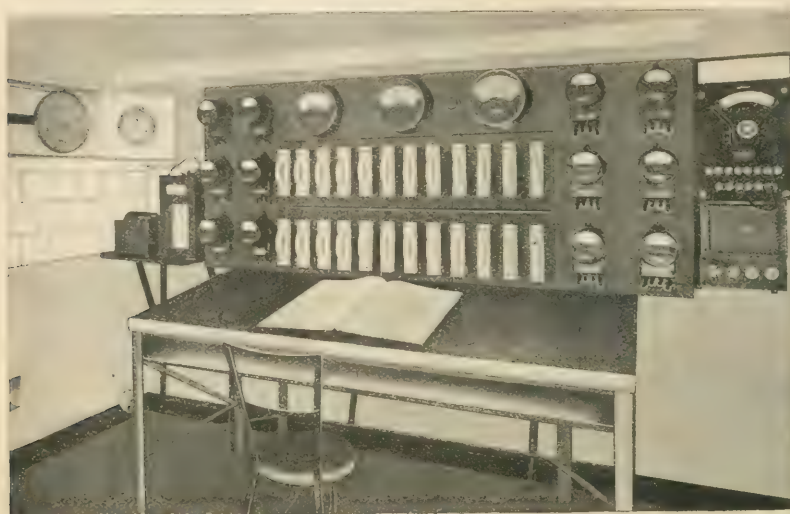


FIG. 3. THE CONTROL ROOM OR NERVE CENTRE.



FIG. 4. VIEW IN THE MAIN RESTAURANT.

The equipment in this portion of the restaurant consists of a steaming oven fitted with five galvanised wire baskets, each capable of accommodating 25 lb. of potatoes, or, when required, fish, sweet puddings, &c. The heating elements are of the immersion heater type, thus insuring a very high efficiency in operation and easily replaced if necessary. There is also a five-tier steamer for similar operations to the above, and a large 30 gallon boiling pan is also installed, together with a model "C" domestic cooker, which is used in this case for the roasting of potatoes and the preparation of specialised vegetable dishes.

Adjoining this kitchen is the scullery for washing, cleaning and storing all cooking utensils. On the opposite side of the main kitchen are two further rooms, the staff room and the larder; the latter cool, clean and bright.

The Pastry Kitchen.

* Immediately opposite the larder and to the left of the main kitchen is the pastry kitchen. This is equipped with one two-tier pastry oven which supplies the whole of the confectionery department with French and English pastries. The excellence of the "B. & K." pastry, we are told, is due in a large measure to the certainty of results obtained from this oven where the elimination of all variables or guess work, which is the predominant feature of all electric cooking, is more pronounced in this branch of the culinary art than in any other.

Following the system in the main kitchen, all the tables are placed on rollers, a feature also applied to the two galvanised iron flour bins. This gives the additional advantages of convenience and space economy, the bins being pushed under a table when not required.

The pastry kitchen is in direct telephonic communication with the confectionery counter just as the main kitchen is also in contact with the Restaurant Manager's Office, thus facilitating the smooth running of the whole establishment. In this kitchen is the main supply lift from the stores. This supplies the whole of the kitchens and does away with the necessity of any superfluous traffic through the servery.

The Control Room.

From the pastry kitchen a circular stairway leads down to the control room (Fig. 3) which is situated immediately beneath the kitchen and is the nerve centre of the whole establishment. It consists of a very complete equipment for recording the consumption and measuring the temperature at which each and every cooking operation is carried out in the kitchens. To attain this end, a separate watt-hour meter is connected in circuit with each oven, boiling table, fish fryer, &c., in the various kitchens. In this way it is not only possible to obtain the overall consumption for the whole kitchen for any period of time, but it is also possible to check the consumption on any single piece of apparatus. A recording ammeter is also installed which can be connected in series with any piece of apparatus on test so that a diagrammatic record of the variation of the loading may be obtained.

The temperatures are efficiently checked by means of a multiple electrical distance thermometer. A platinum resistance thermometer is fitted not only in each oven, fish fryer, hot cupboard &c., but also inside and outside the main kitchen in order to get a comparison of the actual working temperature in the kitchen with that of the atmosphere outside. These thermometers are connected to a galvanometer in the control room, so that an immediate and accurate reading of the temperature prevailing during any cooking operation may be obtained at any moment. The equipment in the control room is completed with an electric clock synchronised with every clock in the building and a Cardew open dial voltmeter.

As will be seen from a tour round the whole restaurant establishment the utmost use of electricity is made throughout the whole establishment through the multifarious operations connected with the preparations of cooking and serving of meals down to the electric cash registers, signs and plate washers. With regard to the latter a very efficient and up-to-date teak plate washing sink, electrically operated, is installed in the basement for cleansing all

the plates, dishes, &c., from the restaurant. One attendant can deal with as many as 1 000 plates per hour which are soaked, washed, sterilized and dried with the minimum of labour. It is hardly necessary to add that electrical engineers and others who want an efficiently cooked and tasteful meal in pleasant surroundings see



FIG. 5. THE NEW RESTAURANT, SHOWING LIGHTING ARRANGEMENTS.

Figs. 4 & 5) cannot do better than visit the "B. & K." restaurant with the least possible delay.

New Sub-Station at Bethnal Green.

THE third of the transformer stations equipped by BETHNAL GREEN (LONDON) BOROUGH COUNCIL was opened on Monday by the Mayor, Councillor J. J. Vaughan. The building, which has been adapted for the new station was until recently an institute.

The Chairman of the Electricity Committee (COUNCILLOR J. J. CUNNINGHAM) gave a short account of the history of the Bethnal Green supply. The Provisional Order was obtained in 1899. Sir John Small drew up a scheme, and it was adopted by the Council in 1912. The Council did right in not undertaking generation, for many of the existing seventy generating stations were going to be scrapped. In 1914 the Council entered into an agreement with Stepney for a bulk supply, and appointed Mr. H. W. Couzens, consulting electrical engineer. The transformer sub-stations at the Digby-street depot and New Tyssen-street were opened in 1916. The services connected were 101 at the end of September, 1918, and 781 (with a further 115 in progress) at the corresponding time this year. An income from the sale of current of £21 420 and a small surplus over expenses were anticipated for the year ended March 1922. There were connected with this new sub-station a 1 sq. in. three-core h.t. feeder from New Tyssen-street and another of smaller size from Digby-street, so that there was an alternative means of supplying energy to the new station. The transformers were one of 500 k.W. and one of 250 k.W., one being connected on either side of the h.t. switchboard. The l.t. side of each transformer was connected with the l.t. switchboard, from which ran three 0.5 sq. in. feeders, which fed into the distribution network at different points. Mr. Couzens had prepared the specifications and superintended the installation work. The contractors were the British Insulated and Helsby Cables (Ltd.), for cables; the Hackbridge Electrical Construction Company, transformers; Metropolitan-Vickers Electrical Company, switchgear; L. G. Tate & Company, wiring; Dorman, Long & Company, steel and iron work; and Higginbottom & Mannock, travelling crane. In conclusion, he wished to thank Mr. Tapper, the chief engineer of the Stepney Electricity Department, for his able assistance.

THE MAYOR OF BETHNAL GREEN, who performed the ceremonies of coupling-up the connecting links and declaring the station open, remarked that he obtained his livelihood in the electrical industry. In that little sub-station he saw the forerunner of many such stations, which would be brought into existence for the purpose of enabling the residents of London to get cheap electricity. There was no more economical energy than electricity when properly used. While they were fortunate in getting Stepney to co-operate with them, he did not quite agree with Mr. Cunningham that the policy of taking bulk supply in preference to establishing a generating station was the right one. He looked forward to the day when meters would be a thing of the past.

A Self-Contained Instrument Works.

Modern Manufacturing Methods.

Great as the advances have been in the design and manufacture of all classes of electrical apparatus, it will probably be agreed that the greatest improvement is to be found in the methods of applying the science of electrical measurements to industrial conditions. Cumbersome silver voltmeters and non-portable electro-dynamometers have given place in the course of only a few years to compact voltmeters little larger than watches and testing sets which are not only portable, but are capable of standing the roughest of operating conditions. This advance, it is only right to note, has been accompanied by a large increase in the accuracy of the measurements recorded, by a reduction in price and by a widening in the number and range of the quantities that can be measured. The first two of these contentions are axiomatic and, as an example of the third, we may refer to the design and manufacture of recording instruments of all kinds, and especially to the construction of ohmmeters, whose development, as we pointed out only a short time ago, for a time lagged somewhat unaccountably behind that of other electrical measuring instruments.

A Real Advance.

That this advance, which is a very real one, has not been automatic, was sufficiently evident from what we saw on a visit which we recently paid to the Collindale Works of EVERETT, EDGUMBE and Company at Hendon. The electrical measuring instruments turned out by this firm have long enjoyed a justly high reputation, but reputation, like capital, must be treasured rather than expended and Mr. Everett is therefore constantly considering new details of construction. These, of course, include such points as interchangeability, quantity, production, due economy of material, and regard for finish, while Major Edgcombe, by testing and theory, is examining methods whereby further improvements may be introduced in marketable form. This is no sinecure, in view of the very wide scope of the firm's products, varying as they do from geographical instruments to lightning arresters, and from photometers to protective relays.

Super-Scale Instruments.

Before describing the methods followed to attain this end and the actual arrangement of the various shops in the works, we may instance as an example of what we have just said the "super-scale" instruments which the firm placed on the market a short time ago. The primary object of these instruments is to provide a large and very open scale so that clearness and accuracy of reading may be obtained with a minimum of trouble; without too close inspection. Thus to modify the scale may appear a simple matter, but, as a fact, it has necessitated several slight departures in the design of the instruments themselves, particularly in the pointers and movements, and generally owing to the need for strengthening the construction of the moving parts. This in its turn has necessitated much experiment and re-organisation, which has been justified by the somewhat unexpected development, for these instruments bid fair to displace what have up till now been regarded as standard patterns.

The History of the Firm.

A few notes on the history of the firm may be inserted here. Everett, Edgcombe and Co., was originally founded in 1900 with works at Charterhouse Square, but owing to the expansion of the business these premises soon became too small and a move was made to Saffron Hill in 1902. But even that change did not prevent congestion and these premises rapidly proved too inconvenient and cramped for the development which was taking place, so that a move was made to the present site alongside the main Edgware Road in 1905. Since that time the works have constantly been extended, and now occupy 1½ acres of ground. A general view of the present layout is visible from the aerial photograph which we reproduce in Fig. 1. It will be noted that there are three main buildings, the principal of which contains the office accommodation, machine shops and, in an extension, the large test room and stores. One of the smaller buildings contains a small brass foundry, while in a third building are die-casting shops, grinding shops and plating shop, and, on the first floor, rooms where enamelling and lacquering operations are carried out. It is interesting to note that the works are very nearly entirely self-contained, for, with the exception of iron castings and such accessories as glass and certain moulded insulating parts, the whole of the parts required in the instruments manufactured is prepared and machined on the site from the raw material.

Case Manufacture.

Turning to the operations in more detail, a particular feature is made at Hendon of the manufacture and finishing of the cases and fronts for the various instruments. The standard pattern case used in Everett, Edgcombe's instruments is of cast iron. The rough casting is carefully ground down smooth, and is then enamelled and polished in the appropriate shops. Before this, however, the rims are nickel-plated in the plating shop, where also the plating or coppering of various other parts which require this treatment is effected. In the die-casting shop the various white-metal parts required in the instruments—such as the dash-pots in the moving iron instruments—are prepared. These parts where required are cast round brass-tapped cores so that the necessary fastening screws can be easily fitted. Contrary, perhaps, to expectation, it is found that this arrangement is really more economical than obtaining such parts from outside specialist firms, not only on account of the special designs which are required for instrument work, but owing to the speed with which parts comprising the many designs may be obtained in emergency. This emphasises the self-contained character of the works, as does the statement that even the white-metal melting-pots used are made at Hendon.

The enamelling and stoving departments are situated in the upper part of the building which contains the die-casting shop. The enamelling consists of providing a dull, black coating both inside and out of the instrument first, and subsequently placing a polished coating on the outside and a white enamel coating on the inside, stoving, of course, taking place between each operation. The lacquering of the instruments and the insertion of the glass in the case is also effected on this floor.

The Machine Shop.

Turning now to the machine shop we find a very complete line of capstans and automatic lathes for preparing all the various instrument parts even down to the screws. Also to be found here are multiple spindle-drilling machines, which are particularly employed on the machine work of the cases, while there is the usual range of milling machines and planing machines for carrying out the heavier work. Special mention among the milling machines may be made to those which are employed for milling the pole pieces. The machine shop also contains the raw material store, whence, in accordance with modern practice, all the material is issued to the machines on the usual checks. The parts are passed from the machine shop into the finished parts store, where they are issued in the usual way to the assembly shop. Also in conjunction with this part of the works is a very complete tool-room with its own store.

Works Generating Plant.

It may be mentioned that the works has its own generating plant, this being provided by a 50 h.p. gas engine, driving a dynamo, which is placed in a separate building close to the machine shop. A small gas engine is installed in a room adjacent to the machine shop itself. This, in the case of an emergency, can be used for driving the various tools direct. This arrangement was necessary in the early days owing to the absence of public supply, but the latter is now available from the mains of the North Metropolitan Electric Supply Company and is used in conjunction with the firm's own generating plant, especially for the supply of current for testing purposes.

As might be expected, therefore, the switchboard in the generating station is rather more elaborate than is usual in works, and contains panels for controlling the alternating current supply from the company's mains for the motor generators which are installed for test purposes and for the lighting supply at 110 V.

The Assembly Shop.

Adjacent to the machine-room is a shop where the movements for the various instruments are assembled. Here we were particularly interested to see the careful design of the pointers which are employed in the super-scale instruments, extreme lightness, with no reduction in strength, being obtained by the use of a modified truss construction. The moving coil instrument movement itself has also been lightened by modifying the design of the pointers. This question of weight has also been one of the problems in connection with the design of the super-scale instruments, as the bigger angle covered by the pointer requires a careful redistribution of parts when compared with the standard pattern of instrument. As regards the mounting of the movements, the necessary jewels are carried in small plugs sliding in the central core. These

are pressed outward by a light spring, and are locked by grub screws. The pivots are returned from the former of the moving coils, so giving greater freedom for the control springs and stronger support for the pivots than attachment to the winding of the moving system. Besides the assembly of the movements themselves, the instruments are really practically built up in their cases in this shop. This applies equally to instruments of the ordinary kind as to the fixed and portable and switchboard transformers, the assembly of recorders and portable instruments generally, metrometers, reverse relays, resonance frequency meters, speed indicators, synchroscopes, testing sets, flame-proof instruments, rail bond testers and other instruments made by the firm. Fig. 2 shows a view in this shop.

ment consists of a graduated disc about 6 in. diameter, which revolves on a vertical axis at a speed of one revolution per second. The disc is driven by a flexible shaft and can be kept from rotating by a pair of rubber-faced grips, which are controlled by a solenoid in the circuit of the relay that is being tested. When the current is switched on the disc is released and revolves until the relay operates, when it is gripped and held fast. In this way a measurement of the time taken to open the circuit can be obtained to a small fraction of a second.

In the foreground of Fig. 4 is seen a view of the machines used by the firm for scaling the instruments. During test each instrument is fitted with a scale of degrees, the current or other quantity, corresponding to about 10 points on the degree scale, being determined by comparison with sub-standard instruments.



FIG. 1. VIEW OF WORKS TAKEN FROM THE AIR.
FIG. 3. GENERAL VIEW OF TEST ROOM.

FIG. 2. UPPER MACHINE AND ASSEMBLY SHOP.
FIG. 4. SCALING DEPARTMENT.

Testing Department.

As will be seen in Figs. 3 and 4, the most elaborate and important part of the works is the test room, where, it is hardly necessary to say, all the instruments manufactured are carefully checked, calibrated and adjusted, and where a good deal of research work tending to improvements both in design and manufacture is carried out. In this connection we particularly noticed a photometer which is being designed for measuring the total flux. The details of this instrument have not been fully worked out, but they are predicated by the necessity, caused by the increased use of gas-filled lamps and protective fittings, of obtaining some method of easily measuring the total spherical candle-power instead of the average hemispherical candle-power.

Measurement of Time Lag.

Among the instruments to which particular attention has been given by Everett, Edgumbe and Co. are protective relays of various kinds, and an interesting instrument has been devised for testing and accurately fixing the time lag of these instruments. It is obvious in the case of an interconnected system that this is a matter of high importance in order that the various relays may operate in due sequence. This instru-

These results are tabulated on a card, and from them a polar calibration curve is thrown on the table of the scaler. The actual scale is then produced from this curve by a drawing-pen fixed to the arm of the scaler, and so an accurate interpolation of scale points between those found on the test can be obtained.

Electrostatic Instruments for Wireless Work.

Another interesting point which is now receiving consideration is the design of electrostatic voltmeters for use in connection with C.W. wireless work. These instruments are required to measure direct-current voltages up to about 20 000 V. For such measurements condensers are usually used with this type of instrument are, of course, not practicable, so that the whole voltage has to be placed on the instrument itself. This introduces some problems which have only recently been solved. In connection with this question of electrostatic voltmeters a difficulty arises even in their use on alternating current, when, of course, condensers can be employed owing to condenser leakage acting as a resistance and varying the reading as the frequency changes. To conserve this various ingenious arrangements of guard rings have been developed.

Electrification of the South-Eastern and Chatham Railway.

A comprehensive scheme for the electrification of the suburban lines of the South-Eastern and Chatham Railways has been formulated and is to be proceeded with as soon as conditions permit.

According to "Modern Transport" these plans embrace the complete electrification of the Committee's suburban lines within a radius of approximately thirty miles from Charing Cross. At the present time an enormous traffic passes to and from Charing Cross and Cannon-street Stations, but the Managing Committee appreciates the possibilities of the quicker and more frequent train service which would be possible with electrical operation. It was hoped that it would be possible to begin the work shortly after the conclusion of the war, but the financial and industrial conditions which have obtained during the last year or two have definitely prevented a commencement being made.

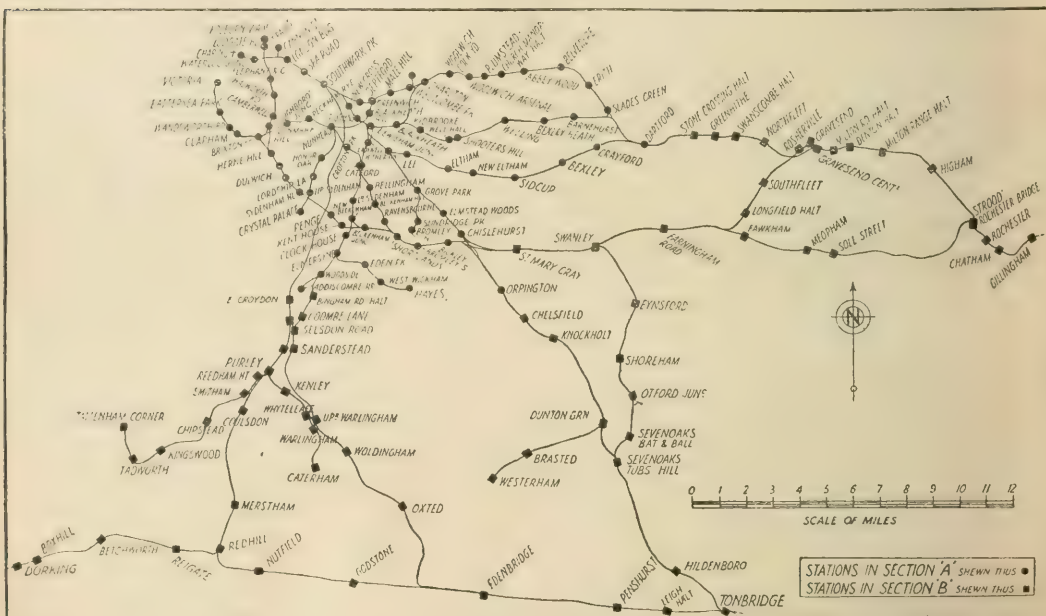
It is understood, however, that the Managing Committee may be making application to the Treasury, under the Government's new scheme, for a guarantee in respect of a loan sufficient to cover the

Traffic Operation.

In order that traffic may be electrically operated at the earliest possible moment, it is proposed that the scheme shall be undertaken by stages, and that, at the completion of each stage, a gradual increase shall be made in the scope of traffic to be worked electrically. Thus, at Stage I, suburban services will be operated to and from stations within Section A; at Stage II similar services will be run within Sections A and B; whilst, at Stage III, not only will suburban services be worked to all stations within Sections A and B, but also through passenger trains and goods traffic. Suburban services will in all cases be worked by motor-car trains; through passenger and goods trains, on the other hand, being hauled by electric locomotives.

Improved Speed and Frequency.

The proposed electrification of the railway will necessarily result in considerable increases in the speed of trains and frequency of



MAP SHOWING THE ELECTRIFICATION SCHEME TO BE UNDERTAKEN BY THE SOUTH-EASTERN AND CHATHAM RAILWAY.

cost of the first section of the scheme, so that the work may be undertaken at the earliest possible moment.

Division of the Work.

Having regard to the heavy capital expenditure now involved in undertakings of this nature, and, in order to bring first into commercial use that section of the area to be electrified which will return the greatest financial benefit and provide the greatest traffic relief, the work has been divided into two sections corresponding to the inner and outer suburban areas. The stations comprised in these two sections are shown on the accompanying sketch map.

Section A, which has a route mileage of ninety-four, and a single line mileage (including sidings) of 210, comprises the following:—North Kent and Greenwich lines; Bexley Heath line; Dartford loop line; main line to Orpington and the Bromley North branch; Mid-Kent and Hayes branch; main line to Bickley and Orpington; Crystal Palace and Greenwich Park branches; and Catford loop line.

Section B covers 140 route miles, representing 438 miles of single line and sidings. It includes the following:—The lines from Dartford to Strood, from Bickley Junction to Gillingham, from Swanley to Sevenoaks; from Orpington to Tonbridge and the Westerham branch; the Croydon line to Redhill and Dorking; the Caterham and Tadworth branches; the Oxted line; and the Redhill and Tonbridge line.

service. It is estimated that there will be a 30 per cent. average increase in speed and frequency of service to stations within Section A, whilst to stations in Section B the average increase in speed will be as much as 40 per cent., and in frequency of service 60 per cent. The congestion at the approaches to the two London termini will be overcome, as, by reason of the more rapid acceleration and increased speed resulting from electric working, the committee will be able to increase to a very considerable extent the number of trains passing London Bridge in the heaviest hour, and consequently to provide improved accommodation during business hours.

Electrical Equipment.

The equipment of the running lines will be of the direct-current conductor rail type, supplying energy to the train motors at 1 500 V. High-tension alternating-current will be delivered to sub-stations, whence, after having been transformed and converted to direct current, it will be fed to the conductor rail. The rolling-stock for suburban services will be of the motor-car type with "multiple-unit" control, which, to insure the greatest flexibility of service, will be permanently coupled up with units of three coaches, each unit consisting of two motor coaches each equipped with two 200 h.p. motors and one trailer coach. This arrangement will enable the committee to provide trains of three, six, or nine coaches, accommodating 256, 512 and 768 passengers respectively, in accordance with traffic demands.

Reviews.

Power House Design. By SIR JOHN F. C. SNELL. (London: Longmans, Green & Co.) 2nd Edition. Pp. xii. + 535. 42s. net.

In the introduction to the second edition of his universally known "Power House Design" Sir John Snell states that he has had "entirely to recast" some of the chapters which he wrote in 1911. The greater part of the new matter is in Chapter XI., but in many instances the text has been rearranged.

In giving costs, the author has adhered to pre-war figures, leaving his readers to apply, according to their judgment and the date at which they refer to the book, a factor which one may perhaps call "the factor of rapacity." It is interesting to note that, notwithstanding the whirl of capital stations in which the Chief Commissioner lives, he has not become a megalomaniac and in his introduction he makes the significant remark that there must always remain instances in which small power houses are required.

The general scope and character of the first edition are well known and are maintained in the second. The work is essentially practical throughout, and teems with information and figures which are of great use in preparing estimates of cost and space required, and in laying out the various essential parts of a new station. In places it may be thought that the treatment is not altogether uniform, some matter being in great detail, while other of like importance is more lightly sketched in. This doubtless arises from the fact, which is patent throughout, that the author is in most cases drawing on his own experience and has embodied matter which was in his possession first hand. As before, the book is well printed and profusely illustrated, five plates having been added and two old ones dropped out.

Chapter I., dealing with "Systems," is practically unaltered; in passing, it may be observed that it is probable that for the larger turbo sets contemplated in capital stations the pressure generated will be 10 000 to 11 000 V instead of 6 600 V, which is still put forward as the maximum pressure desirable.

Chapter II., comprising preliminary notes on the choice of site and type of plant, has been somewhat shortened. It may be noted that the author considers eight units of plant the ideal in order to allow for one being under repair and one a standby. Evidently he does not agree with the B.E.S.A. maximum rating, as he assumes the plant to be capable of a 25 per cent. overload. There is much to be said for reserve plant in the shape of overload capacity, inasmuch as such standby is in an instantly available form, whereas a reserve set has either to be kept hot or time must be lost in warming it up. In the next chapter detailed questions in regard to power station buildings are dealt with. There is little alteration from the first edition except in regard to the instances cited: in connection with these a verbal slip occurs in referring to "triple expansion steam *turbo* alternators" at Bahia Blanca.

Chapter IV. is devoted to "Steam Raising Plant," and has been extended by the inclusion of a detailed consideration of the kind and lay-out of boilers most suitable for stations of various sizes, and by an account of the advantages of oil-fired and gas-fired boilers, though no reference is made to pulverised fuel. When describing the storage of coal, it might have been worth while pointing out that the high prices of construction now ruling practically put silos out of court for this purpose, and some reference to the hydraulic and pneumatic conveyance of coal would have been of interest. Chapter V., on "Steam and Feed Pipe Systems," is practically unaltered except for the introduction of rotary feed pumps.

Chapter VI., dealing with "Steam Engines and Turbo-Generators," covers much the same ground as in the first edition. A description of the Brush Ljungström and Belliss and Morcom turbines is added, as well as useful

information in regard to the weight and performance of turbines. Some of the matter relating to direct-current plant has been omitted, though a long detailed description, with indicator diagrams, of a 1 500 B.H.P. reciprocating engine running at 188 revs. per min. is retained. Air filters are dealt with in this chapter, but no reference is made to the system whereby the same air is circulated through the machine and cooled—a system which is beginning to find favour.

Chapter VII., on "Condensers," is practically unchanged. On the other hand Chapter VIII., on "Gas Engines," has been largely rewritten; a considerable amount of the matter in the corresponding chapter in the first edition has been transferred to a later one and the remainder has been amplified. The author points out the limitations to the use of existing types of gas-engine-driven plant in large generating stations, and then considers gas engines and oil engines separately for stations of moderate size. Having described the kinds of gas engine available and the various types of producer, together with the use of ammonia recovery plant, he proceeds to give examples of typical gas engines, and then deals with their capital cost and operating costs. Oil engines are next dealt with and their value in small stations indicated.

The order of the remaining chapters in the book has been rearranged. Chapter IX. is devoted to practical notes on generators, motors, &c., and opens with the description of a 5 000 kW, 750 revs. per min., 25 period turbo-alternator as typical, this being the same machine as was described in the first edition, but reference to slow-speed alternators is omitted. It is interesting to note that the author favours direct-current motors for driving the auxiliaries, although recent practice tends in the direction of alternating-current motors, it being generally considered that facilities for varying their speed are not ordinarily sufficient justification for using direct current. The remainder of the chapter covers much the same ground as in the first edition.

Chapter X. deals with "Switchgear," and is identical with the chapter in the first edition except that examples are given of the switchgear at Buenos Ayres and Belfast.

The greater part of Chapter XI. is quite new and is of particular interest because it discusses matters which are very much to the fore at the present time. The author indicates the advantages and field of utility of capital stations, and shows how they may be economically worked in conjunction with less efficient stations already existing. He indicates the considerations to which regard must be had in choosing a site, and shows why colliery sites are seldom suitable. Specific examples of recent large power stations, with particulars of their lay-out, are then given and the detailed items of their capital and running costs. The author next deals with the number and size of units of plant, and points out the importance of high plant load factor. Small stations are then considered, and the bearing of the need for disposing of combustible refuse and for the use of steam for heating purposes. Generation in a local station and bulk supply are compared, and then pre-war capital costs of small power houses are given. The question of power generation in conjunction with the recovery of by-products is discussed, and the conclusions arrived at by the Nitrogen Products Committee in their Final Report are stated. The remainder of the chapter comprises the matter of Chapter XII. of the first edition and portions of Chapter VIII. of that edition.

The final chapter deals with hydro-electric power houses. The matter in the corresponding chapter of the first edition is somewhat rearranged, but most of the former examples of this kind of station are again given in illustration. After general remarks on water power and the choice of a station site, the methods of estimating the flow of a stream are outlined and the question of storage and of the civil engineering works involved are briefly discussed. The leading types of turbine are then described and their application to different kinds of fall. The portion relating to speed and efficiency and speed regulation is new, and a good deal of useful information in regard to capital and working costs has been added. C. H. WORDINGHAM.

Correspondence.

ETHICS OF MUNICIPAL WIRING.
To the Editor of THE ELECTRICIAN.

SIR: I have read Mr. Keats' letter on this subject, which appeared in the correspondence columns of your issue of Oct. 21, and also your editorial comment thereon. I entirely support your view that it is by encouragement of, and co-operation with, contractors that the best results are to be obtained. I cannot agree with Mr. Keats in his contentions, as, in my opinion, a body of enterprising contractors in any city engaged in vigorous canvas for work, which must be obtained if their doors are to be kept open, will do more for the electricity supply business than local authorities can do in the same direction. It has also to be borne in mind that contractors are not alone in having to reckon with overhead charges. The supply authority has to take these into account if the work is to be done on an economic basis. It is true that the authority is not looking for profit on this work, but their overhead charges are heavier, and go a long way to compensate for contractors' profit allowances. The shoddy contractor is always with us, but his class is few in number, and as an individual he does not live long. The average contractor is above using the methods adopted by him. On the other hand, where supply authorities go in for hiring schemes, it may be argued that the wiring entailed in connecting up cookers, &c., let out on hire or hire-purchase, is work which may quite legitimately be carried out by the authority's own workmen. I am, &c.,

Glasgow, Oct. 31.

R. B. MITCHELL.

To the Editor of THE ELECTRICIAN.

SIR: Relative to the correspondence in your columns as to whether electricity supply authorities (municipal or company) should be allowed to act as "universal providers" for the electricity supply industry, to a certain extent your contention is correct that "it is not equitable for a local authority to enter into competition with its own ratepayers." The supply side of the industry would like to devote their efforts entirely to ways and means of generating and distributing the "cheap and abundant supply of electricity" asked for, this being without doubt their legitimate portion of the work. That being so, one might go further, and say that the equipment of consumers' premises should be left entirely in the hands of contractors outside the supply industry, always provided that sufficient evidence was forthcoming that they were efficiently developing and energetically carrying out their part of the bargain. Generally speaking, however (there are a few exceptions), this has not been so in the past, and, therefore, if, as Mr. Keats very truly states, "the fine organisation of the gas companies is to be reasonably held and electricity developed," a more formidable means of meeting the opposition and the resultant development has yet to be found. Before the passing of the Electricity Supply Act, 1919, supply authorities had no powers, except by the grant of a Special Order, to develop a consumers' trading section, and, therefore, such work was of necessity left in the large majority of cases in the hands of the contractor. Section 23 of the 1919 Act alters this slightly, and supply authorities can now provide and hire out apparatus for use on consumers' premises. If advantage is taken of this section generally all over the country, we can safely assume that, as in the past, the usual opposition will be set up by the contractors, which, unfortunately, in former years did modify the proposals put forward by certain corporations as to hiring and so forth. While this was no doubt gratifying to the contractors' side, it was only additional evidence of their destructive policy, as, being unable themselves to finance a hiring-out scheme, they strongly objected to anyone else acquiring or making use of hiring powers. This, you will admit, is neither magnificent, nor is it war, but that it is possible for local traders to hinder development in this way merely emphasises the need for a change in the law.

There may be a ray of hope in Section 23 of the Act if

the contractors can be induced to work amicably with the supply authority and co-operate zealously in pushing to the utmost limits the advantages to be gained by the introduction of the clause, but in view of past experience it is doubtful if we can expect much.

If, therefore, future efforts of the contractors are to be of the "lukewarm" variety, then I say with Mr. Keats (though somewhat reluctantly) that supply authorities must tackle the job themselves (despite the fact that they have plenty to do otherwise), but they must be given more powers than those contained in Section 23, and I cannot do better than recommend the ideal aimed at in the Parliamentary Bill promoted by the I.M.E.A. in the early months of fateful 1914.

If such should come to pass, then, and only then, will there be any chance of Mr. Keats hiring his electric cookers at 2s. 6d. per quarter, *with no maintenance costs*—when manufacturers are called upon to produce in "mass" and give apparatus which can hold its own as a commercial proposition with our opponents, minus the "fancy" price. I am, &c.,

GEORGE FOWLER,

Superintendent of the Consumers' Dept., Dundee Corporation Electricity Supply.

Dundee, October 31st.

To the Editor of THE ELECTRICIAN.

SIR: With reference to the communication from Mr. G. W. Keats in your issue of Oct. 21. May I suggest that the very important subject raised can to-day only be dealt with upon its merits—that is to say, differently in different districts.

It appears to me that the day has passed for considering whether supply undertakings should take over the work of electrical contracting or not. In the electrical contractors we have a large, important and established body. The fact that they may vary in weight and skill in different districts only goes to prove that the policy of the supply undertakings may properly vary as between one place and another, and should be sufficiently flexible to permit of change as time goes by and alteration as circumstances justify it.

The position is not quite the same with gas. Although the gas undertakings generally carry out a good deal of installation work, and particularly additions and alterations, the fact remains that in most new buildings where it is decided to use gas, gas pipes are put in by the builders, who employ gasfitters as well as plumbers and carpenters. It is obvious that many large building firms are beginning to employ direct electrical labour in a similar way.

I am entirely at one with Mr. Keats in emphasising the extreme importance of the installation branch; upon its activity and prosperity depends to no small degree the growth of the supply undertaking and the benefit to the public generally of electricity. It is therefore most essential that every supply engineer should study for himself the best methods of stimulating activity and prosperity amongst those responsible for installation work. It is the more difficult to lay down any general rule for the whole country, because some of the undertakings already possess full wiring powers, others limited powers, and many none at all.

However, all undertakings are at liberty to hire apparatus, and we may at least hope that in the future some method may be found of carrying out hire-purchase without offence or injury to any section of the electrical industry. In the meantime, the general spread of a generous hiring policy will, as Mr. Keats has proved, do more than anything else to bring about electrical development.

I do not think we need regard seriously the statement that municipal engineers take up installation work to avoid stagnation. Those of us who have been municipal electrical engineers can afford to leave the observation unchallenged, whilst those who remain municipal engineers have not, I fancy, the time to bother much about it.

On balance there appears to be evidence to show that

the tendency towards co-operative working between supply undertakings and contractors is growing. Each section possesses plenty of energy and, generally speaking, enthusiasm for the cause, and anything which can be done to bring the various energy impulses into phase with one another will probably in the course of the next few years do more real good to the industry than anything else, and at the same time greatly increase the business getting efficiency of any propaganda or advertising work being carried out. I am, &c.,

J. W. BEAUCHAMP,

Director, British Electrical Development Association.
London, Nov. 1.

An After-Dinner Reflection.

By A. S.

I sat down to dinner last week with forty other men—a dinner cooked to a turn, and there wasn't a pound of fuel or a cubic foot of gas in the building. We had canapés, consommé, sole florentine, turnedos rossini, faisán roti (I got on to this one—it's roast pheasant) omelette surprise, Scotch woodcock, and real coffee. I say real, because so often it looks like rain. The dinner was hot, the plates were hot, the champagne was cold, and the guests comfortably warm. Followed smoke, and a limited amount of talk, naturally electrical, as was everything else.

Chairman, Government Official, and Electrical Man.

The Chairman spoke first—for the Directors—whose guests we were. He was followed by a Government official, whose duties brought him into close touch with the Company under the hospitality of which we felt a cheerful glow. Then a few sentences from a man very wise in all that pertains to things electrical. Finally, the Company's manager. Thus we had successively the views of the financier and man of large affairs; the man who is balanced, so to speak, between the corporation and the public; the man of science who applies the forces of nature to the use of the world; lastly, the man whose job it was to saturate his district with electrical energy. And I've been thinking about that last man ever since.

Cookers—Small and Brobdingnagian.

He had showed us over his kitchen, which was, to my mind, something like an oratory, with vaulted roof, stone floor, and an incense that knocked corners off any spikenard I ever smelt. He had exhibited cookers, small and brobdingnagian, hot plates, kettles, boilers, and an amazing long distance thermometer that instantaneously told the temperature in every oven, cooker, and room in the building. He demonstrated what it didn't cost to prepare a meal electrically, and how, for some reason or other, the business done by the pet restaurant he had organised was multiplying till the multiplication had become embarrassing. Then he led the way to the flower-decked table, and told us to do our worst.

He didn't say much after dinner, perhaps because the dinner was speaking for itself with a quiet, comforting voice that I, for one, found very reassuring. But while he spoke it seemed to me that he had found something more than merely occupation in his job. His mental fingers were on the pulse of the public—his public. He struck me as a man who had absorbed his life's programme till it took on something of the aspect of a religion. He might have been a monk, whose sense of humour was near his skin, and officiated with a certain priestly satisfaction at his scientific shrine.

Keeness and Deliberation.

He was keen, undeniably keen, but there lurked in his eye a whimsical gleam that suggested many things. If he had been an American, he would also have been an electrical crank, recognised, respected, and accepted as such. But, being a Britisher, he avoided the superlative, and said what he had to say with a touch of deliberation that gave no hint of the energy behind it.

It is a fortunate truth that the psychology of work encourages us to fasten our memories on our successes rather than the cost at which they were achieved. We would be a long-faced race were it otherwise. It is also fortunate for the progress of the world that there can be found at all times men who will contentedly take the bitter with the sweet. It must be a weary job to reduce one's brain to the level sometimes needed to make one comprehensible to certain individuals one meets. In the best managed undertaking there are opportunities missed and situations misread. To realise this, profit by it in experience, and go on to ultimate triumph is the highest office of human intelligence.

Blessed Electrical Industry.

It seems that the electrical industry is blessed in having such men. The unseen work they do is enormous. The good they do is great, and the seed they are sowing will spring to that which is greater still. That inchoate mass we call the public is hard to move, but it is beginning to stir. The momentum it will ultimately reach is beyond our present thought. And that will be the real compensation of the men who are doing the dog-work now.

Smokeless Fuel for Domestic Purposes.

The problem of treating coal by a preliminary process so that certain useful products can be obtained from it and the residue be still suitable for domestic purposes, is one that has recently been receiving close consideration. A solution would not only permit of economy in our fuel resources, but would result in availability of an almost smokeless fuel for domestic grates without any reduction in heating efficiency.

One of the most hopeful processes for bringing this about is that used at the Barnsley works of the LOW TEMPERATURE CARBONISATION COMPANY, which we recently had an opportunity of inspecting. This firm undoubtedly have produced a fuel which will give practically smokeless combustion in open grates, and at the same time they have extracted certain bye-products of value. The only doubt is whether the scheme is economically sound on the present capacity of the plant.

For to make any process of this kind a good business it must be possible to sell the low temperature product at some price equivalent to its fuel value. All coking processes are fairly high in capital cost and expensive to work, and any low temperature scheme will probably depend for its ultimate success on the price that can be obtained as against that paid for coal.

Details of the Process.

With this end in view a new type of continuous oven has which recently been installed at Barnsley, the particular features of which are the method of discharging the coked product without having to ram it out, and the discharging chamber, which is sealed from the atmosphere, in which the coked product cools. Twenty ovens are installed as a unit, and these are capable of a continuous production of about 30 tons of coke per day.

The charge is carbonized in an upright oven, which is divided longitudinally into three compartments by two perforated iron plates.

These iron plates can be moved together, enlarging the spaces between them and the outside walls. The coal is filled into these two spaces, the plates keeping it in position and keeping the coked product compact. The gases escape through the perforations.

Thus two thin slabs about 4 in. thick of the coked product are produced. At the end of carbonization a bottom door is opened and the two perforated plates moved towards one another. Thus the coked charge is dumped into the cooling chamber. The retorts are gas heated either from their own gas or from producers.

It is stated that for one ton of an average small slack coal the following can be produced: 14 cwt. of a smokeless fuel, 16 to 18 gallons of tar oil, 6,000 cubic feet of gas, 14 lb. of sulphate of ammonia, 2 to 3 gallons of motor spirit. The coal used in the low temperature process is generally two parts non-coking to one part coking.

The coke or coalite, as it is called, which is produced, is of a hard texture, and we understand travels well without the breaking up which was experienced with the fuels produced in the earlier attempts. The present price of the fuel is £3 per ton on site.

"Alubon" Aluminium Solder.

At a Press demonstration by the MELTAN ENGINEERING COMPANY of their "ALUBON" aluminium solder, the claim was made that a joint stronger than the metal itself could be obtained by its use.

There is certainly a great deal in this, for butt and edge to edge joints of pieces of sheet aluminium defied all ordinary efforts to break them, as did the corners of canisters soldered edge to edge without overlap, and aluminium rods soldered end to end stood a considerable amount of bending without showing signs of fracture.

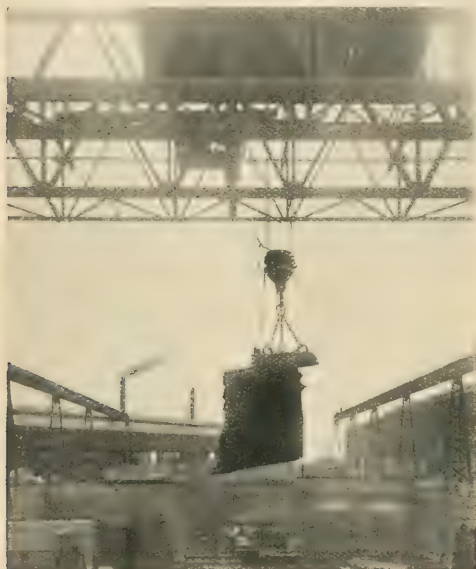
We were informed that this solder has proved extremely useful and cheap for big jobs such as gear boxes, the solder being simply run up the joint, an operation that can be done in a quarter of the time that would be occupied by welding.

It is also stated that "Alubon" is the only solder which will stand the boiling test—as far as is known—for an indefinite period. It is made in three grades, and the soft grade has been certified by the chemist at Woolwich Arsenal to have stood 26½ hrs. boiling without deterioration, which is 50 per cent. more than any other solder tested at the Arsenal.

We were shown a piece of soldered aluminium in the company's shops which had been boiling 79 hrs., the solder on which showed no signs of disintegration. No flux is required. The metal is filed to remove oxidation and then tinned by scratching in the solder with a wire brush, after which more solder is run on the joint with a blow lamp. The solder can be used for jointing aluminium or any of the aluminium alloys to either aluminium, copper, or brass, and cooling off in water does not weaken the joints.

A Large Lifting Magnet.

There has recently been installed, in an important British steel works, what is believed to be the largest lifting magnet yet constructed, certainly the largest made in this country. The magnet is 66in. in diameter, weighs 58 cwt., and is capable of raising a maximum load of 15 tons. It forms part of an installation for handling and breaking up scrap metal, and delivering it to the charging box for furnace filling. The complete equipment takes the form of a 25-ton overhead crane, which spans the road on which the metal is received, the scrap yard, and the road on which the charging boxes are assembled. The magnet is first used to unload the scrap. This consists largely of skulls—the linings of the steel ladle—composed chiefly of slag, not of great weight, but of thin section, bulky dimensions and extremely poor magnetic quality, containing but little metal, and therefore requiring a large magnet area to lift. The scrap is then placed into stock by the magnet, and delivered by the same means from stock to the breaking pit. The



LIFTING MAGNET IN OPERATION.

skulls are broken by means of an 8-ton ball. A round cracker ball is used so that in whatever position it may fall, it presents the same surface to the magnet. No centring device is necessary, and the magnet lifts the load on practically a point contact. After the scrap is broken up, the metal is removed by the magnet and fed to the charging boxes.

All these operations can be controlled and carried out by the crane driver, with the sole exception that when filling the boxes a ground man is required to rake into position the metal which is delivered in bulk over the row of boxes. The accompanying illustration shows the magnet at work. The speed of operation and the consequent economies effected will be evident. The magnet was constructed by the Witton-Kramer Electric Tool and Hoist Works at their Witton Works, near Birmingham.

A Dangerous Use of Electricity.

The ingenious Teuton has invented a device for lighting gas from the public electricity supply in a house or building. This device consists of a single flexible cord attached to a stick-like handle, at the end of which, so far as can be gleaned, there is a sparking point, probably with some little resistance in series. The flexible cord is either plugged into a socket on the wall or attached to a switch, and the device is used by turning on the gas and flickering the burner with the sparking point.

Of course the earth connection is provided by the gas stove, and where that is connected with a rubber pipe the running of a bare wire to connect the body of the stove with the metal gas piping is recommended. No doubt when used this device does light the gas, but may do all sorts of other things also. It appears to be against the rules of every supply undertaking, to be dangerous to the owners of the gas system, and to offer risk to the user both of shock and of fire, and would presumably produce difficulties with the fire insurance people. We hope no one will be tempted to use it in this country.

Bedford Electricity Extensions.

Important extensions of plant have recently been completed at Bedford, and the official inauguration took place on Saturday last. Supply was originally commenced on Dec. 6, 1894, and extensions were carried out in 1896 and 1898. Various additions were subsequently made to the plant, but no new buildings of a permanent nature were erected until 1904, when a building for stores was provided. Later this became a test room for meters, &c., and in 1917 a permanent stores and mains shed were built, the temporary buildings being removed to make room for the first instalment of the new buildings, which are of a substantial character and well-designed.

Condensing and Boiler House Plant.

Two concrete pipes, 3 ft. 6 in. diameter, convey water from the river to the cold wells affd from the condenser discharges back to the river. For purposes of the ash plant the condensers may discharge alternately either all or part of the water to a reservoir under the stoking floor. This reservoir discharges flushes of about 5 000 gallons by means of a swinging weir and conveys the ash across the road to the sump, where the water is filtered and returned to the river. The ash remains in the sump, and is periodically removed by means of a grab crane.

The new boilers are Babcock and Wilcox standard land type, four in number and set in pairs with the chimney between them. Each boiler is rated to generate 15 000lb. of steam per hour at 200lb. per sq. in. superheated 250° F. The stokers are chain grates, and can be used for forced or natural draught. The chimney, 100ft. high, is of steel lined with bricks to the top. The main flue is below the back of the boilers, and a tunnel alongside it provides the necessary access for removing flue dust, &c. Below the boilers are also the water duct for conveying the ash and the air duct for the forced draught, which is supplied by a "Sirocco" fan. In order to use the new boiler plant to greater advantage a connection has been made with the old steam range, so that the Westinghouse turbine in the old works can be supplied with steam from the new range through a reducing valve which reduces the pressure to 130lb. per sq. in.

Turbo-Alternator, Switchgear, &c.

The new turbine is of the Parsons reaction type, and drives an alternator at 3 600 r.p.m. generating 1 phase alternating current, at 6 600 volts. The new set is confidently expected to generate power for less coal, and the auxiliary plant has been arranged so as to enable light load periods to be dealt with economically as well as at higher loads. Two pumping sets are provided: one driven by a small steam turbine will deal with full load when the river is cold. The other, electrically driven, will assist the steam set at high loads when the river is warm, but it can also be used alone during light load periods.

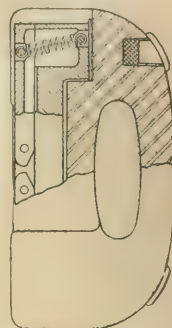
The exhaust steam from the auxiliary plant is used for heating the condensate and make-up water, which is returned to the boilers at about 200° F. The condensate is measured by a Lea recorder. Another recorder is installed which measures, records and adds up all water returned to the hot well for boiler feed purposes, and is a check on the boiler evaporation.

The 6 600 V switchboard consists of stone cubicles containing oil switches, isolating switches, and other details. These are on the first gallery. Each cubicle is entirely separated from its neighbour, and the access doors are interlocked so that the cubicle cannot be opened unless the switches are "off." The switches are electrically operated and controlled from the top gallery, where are also the instruments and indicators. This 6 600 V gear is linked up to the 2 000 V switchboard (1917) through three transformers.

A battery of fifty-seven cells, housed in the basement, operates the switches, lights the signal lamps and also some emergency lighting. It is charged by means of a mercury vapour rectifier.

Henley Fuse Links.

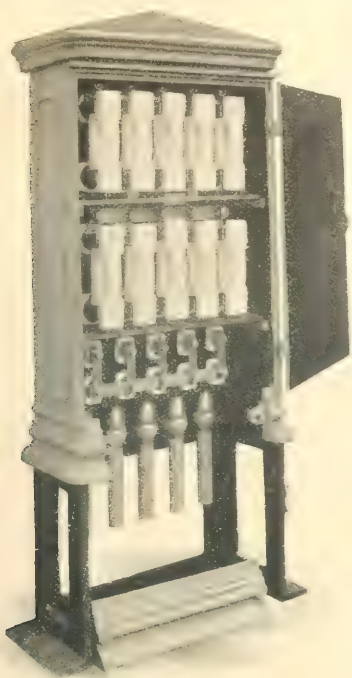
W. T. Henley's Telegraph Works Company, Ltd., have recently patented and put on the market a very useful form of quick break disconnecting link, which consists of a copper link fitted with an auxiliary blade or flicker at both ends, the whole being mounted in a heavy porcelain carrier, which is interchangeable with the well-known shrouded fuse carriers manufactured by this company. The arrangement provides a simple means of disconnecting under load, where it is impossible to use quick-break knife switches owing to the lack of room. For instance, they are now being largely used in feeder pillars and sub-stations, where the saving of space is an important feature. We understand these patent quick-break disconnecting links can be supplied from stock in all sizes from 60 A to 500 A for use on 500 V circuits. An illustrated description is given in Messrs. Henley's list W.O. 1, and the firm are prepared to send a complete sample link for demonstration purposes to any engineer interested.



PORCELAIN HANDLES WITH Q.B. LINKS.

Prescot Pillars.

The British Insulated & Helsby Cables, Ltd., Prescot, Lanes., have recently placed upon the market a NEW DESIGN OF UNDER-PILLAR, which represents the very latest development in the design and construction of electrical distribution pillars, complying fully with the exacting requirements of a thoroughly satisfactory pillar.



PRES-COT PILLAR.

The unit consists of a suitably stiffened enamelled sheet-iron frame carrying porcelain insulators, upon which are mounted the copper cable and busbar terminals. The sealing chamber for the incoming cable is screwed direct to the frame, and a compound-tight joint between the two parts is provided by means of packing. The sealing chamber is split to facilitate jointing, and to avoid the necessity of breaking the compound-tight joint aforementioned. Fuse clips may be readily changed without disturbing any other parts. The sealing chambers are supplied with brass glands, for plumbed joints to the lead covering of the cables, and armour clamps are provided if necessary. Units varying in size are interchangeable, and can be added to or removed from our standard pillars without the supply being cut off for more than a few minutes. The fusecarriers are of the shielded, cool-handle type, and fitted with self-aligning contacts. The illustration is a reproduction from a photograph of the actual pillar.

Foreign Competition for Electrical Contracts.

A communication has been issued to municipal electric supply undertakings by the chairman of the National Joint Industrial Council for the Electric Cables Industry, urging that no contracts for electrical plant and cables be placed abroad that can possibly be carried out at home. It is urged that by sending contracts abroad unemployment is caused in this country. The unsettled state of the foreign exchanges no doubt gives the impression that the foreign products were cheaper, but it must be remembered that to the cost of the foreign manufactures had to be added the cost of providing relief for the unemployed.

Edinburgh Corporation have remitted the letter to the Electricity Committee.

The result of the ballot of the members of the ENGINEERING and SHIPBUILDING TRADE UNIONS shows a small majority in favour of the WITHDRAWAL of the MUNITIONS BONUS in three instalments. Only a small percentage of the total members (about 2 000 000) voted, and of these 170 471 voted for the withdrawal and 147 630 against. The outcome of the ballot is, therefore, satisfactory, as it removes the possibility of a strike in two of the most important industries of the country.

The Finance of Unemployment.

The current "English Electric Journal" contains the following paragraph:—"It is not always realised what the loss to a nation through ordinary relief work is. Take a man earning £4 a week in an engineering shop and transferred through lack of employment to relief work at the same wage. His normal employer has a clear loss, in unabsorbed establishment charges, of £5 a week, on the moderate basis of establishment charges of 125 per cent. on labour. On relief work a good tradesman is inefficient and uninterested, and of the £4 a week which he is paid probably not more than £1 on the average has any permanent value. There is, therefore, a loss to the nation of £3 a week through this one man being turned adrift from his normal employment. An electric power station, on the other hand, or the electrification of a railway absorbs an enormous amount of direct labour per pound expended, and it is an important addition to the wealth and the wealth-producing capacity of the country."

A New Lamp-Holder Adapter.

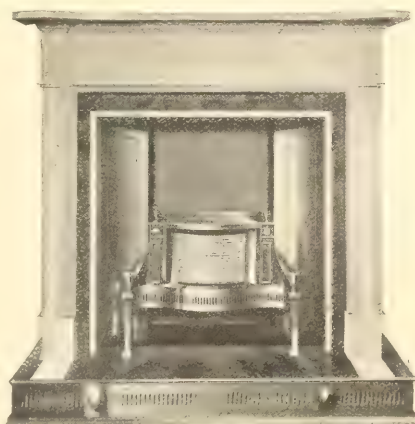
The illustrations given below show a new lamp-holder adapter recently put on the market by Messrs. J. J. EASTICK & SONS. The apparatus is made of polished brass or finished in nickel, and the



china portion of white china, highly glazed. The adapter is so arranged that the plugs project at an angle which enables it to be used without removing the lamp shade.

Carron Electric Fires.

The rapid development of electricity and its consequent general adoption for domestic purposes has created a demand for electric heating appliances designed and finished in harmony with the more substantial and dignified furnishings such as grace many of Britain's best homes. The dog grate, which has always been a favourite type of grate in decorative art, is particularly well fitted for adaptation to electric heating, and the Carron Company are fortunate in having at their command a unique selection of models of this popular form of fire. These include authentic period designs, many of which are admirably adapted to carry electric elements. The example illustrated shows a Carron dog grate finished in armour bright, having panels and kerb in the same finish, with marble surround and hearth, and appropriate mantel complete. Electrical engineers and contractors interested in better-class heating appliances should communicate



CARRON DOG-GRATE FIRE.

with the Carron Company, whose wide range of designs should meet the most exacting demands. At the company's West End Showrooms, 50, Berners-street, Oxford-street, W. 1, there is an extensive array of artistic electric cooking and heating appliances.

Trade Conditions in the Electrical Industry.

SIR ALFRED M. NEAL, in his report of the Cable Committee on the state of the electrical industry, made an important recommendation. He deputed a sub-committee of representatives of the Joint Industrial Councils of the electrical industry and the various associations connected with the industry.

In the course of his reply to the deputation, Sir Alfred said he appreciated the paralyzing effect of the uncertainty existing in regard to the future of electricity control in some districts. He was much impressed with the suggestions for assistance towards the payment of interest on municipal loans, and he would see that further information was given to local authorities on this subject. He was in full sympathy with the suggestion for postponing sinking funds until works became remunerative. Interesting announcements upon this and also upon the proposals for putting telephone work in hand, and speeding up a decision on railway electrification, might be anticipated within a short time.

A full account of the proceedings will be given in our next issue.

Legal Intelligence.

AN ELECTRIC COMPANY AND A DEBENTURE HOLDER.

AT the recent sittings of the County Court, Mr. Justice Anthony by Mr. C. Wreford Brown to be allowed to rank as a holder of £1,000 mortgage debenture stock (1916) in the Lobito, Benguela and Catumbela Electric Light and Power Company. Counsel for applicant said the Master of the Court had disallowed the debenture. The writ and notice of motion for a receiver of the company was served on June 26, 1919, and a receiver was appointed on July 11. Mr. Brown's debenture was signed and sealed, and the company was incorporated, and the debenture was issued on July 17.

MR. BYRNE (for the Receiver) said the Master had intimated it would be a fair compromise if Mr. Brown had his £1,000 back with interest, but not a bonus of 7s. 6d. in the £1, which he also claimed under a collateral agreement.

His Lordship intimated that he was in a compromise and he ordered the repayment of £1,000, with interest at 6 per cent.

ILLEGAL USE OF ELECTRICITY.

ON Saturday, the 10th, Mr. Justice Warrington imposed the maximum penalty of £20 on Thomas Jones, a local hairdresser, for fraudulently consuming electricity of the value of £2. Mr. S. Southall, who prosecuted, said before defendant occupied his shop, a supply of electricity was provided by the Corporation, but, on the change of occupier, the supply was given up, and the Corporation took steps to see that current should not be used. Recently an electric light was noticed in the front of the shop, and, as there was no meter, inquiry was instituted. The seals which had been put in when the supply was cut off were broken, and, by means of a thin wire, an improper connection was made with the Corporation fuses.

Defendant, who pleaded guilty and wrote an apology, had been in business for forty years, and hitherto had borne a good character.

The Chairman said the magistrates had considered sending the defendant to prison, but in view of his long residence and his previous character, they imposed the maximum fine, or one month.

Parliamentary Items.

ELECTRICAL SCHEMES TO RELIEVE UNEMPLOYMENT.

IN the House of Commons on October 27th, Mr. HANSON asked the Minister of Transport whether a large number of schemes relating to the development of electricity supply were at present under the consideration of the Ministry; whether those schemes were concerned with projects which presented opportunities for the employment of a considerable volume of unskilled and semi-skilled labour; whether several of the large schemes submitted to the Ministry could be financed by their promoters without any assistance from the Government, and could be undertaken immediately they received the sanction of the Ministry; and whether he would take steps to accelerate the adoption of those schemes with a view to the absorption of large numbers of unemployed into productive industry.

In reply, Mr. NEAL said the answer to the first three parts of the question was in the affirmative. The Electricity Commissioners were anxious to expedite the commencement of work, and would take every step in their power to secure that result. In reply to a question, addressed to the Minister of Labour, Mr. Neal admitted that the further facilities contemplated in the development of electricity supply would enable large numbers of men to be employed, and the Electricity Commissioners had that fully in view in their endeavours to expedite as much as possible their decisions upon the schemes submitted to them.

Replying to a question by Mr. Waterson, the Parliamentary Secretary of the Ministry of Transport, Mr. A. NEAL stated that he understood the preparation of the electrification scheme of the London and Tilbury Railway. The scheme was in an advanced state. The Great Eastern Railway Company had a scheme of electrification under consideration, but owing to financial considerations had not proceeded with it. He was communicating with all the principal railway companies, calling their attention to the financial provisions of the Trade Facilities Bill, and requesting them to consider what schemes they were able to inaugurate with a view to helping to find new work in districts affected by abnormal unemployment.

Electric Traction.

THE SUNDERLAND TRAMWAYS Committee is considering the advisability of establishing a superannuation fund for their employees.

THE ACRINGTON TRAMWAYS Committee has reported that even a restricted service of cars on Sunday mornings would entail considerable loss.

ENGINEERS of the NOTES and DERRYSHIRE TRAMWAYS COMPANY are engaged on a survey of a proposed tramway between Hemm and Ilkeston.

FOR the half-year ending Sept. 30, the receipts of COLNE Tramways were £12,697, against £14,208 during the corresponding six months of 1920.

A sub-committee of the CHESTERFIELD TRAMWAYS Committee has been appointed in order to consider the question of reduced, i.e., penny, fares on the tramways.

THE reduction of wages, which took effect on the 1st inst., will result in a saving of £10,000 a year on the working expenses of the LEEDS Corporation tramway service.

THE new tramway lines along Seymour Grove, MANCHESTER, have been completed, and provide an independent route between Chorlton and the city. The strike of the maintenance workers has not yet been settled, though the dispute will, probably, be referred to arbitration.

BLACKBURN TOWN Council have decided to include in their next omnibus Bill clauses to authorise the extension of the tramway system from Cherry Tree to Feniscowles, Billinge End to Borough Boundary and Wiltshire to Langho, and also powers to run motor-omnibuses within and outside the borough.

THE question of granting a renewal of the lease of the LIGHT RAILWAYS and TRAMWAYS in MIDDLESEX to the Metropolitan Electric Tramways, Ltd., for a further period of twenty years was before the County Council last week, but as members were desirous of obtaining further information as to the financial arrangements the question was adjourned.

Among the improvements likely to be made in consequence of the amalgamation of the L. & N.W. and the Lancashire & Yorkshire Railway Companies is the ELECTRIFICATION of the MANCHESTER-OLDHAM services and the Blackpool-Lytham and Blackpool-Fleetwood lines, plans for which are ready and only wait for a favourable opportunity for being carried into effect.

At the meeting of the LONDON COUNTY COUNCIL on Tuesday, Mr. A. Emil Davies moved that the Council make application to Parliament for the necessary powers, with a view to applying for the sum of £5,000,000, for the construction of tube railways within the country, and especially such as would link up South London with other portions of the Metropolis.

After discussion, the motion was defeated.

IN order to obviate unemployment, the LEEDS tramways department has adopted a scheme of work-sharing. A number of surplus men are to be "played off" for a full week, the decision being by ballot; the men are to be invited to contribute 1s. 6d. per week, or such sum as may be necessary, to pay the men drawn off an "almost equivalent" wage, and in default to have no claim if they are themselves "drawn off." Special duty or overtime is not to be worked.

FOR the Reading Corporation electric tramways department a WORKS COMMITTEE of five representatives of the management and five of the employees has been set up. It has been agreed that no matter is to be referred to the District Council without first being submitted to the Tramways Committee for consideration. Already the liability of employees for lost tickets and the disposal of property found in the cars have been discussed. The decision of the Tramways Committee not to allow dogs on trams has been rescinded, but they are to be charged for at the rate of the ordinary passenger fares.

BLACKPOOL Corporation in Committee have been considering the question of a proposed motor-bus service in the borough. As a municipal service was estimated by the electrical engineer (Mr. C. Furness) to involve a loss of over £2,000 a year, the Tramways Committee were recommended to allow private enterprises to supply the services required as a temporary expedient until such time as the Corporation can see its way to establish a municipal motor-bus service.

Motor-buses are already feeding the tramway services, and are linking up the out districts. The Watch Committee have renewed motor-bus licences granted to Mr. Wm. Smith for a service between Layton, Carleton, and Bispham, and have also licensed two additional buses to augment these services between Layton and Poulton.

EDINBURGH Tramways Committee has abandoned the proposal to convert the double cable tramcar trucks to the electric system, and the Council are now recommended to order fifty-one single trucks for the new electric system. The trucks will cost, with the necessary equipment, about £70,000.

THE residents of York-place recently protested against the proposal to attach brackets and rosettes to the buildings from which to spread wires diagonally across the street in connection with the electrification of the tramways. Strong opposition was manifested, and it was unanimously agreed to form a committee, with powers to act.

Electricity Supply.

A Special Order is being applied for by TRURO Council in order to establish electricity works.

LANCASHIRE Urban Council have decided to proceed with an electric supply scheme at an estimated cost of £10,000.

The TENBY Special Order, which was granted in 1915, will come into operation on Jan 1 next, and steps are being taken by the Council for the introduction of electric supply.

The directors of the DEAF and WALMER Gas and Electricity Company have decided, in view of the altered financial position of the undertaking, not to proceed with their electricity supply powers.

CHESTER Corporation is applying to the Electricity Commissioners for a Special Order authorising the supply of electricity within the area of Hoole Urban District and the rural districts of Chester, Tarvin and Hawarden.

The Electricity Commissioners have extended the time until March 31, 1922, for submitting schemes in the MID-LANCASHIRE ELECTRICITY DISTRICT. This is the fourth extension of time granted for this area.

The BURNLEY Electricity Committee recommend the Corporation to approve the scheme for the reorganisation of electricity supply in the mid-Lancashire Electricity District, and to authorise its submission to the Electricity Commissioners.

HURST Urban Council propose to apply for a special order to authorise the supply of electricity in the district. If obtained, the order will be transferred to Ashton-under-Lyne Corporation, providing the latter body agree to pay all costs.

CARDIFF Corporation Electricity Department is distributing a neat and well-illustrated booklet, entitled "Electricity for Domesticity," which should prove extremely useful in popularising the demand for electric heating, cooking and other domestic appliances.

The ALBERT MILLS, BARROWFORD, Burnley, are to be electrically driven and lighted. The motors are to be mounted on brackets fixed to the wall, and directly geared to the line shafts. The control apparatus is grouped together to facilitate wiring.

OLDHAM Town Council has approved the formation of an advisory board for the South-East Lancashire electricity area, but considers the establishment of a joint electricity authority to be undesirable.

As some of the municipal houses at PORTSMOUTH, which have been wired for the electric light, have not the necessary fittings, the Council has asked the Housing Committee to make an arrangement with the Electric Lighting Committee for supplying and fixing the fixtures.

A sub-committee, which has been inquiring into the condition of the plant of the LANCASTER Corporation Electricity Department, recommends the purchase, at a price not exceeding £5,000, of the electrical plant of the Caton Engineering Works, Lancaster. It will cost about £2,000 to transfer and re-erect the plant at the Lancaster station, and it is proposed to apply for sanction to borrow £8,000.

The Housing Committee of HAMMERSMITH (London) Council report, in regard to the loss sustained in supplying electric light to the tenants on the temporary housing estate at 1s. per week, that the Electricity Committee have been asked to install separate meters in each of the forty-two hutments, with a view to the tenants being responsible for the current used. If this course is adopted, consideration of the question of reduction of rent will be necessary.

The ELGIN Town Council has provisionally approved the hydro-electric scheme prepared for the INVERNESS Council by Mr. M. Buchan. It is proposed to supply electricity in certain parts of the north of Scotland, including Inverness, Ross-shire, Nairnshire and Morayshire. Mr. Buchan thinks it would be possible to supply electricity in bulk in Elgin at about 1d. per unit, and it could be distributed at from 2d. to 2½d. per unit. The water power would be derived from several lochs in the Strathcarron district, the principal being Loch Leuchart.

In consequence of a reorganisation of the staff, DOVER Electricity Committee has called upon the works and mains superintendents to resign their positions, failing which they will receive notice. Both were involved in the salaries' dispute in July last, and it is alleged that this is the real reason for the changes in the staff. If so, it is somewhat unfortunate, as it may lead to a revival of the dispute.

At Tuesday's meeting of SOUTHPORT Corporation the Electricity Committee reported that turbine No. 2, which broke down on Sept. 11, had not yet been repaired, and that, owing to the delay which had arisen, the Town Clerk wrote to the Brush Company asking when the new machine would be installed, and also for full particulars of the damage to the machine, and the cause of the breakdown. It was resolved that notice should be given to the company that, when repaired, turbine No. 2 will be fully tested on replacement, and that action be taken towards securing an extension of the maintenance period by twelve months after the erection and putting into commission of turbine No. 2.

A further step in facilitating the work at the new electricity station on the harbour estate was taken by BELFAST Corporation at a special meeting on the 26th ult., when it was resolved to apply to the Electricity Commissioners for sanction to loans of £550,000 and £52,000 respectively. The Electricity Committee reaffirmed a minute of a meeting on Sept. 28, recommending the provision of a 12,500 kW turbo-alternator, the establishment of a sub-station in

Ballymacarrett district, the extension of the existing feeders, &c. The £52,000 is required for capital expenditure on service mains, meters, &c. Both recommendations were approved after discussion and after an explanation by the City accountant.

The POPLAR (London) Borough Council have authorised the Electricity Committee to expedite the work of laying of electric supply mains in streets in the borough not at present supplied, in order to provide employment under the Government scheme for the unemployed. The Council authorised the extension in July, 1920, by a gradual process, spread over ten years. The proposal, which will involve a cost of £70,053 (including £33,715 for labour), has been submitted to the Unemployment Grants Committee.

The Electricity Committee also propose to submit a scheme for the conversion to electric lighting of the public lamps, at an estimated cost of £5,000, as a non-revenue producing scheme, ranking for grants of 65 per cent. of the interest and instalments for one-half the loan period.

Only qualified support is to be given by LUTONBOROUGH Corporation to the N scheme for the formation of a joint electrical authority for the EAST MIDLANDS DISTRICT. It has passed a resolution approving of the principle that the supply of electricity should be provided for the whole district from four main stations at Leicester, Nottingham, Derby and Burton-on-Trent, but declining to assent to the scheme until provision is made enabling any authorised distributors in the district to obtain a reasonable supply of electricity in bulk, either to themselves directly or through the joint authority from one or other of the main stations on such terms as, failing agreement between the parties respectively requiring and giving the supply, should be determined by an independent arbitrator or authority.

At the meeting of the MANCHESTER City Council last week it was decided, on the recommendation of the Electricity Committee, to approve of the scheme for the establishment of the South-East Lancashire Electricity Board. Reporting on the subject, Mr. S. L. Pearce, the chief engineer and manager of the Electricity Department, stated that it had been conclusively shown and agreed that under the technical proposals of the scheme great savings in coal and capital expenditure could be effected through co-ordination. By the year 1925-26 these savings will amount to £172,316 per annum, increasing to £250,168 per annum by 1930-31. Mr. Pearce therefore thinks there is a definite obligation upon all authorised undertakers in the district to co-ordinate, and it is only to be expected that, if they decline to do so, the Electricity Commissioners will have a good case for taking such steps as they may consider necessary to bring about the admitted savings.

Both Manchester and Salford Corporations have now approved the technical scheme for the reorganisation of electricity supply in the SOUTH-EAST LANCASHIRE Electricity District. Ald. W. T. Dagnall, of Manchester, announced last week that out of forty-one local authorities interested not one had raised any objection. All felt that the scheme would not in any way harass their work, but would leave them as free as they were now to carry on the distribution of electrical energy. Before new works and extensions could be undertaken, however, they would have to be considered by the Engineers' Committee of the proposed Board, which would report to the Electricity Commissioners.

The question of providing a working balance for the SWANSEA electricity department has been under consideration by the Electricity Committee. It is considered that a working balance of £40,000 should be available, and this can be secured in four ways: (1) Increasing price of current; (2) getting income in faster; (3) insisting on deposits; (4) accumulating profits and charging all capital expenditure for some years to loan. The borough treasurer (Mr. Ashmole) was of opinion that the best policy would be to charge everything of a real capital nature to loans. This would not only provide the necessary working balance, but a reserve for emergencies, and there should be no rate relief until the £40,000 working balance was available. It has, however, been decided to institute monthly accounts for as many large consumers as can be dealt with without increase of staff, and to adopt the treasurer's recommendation that there shall be no expenditure charged to profits or reserve without special resolution.

The extensions to the SOUTH SHIELDS electricity works were recently inaugurated by Ald. J. W. Henderson, chairman of the Electricity Supply Committee. The ceremony synchronised with the completion by the electricity undertaking of a quarter of a century's existence. The new plant includes two water-tube boilers, each capable of evaporating 22,000 lb. of water per hour, and a 3,000 kW high-pressure impulse type turbo-alternator and auxiliaries. The plant, which is temporarily housed in a building of corrugated iron, is to form the first portion of a new engine-room. After Ald. Henderson started the new 3,000 kW set and proposed success to the new undertaking, he said that originally the station was for lighting only, and only when the trams came along did they begin to think of power. Frequent additions had been necessary, owing to the ever-growing demand for electricity. Mr. E. Moxon, the present engineer, set to work on the scheme when he came to the town two years ago, and it included the laying of the foundation for a 5,000 kW set. The two principal contractors were the Metropolitan-Vickers Electrical Company and Messrs. G. Bailey & Company. On behalf of Messrs. Bailey, Ald. Henderson was presented by the Mayor with an electro-plated tea service, adapted for electrical heating, as a memento of the occasion,

Institution Notes.

The next preliminary, intermediate and final examinations of the INSTITUTE OF COSTS AND WORKS AGREEMENTS (Limited by Guarantee) will be held on Dec. 5, 6, and 7, at London, Manchester, Birmingham, Sheffield, Glasgow and Bristol. Other centres will be arranged should sufficient demand arise. Forms of application can be obtained from the Secretary, 38, Grosvenor-gardens, S.W. 1.

THE FRANKLIN INSTITUTE, acting through its Committee on Science and the Arts, has awarded its Elliott Cresson gold medal to Dr. Byron E. Eldred, of New York, for his low-expansion leading-in wire for incandescent electric lamps. The Institute has also awarded to Mr. Alfred O. Tate, of Cranston, Rhode Island, its Howard N. Potts gold medal for his electrolytic process of waterproofing textile fabrics.

The following officers of the ROYAL SOCIETY OF EDINBURGH have been elected for the ensuing year: President, Prof. F. O. Bower; Vice-Presidents, Sir Geo. A. Berry, Prof. Wm. Peddie, Principal Sir James Alfred Ewing, K.C.B., Prof. J. W. Gregory, Major-Gen. W. B. Bannerman, C.S.I., and Dr. W. A. Tait; General Secretary, Dr. Cargill G. Knott; Secretaries to ordinary meetings, Prof. E. T. Whittaker and Prof. J. H. Ashworth.

THE ROYAL SOCIETY possesses a collection of engravings and photographs of fellows of considerable interest, and the President and Council wish to continue the collection on the lines which have been adopted by the Trustees of the National Portrait Gallery, and arrangements have been made with Messrs. Russell & Sons, 73, Baker-street, W. 1, by which they will take a photograph (by appointment) of any fellow, free of charge, and deposit a copy with the society. The President and Council hope that those fellows who have not within the last two or three years given a sitting to Messrs. Russell, will assist in making the collection complete by arranging for a sitting as soon as possible.

Mr. E. T. Goslin will deliver his Presidential Address to the SCOTTISH CENTRE of the INSTITUTION of ELECTRICAL ENGINEERS on Tuesday, Nov. 8, at 7.30 p.m., at 207, Bath-street, Glasgow, and the opening address to the students' section of this centre will be delivered by Mr. Alex. Lindsay on Nov. 11, at 7.30 p.m., at the Royal Technical College, Glasgow. A smoking concert will be held on Saturday, Dec. 17, and the date of the dinner is fixed for Tuesday, Feb. 28. It is announced that the response to the appeal on behalf of the Benevolent Fund was poor, and out of the £250 required only £70 was contributed. Mr. Alex. Lindsay will therefore be glad to receive further sums at 173, Bath-street, Glasgow.

At the recent inaugural meeting of the newly-formed SHROPSHIRE PHILOLOGICAL SOCIETY, held at Shrewsbury, Mr. T. Plummer read a Paper on "Thermionic Valves as used in Long-distance Telephony." The Paper, which was fully illustrated by lantern slides and working apparatus, gave a description of the difficulties met with in long-distance telephone transmission through the attenuation and distortion of the speech currents, and gave details as to how these had been mitigated by the loading of underground circuits, and more recently by the use of thermionic valve amplifiers in telephone repeaters. Information was also given respecting the economies in cost of line plant resulting from the use of telephone repeaters, and of the extensive programme of new underground main cable routes either completed or in course of construction by the Post Office.

The new board of the INSTITUTE of PHYSICS is constituted as follows: President, Sir J. J. Thomson, O.M., F.R.S. Past-President, Sir Richard Glazebrook, K.C.B., F.R.S. Vice-Presidents, Prof. W. H. Eccles, F.R.S., Prof. C. H. Lees, F.R.S., Major E. O. Henri, R.E., and C. C. Paterson, O.B.E. Treasurer, Sir Robert Hadfield, Bart., F.R.S. Hon. Secretary, Prof. A. W. Porter, F.R.S.

Non-Official Members of the Board: Inst.-Comm. T. Y. Baker, R.N., J. E. Barnard, Dr. R. S. Clay, W. R. Cooper, Prof. C. L. Fortescue, O.B.E., Prof. Andrew Gray, Dr. G. W. C. Kave, Sir Charles Parsons, K.C.B., F.R.S., C. E. S. Phillips, O.B.E., Dr. E. H. Rayner, Prof. S. Russ, F. E. Smith, O.B.E., F.R.S., Sir Napier Shaw, F.R.S., and R. S. Whipple.

The Secretary is Mr. F. S. Spiers, O.B.E., 10, Essex-street, London, W.C. 2.

In the course of his presidential address at the meeting of the MIDLAND INSTITUTE of MINING, CIVIL and MECHANICAL ENGINEERS at Rotherham on Saturday, Lieut.-Col. H. Rhodes reviewed the progress of the Institute since its formation in 1857. Referring to the use of electricity in coal mines, he said the first colliery in South Yorkshire at which electricity was seriously adopted as motive power was Hickleton Main, where continuous-current system was used for the main haulage in 1895. With regard to the use of electricity for lighting in mines, his father (the late Mr. C. E. Rhodes) expressed the opinion that the question of a portable miners' electric safety lamp was almost solved, adding that he had seen one or two which met nearly every requirement, but had the drawback of heavy first cost. Colonel Rhodes said he was not quite sure that that objection had been overcome yet.

Turning to present-day conditions, the new president said they were always seeing it right that wages must come down. He did not think that was the way of putting it. What they wanted to see was the cost of production come down, which was a very different thing. The cost of production must come down, and the only way in which it could be brought down was by the co-operation of all such societies as theirs with the other partners in the industry.

Educational.

In answer to the UNIVERSITY of BRISTOL APPEAL, a sum of £5 000 has been given by Mr. C. Hiatt Baker, of Almondsbury, near Bristol.

Gifts of the value of about £10 000 have been made by Sir Garrod Thomas, of Newport, to the UNIVERSITY COLLEGE of WALES, Aberystwyth, for the purpose of stimulating science research. Sir Garrod proposes to give landed property in Cardiganshire for founding a science research scholarship, and also a capital sum to perpetuate the scholarship founded by his father-in-law, the late Mr. R. H. Richards.

In his recent valedictory address the outgoing Vice-Chancellor of the UNIVERSITY of CAMBRIDGE (Dr. Peter Giles) stated that the largest building scheme which the University had in hand was that of the new engineering laboratory. The extension of the schools of physics and of chemistry was impossible till the engineering school had left Free School-lane. The donors of the great benefaction to the school of chemistry were anxious that the application of their gift should not be delayed, and it was agreed that from the Chemistry Endowment Fund £17 500 should be paid to replace on the new side the Hopkinson Memorial Wing of the engineering department, and that the same fund should lend, for a period not exceeding five years, a further £25 000, on the understanding that the premises of the engineering department should be vacated by the end of December. A further £15 000 would have to be found from other sources. The undertakings which the University had in hand were numerous and costly, but apart from the new engineering laboratory and the Cavendish laboratory, extensions were provided for from endowments.

Business Items, &c.

Mr. A. RUSS, dealer in electrical supplies, has removed to 22 and 23, Verulam-street, Gray's Inn-road, London, W.C.

Mr. O. A. WHITTAKER has started in business as an electrical contractor at 1, King's-walk-chambers, Parliament-street, Nottingham.

THE GORWALL TRADING COMPANY, 40, Shaftesbury-avenue, Piccadilly Circus, London, W. 1, are the sole agents in the British Empire of Messrs. Kieserling & Albrecht for all kinds of metal-working machinery.

The registered office of the ENGLISH ELECTRIC & SIEMENS SUPPLIES, LTD., has been transferred to the company's City premises, 38 and 39, Upper Thames-street, E.C. 4, where all future communications should be sent.

MESSRS. E. H. BISSELL and COMPANY, 212A, Shaftesbury-avenue, London, W.C. 2, have been appointed British representatives of the Compagnie Générale d'Electricité of Paris, manufacturers of insulating materials and moulded insulation.

Mr. Walter Lewis, who has resigned the position of goods superintendent on the G.W. Railway at Cardiff on reaching the retiring age, has joined the board of Booth & Bamford, Ltd., electrical engineers, St. Andrew's-crescent, Cardiff.

THE MANSFIELD ENGINEERING COMPANY, LTD., have acquired and taken possession of the Hucknall aerodrome in order to provide premises for the expansion of their business. The new buildings are substantial concrete structures, and electric supply is already available.

We have received from Messrs. BARDMAR, LTD., a copy of the waistcoat pocket edition of "The Welding Test." It is fully illustrated, and comprises sixteen pages of condensed data relating to scientific welding. Those interested may secure a copy by sending a postcard to 10, Poland-street, London, W. 1.

MEDWAY'S SAFETY LIFT COMPANY, LTD., of London, have opened a new branch office at 131, Oxford-road, All Saints, Manchester (telephone: Central 1754), with special staff of skilled engineers to deal with the erection, maintenance, and repairs of all kinds of electric and hydraulic lifts.

Mr. John W. F. Warren, A.M.I.E.E., and Mr. Sydney Warren have commenced business as electrical engineers and manufacturers' agents as WARREN BROTHERS, at Prudential-chambers, Middlesbrough. The partners of the new firm were the founders of Warren, Beattie & Company, Ltd., but they do not intend to undertake, as before, contracts for the complete electrification of iron and steel works, shipyards, &c., though they are in a position to supply all plant, and are prepared to act in a consultative capacity. The principal of the manufacturers whom they represent is the A.C.E.C. (Ateliers de Constructions Electriques de Charleroi), and in connection with this agency they will hold large stocks of V.I.R. insulated wires and cables, and a.c. and d.c. motors, in addition to the usual range of electrical accessories.

Personal and Appointments.

MR. A. S. SINCLAIR, electrical engineer, had to fight to retain his seat on the SWANSEA TOWN Council.

The King has approved the appointment of Mr. HERBERT W. TURNBULL, M.A., to be Regius Professor of Mathematics in the United College of St. Salvador and St. Leonard, in the University of St. Andrews.

MR. OSCAR BERRY, F.C.A., C.C., has been unanimously elected deputy-chairman of the Commercial Education Committee of the London Chamber of Commerce. Mr. Berry has also been elected to serve on the governing body of the City of London College, as a representative of the Chamber.

Tenders Invited and Accepted.

UNITED KINGDOM.

FALKIRK PARISH COUNCIL. NOVEMBER 5.—Six months' supply of electric lamps to Blinkbonny Home. Forms of tender from the Governor.

BRISTOL DOCKS COMMITEE. NOVEMBER 7.—Electric lighting of the cattle lairs at Cumberland Basin. Specification, &c., from the Engineer, Avonmouth Dock.

GREAT NORTHERN RAILWAY COMPANY (IRELAND). NOVEMBER 1.—Year's stores, including electric lamps, fittings, cables, wire, &c. Tenders to the Secretary (Mr. J. B. Stephens), Anderson's Quay, Dublin.

AYLESBURY CORPORATION. NOVEMBER 11.—Two vertical and five horizontal a.c. motors, &c., and two vertical and three horizontal centrifugal pumps, delivery pipes, &c. Plans and specifications from the Borough Engineer.

WARRINGTON ELECTRICITY AND TRAMWAYS COMMITTEE. NOVEMBER 15 (noon).—Motors and transformers. Specifications from the Borough Electrical and Tramways Engineer, and tenders to the Chairman of the Committee.

METROPOLITAN ASYLUMS BOARD. NOVEMBER 23, 2.30 p.m.—Installation of electric lighting cables, &c., on the training ship "Exmouth," off Grays. Specification, &c., can be obtained at the Board's Offices, Embankment, E.C. 4.

SHEFFIELD HEALTH COMMITTEE. NOVEMBER 25.—Plant and machinery for refuse-disposal works, including cranes and grabs, d.c. switchboard, feed pumps and feed-water heaters, steam-driven electrical plant and condensers, electric motors and starters (contracts Nos. 9, 10, 11, 14 and 15), &c. Specifications from Messrs. Mortimore, Lyon & Company, Mansfield-chambers, St. Ann's-square, Manchester.

THE POWELL DUFFRYN STEAM COAL COMPANY, LTD.—Three or six months' supply of copper wire, electrical accessories, ironmongery, rubber, asbestos, &c. Forms of tender from the Stores Superintendent, Aberaman Offices, Aberdare.

AUSTRALIA.

VICTORIAN GOVERNMENT RAILWAY COMMISSIONERS. JANUARY 4, 1922.—60 tons galvanised telegraph wires (contract No. 34 706); 23 steam meters and accessories for Newport power house (No. 34 611); and 150 electric train stops for power signalling (No. 33 546). Tenders must be accompanied by a preliminary deposit of half per cent. of total amount of tender, and local representation is essential.

NEW ZEALAND.

WELLINGTON. CONTROLLER OF STORES, POST AND TELEGRAPH DEPARTMENT. NOVEMBER 21.—* 750 red and 750 white switchboard cords (three conductor), to specification No. 87.

WELLINGTON. PUBLIC WORKS DEPARTMENT. NOVEMBER 29.—In connection with Mangahao electric power scheme. * Section 12: Three water-wheels of 6 450 h.p. and two water-wheels of 3 225 h.p. complete with governors, couplings, and accessories; Section 13: Three 6 000 kVA and two 3 000 kVA alternating-current generators; Section 14: two three-unit exciter sets, each consisting of one 375 h.p. Pelton wheel, one 250 kW direct-current generator, and one 350 h.p. asynchronous motor; Section 15: seven 4 000 kVA single-phase transformers and accessories; Section 17: insulators for 110 000 V 50 cycle transmission lines; Section 18: lightning arresters for operation on two 110 000 V three-phase transmission lines; Section 19: switchboard, switches, and accessories.

INDIA.

CALCUTTA ELECTRIC SUPPLY CORPORATION, LTD. NOVEMBER 9.—One 15 000 kW turbo-alternator and condensing plant, and two water-tube boilers, each of 60 000 lb. evaporative capacity. Specifications from the consulting engineers, Messrs. Kennedy & Donkin, 17, Victoria-street, S.W. 1.

CALCUTTA ELECTRIC SUPPLY CORPORATION, LTD.—NOVEMBER 9.—Paper insulated, lead covered cables, bitumen sheathed cables, v.i.f. cables and joint boxes. Specification (No. 72) from Messrs. Kennedy & Donkin, 17, Victoria-street, London, S.W. 1.

SOUTH AFRICA.

JOHANNESBURG MUNICIPAL COUNCIL.—Nov. 18.—* One water-tube boiler with superheater, economiser, mechanical stokers, &c. Tenders to Town Clerk. Local representation is desirable.

JOHANNESBURG MUNICIPAL COUNCIL. NOVEMBER 24 (noon).—* Supply and delivery of 15 000 traction lamps (110 V 20 W metallic filament), 24 750, 35 400, and 30 200 amp. S.P. knife switches (contract 828). Delivery of lamps to be made as required, commencing early in March, 1922. Tender must be accompanied by a certified cheque for 10 per cent. of total amount of tender (such cheque need not exceed £100). Local representation is desirable.

MUNICIPAL CORPORATION OF HUMANSDORP, CAPE PROVINCE. NOVEMBER 30.—Machinery and plant. Section A: one water turbine and dynamo, switchboard with connections, battery of accumulators, and accessories for same; Section B: electricity supply main and public lighting; aerial distributing lines, street lamps, fittings and accessories, section boxes, service cut-outs, meters, &c.; Section C: ferro-concrete pipe line; Section D: reinforced-concrete tank; Section E: buildings and foundations. Further particulars from the Town Clerk, Humansdorp.

* Particulars from the Department of Overseas Trade.

SOUTH AMERICA.

ARGENTINE NATIONAL BOARD OF SANITARY WORKS. JUNE 1, 1922.—* Plant and accessories for new generating station, including three 4-cycle 375 h.p. Diesel engines, to run on crude petroleum, and three 3-phase alternators, each of 250 kW, 2 200 V between phases, 50 cycles, power factor 0.8.

GREECE.

ATHENS.—Nov. 14.—* New telephone installation of central battery type and of an approximate capacity of 5 000 local lines, forty inter-urban lines, and at least fifty special lines connecting Athens with the Piræus.

WALLASEY Electricity Committee have accepted the tender of Reavell & Company for an air compressor at £112.

COLNE Corporation have accepted the tender of the Premier Cooler & Engineering Company for a natural-draught cooling tower, £1 907.

The tender of the Metropolitan-Vickers Electrical Company has been accepted by SWANSEA Corporation for 6 600 V switchgear, at £185.

WIMBLEDON Corporation have accepted the tender of the English Electric Company for six ironclad switch panels and metering panel, £711 18s.

ST. PANCRAZ (London) Borough Council are recommended to accept the tenders of Mossay & Company for a spare battery for an electric vehicle at £347.

ROMFORD Board of Guardians have accepted the tender of the Private Telephone & Electric Company for a 25-line telephone for the medical officer's residence.

GRIMSBY Corporation have accepted the tender of Goodall, Clayton & Company for elevator, electric motor, &c., to be used in connection with ferro-concrete silos, at £744.

EAST HAM Corporation have accepted the tender of F. Hodgson & Company for intercommunication telephones at the Harts Sanatorium, at £20 per instrument for installation and 15s. per year for maintenance.

SUNDERLAND Electricity Committee have accepted the tenders of the Pirelli General Cable Works, Ltd., for five single-core low-pressure cables, and British Insulated and Helsby Cables, Ltd., for two and three core low-pressure cables.

JOHNSON & PHILLIPS, LTD., Charlton, S.E. 7, have been entrusted by the Post Office Engineering Department with the manufacture, supply and laying of a TRUNK TELEPHONE CABLE between GLASGOW and EDINBURGH. The contract comprises forty-six miles of 204-pair cable.

WALLASEY Corporation have accepted the tenders of the Metropolitan-Vickers Electrical Company for eight 50 kVA oil-cooled transformers, £118 18s. 2d., and one 75 kVA oil-cooled transformer, £142 6s. 2d.; and British Insulated and Helsby Cables, Ltd., for eight switch pillars, £95.

NEWCASTLE-ON-TYNE Transport and Electricity Committee have accepted the tender of Bolckow, Vaughan & Company for the supply of 1 500 tons of tramrails for the Barras Bridge-High Level Bridge route at £12 10s. per ton. The nearest foreign tender was stated to be very little below the one accepted.

BERMONDSEY (London) Council have accepted the following tenders: W. Lucy & Co., twelve service boxes, £1 10s. 6d. each; W. T. Henley's Telegraph Works Company, twelve sets of service cutouts, £1 18s. 8d. per set; Berry, Wiggins & Company, 15 cwt. joint-box compound £15 12s. 6d.; Babcock & Wilcox, boiler parts, £58 10s.

Books Received.

"Elektrische Fördermaschinen." By Prof. W. Philippi. (Leipzig: S. Hirzel.) Pp. viii.+304.

"Atomic Theories." By F. H. Loring. (London: Methuen & Company.) Pp. ix.+218. 12s. 6d. net.

"The Electric Furnace." By F. J. Moffett, B.A. (London: Sir Isaac Pitman & Sons.) Pp. x.+118. 2s. 6d. net.

"Mechanical Handling of Goods." By C. H. Woodfield. (London: Sir Isaac Pitman & Sons.) Pp. xi.+116. 2s. 6d. net.

"Factory Administration in Practice." By W. J. Hiscox. (London: Sir Isaac Pitman & Sons.) Pp. x.+214. 8s. 6d. net.

"Absolute Measurements in Electricity and Magnetism." By A. Grey, LL.D., F.R.S., M.I.E.E. (London: Macmillan & Company.) Pp. xix.+837. Second edition, 42s. net.

"Metric System for Engineers." By Mr. Charles B. Clapham, B.Sc. (London: Chapman & Hall, Ltd.) Pp. xii.+181. 12s. 6d. net.

"Blue Printing and Modern Plan Copying." By B. J. Hall, M.I.Mech.E. (London: Sir Isaac Pitman & Sons.) Pp. ix.+130. 6s. net.

"Hydro-Electric Engineering." Vol. I, Civil and Mechanical. By A. H. Gibson, D.Sc., and H. D. Cook, M.Sc. (London: Blackie & Son.) Pp. x.+232. 25s. net.

"Fifty Years of Electricity—The Memories of an Electrical Engineer." By J. A. Fleming, M.A., D.Sc., F.R.S. (London: Wireless Press.) Pp. xi.+371. 30s. net.

"Electricity in the Service of Man." By R. Mullineux Walsley, D.Sc. Volume 2, Section 3. "The Technology of Electricity." (London: Cassell & Co.) Pp. ix.+835. 15s. net.

Miscellaneous.

On Saturday last OSWYN WILLIAMS, CO. of the U.S. Upper Plate Works, Morristown, Tennessee, was killed by a plank which fell from a gantry.

The advertisement of C. F. ELWELL, LTD., in our issue of Oct. 28, stated, owing to a clerical error, that the company held equipments in stock for commercial ranges up to 30 000 miles. This figure should have been 3 000 miles.

The death is announced of Lieut.-Col. PERCY JOHN PREECE, T.D., late 2/8 London Regiment, Post Office Rifles. Col. Preece was the third son of the late Sir William Preece, K.C.B., and was fifty-one years of age.

The death has occurred, under distressing circumstances, of Mr. ERNEST COATES, M.I.E.E., of Streatham. Mr. Coates was superintending engineer, until 1911, at the Bow Station of the Charing Cross, West End and City Electric Supply Company, and later he was identified with commercial work.

Attributing the present stagnation in industry very largely to the heavy burden of taxation, the Swansea branch of the FEDERATION OF BRITISH INDUSTRIES have passed a resolution urging the Federation to press upon the Government a reduction in income tax and the abolition of the corporation profits tax.

Two boys were ordered to pay 5s. each at Bridgend on Thursday last for BREAKING ELECTRIC LAMPS by throwing stones at them. Mr. A. Adams, secretary of the Ogmore Valley Electric Light Company, stated that a great deal of similar damage had been done recently, the company having had to replace fifty lamps within three months.

On Monday there was a CONFERENCE ON UNEMPLOYMENT between the JOINT INDUSTRIAL COUNCILS of the electrical industry (acting for the cable-making, electricity supply and contracting branches) and representatives of the associations of electrical manufacturers, the wholesalers and the Electrical Development Association. Sub-committees were appointed to collect information for a further conference to be held at the end of the week, when it is hoped to submit to the Cabinet Committee on unemployment some practical schemes.

The third interim report of the DEPARTMENTAL COMMITTEE OF LIGHTS ON VEHICLES has been issued and deals mainly with dazzle headlights. The view is expressed that the prevention of dazzle under every condition and circumstance is at present unattainable consistently with a safe driving light. It is, however, possible "materially to restrict dazzle below the eye level of an adult observer walking or driving towards a headlight." Conditions to which it is desirable that lamps should comply are set out.

The selection of Wembley Park as the site for the BRITISH EMPIRE EXHIBITION in 1923 has been criticised owing to its inaccessibility. In reply, it is explained that the Metropolitan Railway Company has drawn up an ambitious scheme for dealing with the passenger traffic. The company alone will be able to provide seating accommodation from Baker-street to Wembley Park for 36 000 per hour. There will be two trains a minute, each composed of six cars, and each car will seat 300 passengers. Wembley Park Station, which has four platforms, is to be extended. The number of platforms will probably be doubled, the whole station will be covered in, and a covered way will be provided from the station to the exhibition.

The movement in support of the exhibition is being well received in the provinces, and at GLASGOW about £70 000 has been promised.

The first few weeks' working of the TECHNICAL BOOKS ADVISORY SERVICE has clearly shown that its establishment satisfies a very definite need. Following the appointment by us of an expert who has made a special study, over a long period of years, of the technical literature of the industry, and whose knowledge and experience in this respect is unrivalled, we have received inquiries which, both by their number and by their variety, indicate unmistakably the difficulties experienced by a considerable number of our readers in finding the books just suited to their purpose. This is the age of technology, and there can be no greater aid to progress and efficiency than a knowledge of the most up-to-date literature on the given subject; but it is impossible for a busy man, without a tedious search through innumerable catalogues, to discover the book which best gives him the information he requires. It is the object of our Advisory Service to furnish expert and rapid assistance in this direction, and we are happy to find that its establishment has met with so ready a welcome.

In connection with the preparations for NIGHT FLYING on the AIRWAYS OF EUROPE, the French Air Ministry have acquired a new aerial lighthouse that will exceed in candle-power and intensity anything yet attempted. It is reported to have a flashing power of 1 000 million candles; it will be visible from a distance of 200 miles, and will be the guiding light for night air expresses entering or leaving the Paris aerodrome at Le Bourget from the south. The new lighthouse will be erected on Mount Africa, a hill top seven miles from Dijon.

On the London airways seven aerial lighthouses are now in operation or on the point of completion. The stretch of airway between the London air station at Croydon and the coastal air junction at Lympne is now illuminated by four lighthouses, flashing distinctive signals. In addition, it is proposed to make alterations in the Varne lighthouse, which is moored in mid-Channel, so that it will act as a guide, not only to shipping, but also to aeroplanes.

At the third annual general meeting of the INDUSTRIAL WELFARE SOCIETY yesterday (Thursday), Lord Invernairn, head of the firm of William Beardmore & Company, Ltd., in his capacity of chair-

man, held in the near future to consider the possibilities of the welfare movement in the industry, and that H.R.H. the Duke of York would preside. "I sometimes feel," said Lord Invernairn, "that we should be more aggressive and less apologetic. How many thousands of workers—and employers—have been rendered more happy and, in consequence more effective, as the result of the work of our staff? Their happiness and effectiveness are assets to the nation at large, and I hope that those who stand to gain by this will recognise their obligations towards us, and give us something more tangible than goodwill."

H.R.H. the DUKE OF YORK made an interesting speech in support of the work of the society, and he made an appeal for greater sympathy and financial assistance for the movement.

On the 28th ult., the annual installation meeting of the KELVIN LODGE, No. 3735, was held at Mark Masons' Hall, when Mr. H. Porter-Cox, the W.M., installed Mr. E. E. Sharp as his successor in the chair. In this instance particular interest attached to the ceremony, inasmuch as Mr. Sharp is already reigning Master of the Electric Lodge, so that he is now actually reigning over the two Masonic Lodges which are most intimately associated with the electrical profession. The officers appointed were Messrs. P. C. Ebner, S.W., A. Forbes Dick, J.W., Ernest J. Wilcock, P.M., 2087, Treasurer: H. W. S. Rentell, L.R., Secretary: Edwin J. Reid, P.A., Superintendent of Works, D.C.: W. E. Gundry, S.D., Louis H. Euler, J.D., T. E. Pickford, A.D.C., J. Osborne Pearson, P.M., Almoner.

Among those present at the subsequent banquet were Messrs. Percy Still, P.G.D.; Charles F. Quicke, P.G., Superintendent of Works: F. A. B. Lord, P.A.G.St.B.; John W. Elliott, P.Prov. J.G.D. (Herts); G. T. Fairbrother, P.M. 2455; W. B. Ross, P.M. 2767; and C. H. Wordingham, Past President Inst.E.E., as well as many other gentlemen intimately associated with the electrical industry. Mr. Still responded to the toast of the Grand Lodge Officers, and complimented the Kelvin on its rapid growth, and also on the way in which the members had worked for the craft charities, while Mr. Wordingham, who replied on behalf of the visitors, appealed feelingly for the cordial co-operation of all present in these difficult times.

Imperial Notes.

During the seven months ended July 31, the value of the MACHINERY IMPORTS into SOUTH AFRICA was £3 158 825, compared with £1 970 995 in the same period of 1920. It is reported that inquiries for electrical goods are more numerous than in recent months, and the tendency is better. Some reduction is noted in prices of lamps, adapters, lampholders, switches and ceiling roses.

In connection with the annual meeting of the AMERICAN ASSOCIATION FOR THE ADVANCE OF SCIENCE, which will be held in Toronto from Dec. 27 to 31 next, there will be an exhibition of scientific apparatus and products and recent scientific works at the University of Toronto. The exhibits will be limited to apparatus and products of a highly-improved or exceptional type and likely to appeal to those interested in scientific research. Communications should be addressed to the Secretary to the Committee in Charge of Exhibits (Mr. Westman), 57, Queen-street, West Toronto.

STEAMSHIP COMMUNICATION WITH AUSTRALIA will receive an active fillip by the inauguration of a new service of big fast vessels specially built for the Commonwealth Government Line. The voyage from London to Fremantle will be made in thirty days. Five new steamers of uniform register of about 14 000 tons and of rapid speed have been built to uniform design, and are fitted with every up-to-date appliance to ensure rapid and safe hauling of cargo. The "Moreton Bay," the pioneer of the new line, is timed to leave London on Dec. 7, and the other ships of the "Bay" class will follow her at four-weekly intervals.

In the report on the trade and commercial prospects of EAST AFRICA, H.M. Trade Commissioner (Col. W. H. Franklin, C.B.E.) states that his territory has an area of 750 000 square miles, with poor and slow communications. The district is one of great potentialities, but the agricultural and mining industries possess the greatest possibilities at present. Motor-cars, agricultural and mining machinery are the chief imports, and the United Kingdom has had the bulk of the import trade for the past five years, though the United States and Germany are now competing for hardware and electrical apparatus orders, and Belgium for glassware. The chief distributing centres are at Zanzibar, Kilindini, and Dar-es-Salaam.

Telegraph and Telephone Notes.

According to a report from Monte Video, work will shortly be begun on the laying of a new SUBMARINE cable connecting Italy, Spain and Brazil with Uruguay.

The HENDON TELEPHONE EXCHANGE was opened on Wednesday, and, in addition to relieving the congestion at the Finchley Exchange, serves a portion of the Golders (Green) district.

In reply to a question in the House of Commons on the 27th ult., as to the attitude of the several Dominions to the IMPERIAL WIRELESS SCHEME of the Government, Mr. Wood stated that the conclusions arrived at by the Conference of Prime Ministers and representatives of the United Kingdom, the Dominions and India, were printed in the published summary of proceedings, and H.M. Government had not received any later intimation as to the views of the Governments of Canada, the Commonwealth of Australia, and the Union of South Africa.

Foreign Notes.

Experiments are being made in PARIS and ITS SUBURBS with overhead trolley omnibuses for dealing with the heavy traffic.

GERMANY will supply a large number of ELECTRIC MOTORS and other goods to ROMANIA on account of reparations.

Machinery and plant for the generation of hydro-electric power, electric locomotives, electrical machinery and motors are EXEMPTED FROM IMPORT DUTY in BRAZIL.

At present there are eight WIRELESS STATIONS in CHINA which are under the direct control of the Ministry of Communications. These are at Peking, Kalgan, Wuchang, Foochow, Woosung, Tsungming, Canton and Shanghai. There are others under the supervision of the War Office.

The plant of the NANKING (China) Electric Light Company was recently extended in order to meet the increasing demand for electricity for light and power. The plant is of American manufacture, and the new turbo-generator supplies three-phase at 2,500 V, 60 cycles.

The U.S.A. SENATE COMMITTEE on Reconstruction and Production estimate that for every gain of a million in population the public utilities have to raise, by the sale of securities, \$700,000,000 for the extension of plants to serve the additional customers. As normal development was curtailed by the war, utility companies will now have to find \$2,000,000,000 to pay for new construction work.

The value of the U.S.A. EXPORTS of electrical goods in August was \$6,057,489, compared with \$7,110,285 in the corresponding month of 1920. Seven electric locomotives, valued at \$242,362, were also exported in August. There were increases in motors, transformers, controllers, and telephones, but the heaviest decreases occurred in batteries, carbons, fans, heating and cooking apparatus, interior wiring supplies, incandescent lamps and magnetos.

According to the "Electrical Review" of Chicago, the capacity of the testing room of the South Philadelphia works of the WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY was taxed to its utmost capacity recently, when 164,000 kW of steam turbine generators were on the testing floor at the same time. Nearly 150,000 kW of this amount was made up of five turbines for power companies in the States. Two were of 35,000 kW each, three of 25,000 kW each, and one of 10,000 kW.

In a report on the recent ALL-RUSSIAN ELECTRO-TECHNICAL CONGRESS the engineer, Krzhishanovsky, presented a report on the work of the Government Committee in the electrification of Russia. According to "The Financier," he referred "to the relation of electro-technical progress with economical aspirations, and the importance of just estimates of the relative volume of various sources of power which requires the combined action of engineers and electro-technicians." He also reminded his hearers that the plan for electrification that had been the object of attack now compelled general approval. We were not aware that the character of the work undertaken was known outside Russia, and we have not read of any expressions of approval or disapproval of the Committee's plans.

The Commercial Secretary to H.M. Legation at Lisbon states that there are many schemes afoot for the utilisation of water-power in PORTUGAL, the largest of which is that on the Douro, but before this can be carried out various arrangements will have to be come to with Spain, as the river where it will be diverted into a canal flows between the two frontiers. The estimate of this power is 350,000 H.P. The total water-power available in the country is said to exceed 600,000 H.P. The most important station working is that in the Serra da Estrella, which supplies power to wool manufactures, lights various small towns, and is used for the manufacture of carbide of calcium. One of the difficulties in all the water-power schemes is that the flow of water in the rivers is very low in summer owing to the prolonged drought, while in winter there are apt to be floods.

We announced recently that the Westinghouse Electric International Company had secured the contract to supply the equipment for the ELECTRIFICATION of the CHILEAN STATE RAILROAD between Valparaiso and Santiago, and the Los Andes Branch. This contract covers the most important railway electrification undertaken since the beginning of the war. The main line is 116 miles long, and connects the leading seaport (Valparaiso) with the capital (Santiago), while the line to Los Andes is twenty-eight miles long and forms the Chilean State Railway section of the trans-continental line to Buenos Aires. The value of the contract is \$7,000,000, and it was secured after keen competition from German and other companies. The equipment will consist of eleven local passenger locomotives, fifteen road freight locomotives, seven switching engines, and five sub-stations of 4,000 kW capacity each. The 3,000 volt direct current system, which will be used, will be strictly American in character. The capacity of this equipment will be 50 per cent. greater than present traffic requirements, and the plans are such that an increase of traffic capacity three times the existing demands can readily be obtained. Owing to the abundance of water power in Chile and the high price of fuel, all of the Chilean railroads will eventually be electrified, and the present project is the first step in this process. The contract represents the third large order for electric railway supplies recently received by the Westinghouse Company from foreign countries in the past few months, the others being obtained from France and Japan. The Errazuriz, Simpson Company will build the overhead construction.

Arrangements for the Week.

FRIDAY, Nov. 4th (to-day).

INSTITUTION OF MECHANICAL ENGINEERS.

6 p.m. At Storey's-gate, London, S.W. Thomas Hawksley Lecture on "Power Transmission by Oil," by Dr. H. Hele-Shaw, F.R.S.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

7.30 p.m. At the Literary and Philosophical Society, Westgate-road, Newcastle-on-Tyne. Paper on "Sea Casualties and Loss of Life," by Sir Westcott S. Abell, K.B.E.

MONDAY, Nov. 7th.

SOCIETY OF ENGINEERS.

5 p.m. At the Geological Society, Burlington House, London, W. Paper on "Extraction Turbines," by Mr. C. H. Naylor.

INSTITUTION OF ELECTRICAL ENGINEERS.

(WESTERN CENTRE.)

6.30 p.m. At South Wales Institute of Engineers, Park Place, Cardiff. Inaugural address by Mr. A. C. MacWhirter.

INSTITUTION OF ELECTRICAL ENGINEERS.

(INFORMAL MEETING.)

7 p.m. At Savoy-place, Victoria Embankment, London, W.C. Discussion on "How Best to Speed up Electrical Progress," by Mr. J. S. Highfield.

INSTITUTION OF ELECTRICAL ENGINEERS.

(LIVERPOOL SUB-CENTRE.)

7 p.m. At the University, Liverpool. Address by Mr. G. H. Nisbett.

TUESDAY, Nov. 8th.

INSTITUTION OF ELECTRICAL ENGINEERS.

(SCOTTISH CENTRE.)

7.30 p.m. At 207, Bath-street, Glasgow. Address by Mr. E. T. Goslin.

WEDNESDAY, Nov. 9th.

INSTITUTION OF ELECTRICAL ENGINEERS.

(WIRELESS SECTION.)

6 p.m. At Savoy-place, London, W.C. Address by Dr. G. W. O. Howe.

INDUSTRIAL LEAGUE AND COUNCIL.

7.30 p.m. At Caxton Hall, London, S.W. Lecture on "Industry and Its Relation to Finance," by Mr. E. J. Garmeson.

THURSDAY, Nov. 10th.

OPTICAL SOCIETY.

7.30 p.m. At the Imperial College of Science, South Kensington, London, S.W. Papers on "The Theory of the Periscope," by Dr. A. Gleichen; "The Interocular Distance," by Dr. James W. French; and "Note on the Thin Astigmatic Lens," by Mr. T. Chaundy.

FRIDAY, Nov. 11th.

PHYSICAL SOCIETY.

5 p.m. At the Imperial College of Science, South Kensington, London, S.W. Presidential address on "The Structure of Crystals of Organic Substances," by Sir William Bragg, K.B.E., F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS.

(LONDON STUDENTS' SECTION.)

7 p.m. At Savoy-place, London, W.C. Opening address on "The Future of Railway Electrification," by Sir Philip Dawson, M.P.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

7.30 p.m. At the Literary and Philosophical Society, Westgate-road, Newcastle-on-Tyne. Paper on "The Working of a Modern Telephone System," by Mr. C. Whillis.

INSTITUTION OF ELECTRICAL ENGINEERS.

(STUDENTS' SECTION OF SCOTTISH CENTRE.)

7.30 p.m. At the Royal Technical College, Glasgow. Address by Mr. Alex. Lindsay.

INSTITUTION OF ELECTRICAL ENGINEERS.

(IRISH CENTRE.)

8 p.m. At the Royal College of Science, Upper Merrion-street, Dublin. Discussion on the Report of the Fuel Research Board on the Winning, Preparation, and Use of Peat in Ireland, and on the Report of the Sub-Committee on the Water Power Resources of Ireland.

Forty Years Ago.

(THE ELECTRICIAN, NOVEMBER 5, 1881.)

SS. "FARADAY."—We notice that this cable ship returned to Gravesend from the Atlantic on the 1st November.

ELECTRIC LIGHTING AND ARCHITECTURE.—The new volume of the Transactions of the Institute of Architects contains Mr. Slater's Paper on "Electric Lighting."

THE ELECTRIC LIGHT IN HOUSES.—The Duke of Sutherland has decided upon lighting his residence at Trentham with electric lights. The British Electric Light Company have the work in hand.

COMMUNICATION IN RAILWAY TRAINS.—News from North Wales says that the railway department has been testing the Winter's electric system of the intercommunication between passengers and guards in railway trains.

Companies' Reports, &c.

DRAKE & GORHAM, LTD.

Mr. Bernard M. Drake, M.I.E.E., who presided over the annual general meeting of DRAKE & GORHAM, LTD., on the 27th ult., stated that, in spite of the crisis through which the company had been passing, including the coal stoppage and an electricians' strike, they were able to declare a 6 per cent. dividend, after making allowance for the depreciation of their stock. During the twenty years of the company's existence the total profit had exceeded £200,000, of which £134,460 had been distributed among the shareholders, or £9,460 more than the amount subscribed. It was a tribute to the reputation of their company that the issue of seven-year notes was so largely oversubscribed. The excess profits duty and corporation profits tax paid or reserved had amounted to £17,000, a large proportion of which related to peace requirements. Although they should in future be released from the former tax, the latter, amounting to 5 per cent. of the profits, still continued.

German Competition.

If, as reported, the metal workers in Germany were now putting in full work for the equivalent of 15s. to £1 per week it was difficult to see how our country could compete when paying anything approaching the present rate of salaries and wages, and he was afraid that before normal conditions could be restored the general standard of living must be lowered, and labour must be more willing to give proper value for wages received. The rate of exchange was also helping Germany to recover rapidly the trade of the world, and although their company had suffered less than others that were dependent upon export—for they occupied a somewhat unique position on account of their accumulated experience in special home work—it was nevertheless evident that with heavy taxation and lack of dividends the number of those who could afford the purchase of electric lighting fittings was necessarily reduced.

Domestic Labour-Saving Appliances.

On the other hand, the use of electric power was daily extending in connection with domestic labour-saving appliances, the utility of which was more in evidence owing to the difficulty of obtaining servants, and as electricity was rendered more widely available the adoption of such appliances would become more universal. Further, it would be essential for manufacturers who wished to keep themselves up-to-date to consider the problem of utilising electric power throughout their works. That was a subject to which they had for years devoted much attention, and the economy was found to be considerable, apart from other advantages, such as reliability, cleanliness, convenience, absence of noise and the ease with which the power taken by various parts of the works could be measured at any moment. Thus the severe competition might in the end prove a godsend, as before the war it was found that both Germany and America were using about three times as much horse-power per man employed in factories as was used in Great Britain under similar conditions. This was largely due to the senseless opposition of the trade unions to labour-saving appliances. It was hoped that those controlling the policy of Labour might now appreciate that it was only by the increased use of machinery that our trade could be recovered, and that there was sufficient demand to keep everyone employed indefinitely if satisfactory goods were produced at competitive prices.

Their Manchester office had done exceedingly well, and had in hand important power equipment work in factories, as well as a number of private installations. The head office was fully occupied for the first part of the year, but the effects of the depression were felt earlier in the southern than in the northern counties. The Belfast office showed a small profit in spite of the prevailing difficulties, and if normal conditions were restored the business should further develop. At present many were holding back their orders in the hope of obtaining lower prices, and the effect of that was to intensify the troubles caused by the lack of export trade. It should be considered a national duty for everyone to help the Government by putting in hand forthwith any work they could, even if they paid rather more, for it must be borne in mind that they would be getting something they wanted, and at the same time reducing the amount they would have to pay in taxation to meet grants made by the State.

A petition for winding up the PHONOGRAPH CONSTRUCTION COMPANY, LTD., will be heard at Windsor County Court on Nov. 10.

THE ACCOUNT OF THE ELECTRIC WELDING COMPANY, LTD., for the year ended Nov. 30, 1920, show a balance at debit of profit and loss of £340,364.

The directors of the CITY OF BUENOS AIRES TRAMWAYS COMPANY, 1904, LTD., have declared a dividend of 1s. 3d. per share (at rate of 5 per cent. per annum), less tax, for the quarter ended Sept. 30.

It is reported that the AUSTIN MOTOR COMPANY, LTD., is to be re-financed, and that Sir Arthur Hardinge and Mr. L. T. Davies, M.P. for Lincoln, who are finding the capital, will join the board of directors.

Allotment letters for the COUNTY OF SOUTHLAND ELECTRIC POWER BOARD 6 per cent. debentures may now be exchanged for scrip certificates at the National Bank of New Zealand, 17, Moorgate-street, E.C. 2.

At the annual meeting of ERINOLD, LTD., on the 27th ult., it was reported that the trading profit for the past year was £16,717, but after making provision for depreciation of plant, machinery and stock, &c., there was a net loss of £9,718.

The STOCK EXCHANGE Committee has especially allowed dealings in 20,979 £1 fully-paid shares (Nos. 200,001 to 220,979), 45,000 £1 fully-paid ordinary shares (Nos. 120,001 to 150,000 and 400,001 to 415,000), and £43,300 4½ per cent. first debenture stock of the South Metropolitan Electric Light & Power Company, Ltd., and 124,237 10s. fully-paid ordinary shares of Fellows Magneto Company, Ltd.

The name of the TRAMWAYS, LIGHT & POWER COMPANY, LTD., is to be altered to the "Midland Counties Electric Supply Company, Ltd.," and its borrowing powers will be increased to £1,000,000, which will enable the company to make an issue of debenture stock for repayment of temporary borrowing. The undertaking was formed in 1912, and controls a number of electric tramways and supply systems in the Midlands.

New Companies.

The following list is compiled from information supplied by Messrs. Jordan & Sons, Ltd., company registration agents, 116-118, Chancery-lane, London, W.C. 2.

WILLIAM BIRCH (ENGINEERS), LTD. (177,456), Milton-street Iron Works, off Bury New-road, Manchester. Registered Oct. 24. To acquire and carry on business of engineers and makers of self-acting and labour-saving machinery. Nominal capital, £12,000, in £1 shares. Directors: V. S. Wood, H. C. Whittle, and H. Coates. Private company.

J. T. FATHERLY & COMPANY, LTD. (177,578), 32, Grainger-street West, Newcastle-on-Tyne. Registered Oct. 27. To acquire and carry on business of steelpiece and electrical contractor. Nominal capital, £1,500, in 1,000 preference and 500 ordinary £1 shares. Directors: J. T. Fatherly and S. Morris. Private company.

PLUMBERS MERCHANTS, LTD. (177,425), 176, Stockport-road, Ardwick, Manchester. Registered Oct. 22. Manufacturers of and dealers in lamps, brackets, globes, and all gas and electrical appliances. Nominal capital, £7,000, in £1 shares. Directors: C. E. Cooke and J. Fogg. Private company.

Catalogues, Price Lists, &c.

THE STANTON IRONWORKS COMPANY have issued their November stock list of c.i. pipes.

MESSRS. ROBERT HORNEY & CO., LTD., 7, Carlisle-street, Dean-street, London, W. 1, have issued a price list of Siemens' bio-carbons which they have in stock.

The monthly magazine of Messrs HIGGS BROTHERS, Sandpits, Birmingham, contains a list, with prices and particulars, of the a.c. and d.c. motors and dynamos which the firm have in stock.

In a new leaflet, issued by the ARORA COMPANY, of Loughborough, particulars and prices of the well-known Arora fires are set out. Two new lines, the Arora halo fire and the Arora warming plate, which have recently been placed on the market, are also described.

A neat and well-illustrated booklet, containing particulars and prices of their "PLEXISM" PROJECTOR FIRE and of the various sizes of Plexism electric fires has been issued by the SIMPLEX CONDUTTS, LTD., Garrison-lane, Birmingham. An artistic and striking three-colour showcard of the projector fire, which has also been prepared by the company, should assist in increasing the sales of this popular and well-known article during the winter.

An illustrated pamphlet on PRACTICAL PYROMETERS (book No. 26) recently issued by the FOSTER INSTRUMENT COMPANY, of Letchworth, Herts, is an interesting example of technical trade literature. It commences with a description of the design and construction of the two classes of pyrometers manufactured by the company, and their applications and uses, and this is followed by twelve pages of theoretical notes, which give a brief but clear and useful exposition of theoretical considerations influencing the design and use of a successful industrial thermo-couple pyrometer.

A leaflet recently issued by the ZENITH MANUFACTURING COMPANY, Villiers-road, Willesden Green, N.W. 2, contains particulars, with prices, of the "Zenite" vitreous enamelled resistance units. These units provide in a compact form a relatively large ohmic resistance and current-carrying capacity; they comprise a porcelain tube of suitable dimensions, wound with a special high-resistance alloy wire having a temperature coefficient of 0.000023 per degree C., and subsequently embedded in a vitreous refractory mass, fired at high temperature to a smooth, glossy finish. Hitherto these resistances have been mainly imported, but the company claim that, as the result of considerable experiment and research, they are able to produce units in every respect equal to the imported article.

IN MESSRS. HOLLINGS & GUEST'S latest list of hydraulic and screw presses (A 101), illustrated particulars and prices are given of new presses and machines which the firm are making in connection with the motor and solid tyre trades. Specifications, dimensions, and prices are given of a number of heavy presses, including a special two-engine press with 40 in. stroke and daylight in three different series. Illustrations and details are also given of motor-driven pumps, complete with all connections. Another pamphlet (list A 111) gives the foundation drawings and directions for erecting the presses.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Partnership Dissolved.

THOMAS, George Edward, and PRAYNE, Douglas Herbert, electrical engineers, 106, Walm-lane, Cricklewood, London, under the style of Brayne & Thomas, by mutual consent as from Sept. 29, 1921. Debts received and paid by D. H. Brayne, who will carry on the business.

Bankruptcy Information.

MARTLAND, Frederick James, carrying on business at The Albion-yard, Millgate, Wigan, under the style of Fred Martland & Company, electrical engineer. Receiving order, Oct. 25, debtor's petition. First meeting, Nov. 8, 12 noon, Offices of the Official Receiver, 11, Dale-street, Liverpool. Public examination, Nov. 15, 10.45 a.m., Court House, Crawford-street, Wigan.

WORMULL, Frederick Alfred Stanley, 17, Bellingham-terrace, Bromley-road, Catford, S.E., trading at 273, High-street, Lewisham, as the Lewisham Electric Wiring Company, electrical engineer. Receiving order, Oct. 26, debtor's petition. First meeting, Nov. 8, 11.30 a.m., 29, Russell-square, W.C. 1. Public examination, Nov. 15, 11 a.m., Court House, Greenwich.

Notices of Dividends.

BELL, John Vincent, 21, North Bar Within, Beverley, co. York, electrical engineer. Amount per £, 6s., first and final, payable Nov. 4, Victoria-chambers, Bowllalley-lane, Hull.

JONES, John, and JONES, John Richard, carrying on business under the style of J. Jones & Son, at 7, Chapel-street, Penzance, electrical engineers. Amount per £, 9s., first and final, payable Nov. 8, office of trustee, William C. Pezzack, Public-buildings, Penzance.

JONES, John (separate estate), "Glencree," Penare-road, Penzance, carrying on business in co-partnership with John Richard Jones, under the style of J. Jones & Son, at 7, Chapel-street, Penzance, electrical engineer. Amount per £, 20s., first and final, payable Nov. 8, office of the trustee, William C. Pezzack, Public-buildings, Penzance.

Companies Winding-up Voluntarily.

NEW PROCESS ELECTRIC LAMP COMPANY, LTD. W. S. Deyes, 10, Cook-street, Liverpool, Chartered Accountant, appointed liquidator. Meeting of creditors at the offices of Simon Jude & West, 10, Cook-street, Liverpool, on Friday, Nov. 11, at 2.30 p.m. Particulars of claims to the liquidator by Dec. 3.

GUILDFORD ELECTRICITY SUPPLY COMPANY, LTD. B. D. Holroyd, 6 Great Winchester-street, Old Broad-street, London, E.C. 2, appointed liquidator.

Edinburgh Gazette.

M'KERLIE, Jardine, electrical engineer and contractor, 195, Crow-road, Partick, Glasgow, and residing at 2, Thornwood-drive, Partick, Glasgow. The trustee in this sequestration announces a meeting of creditors within the chambers of Mackie & Clark, Chartered Accountants, 124, St. Vincent-street, Glasgow, on Wednesday, Nov. 16, at 12 o'clock noon, to consider an application for his discharge as trustee.

The firm of LAWFORD ROSS & WHITE, mechanical and electrical engineers, 108, Woodlands-road, Glasgow, has been dissolved as from Oct. 17, 1921, by the retirement of Reginald Lawford Ross. William Wilson White will continue the business, and will collect all accounts due to, and discharge all the liabilities of, the firm.

TAYLOR, E.S., electrical engineer, Dawson's-building, Stenhouse-muir, Larbert. The trustee in this sequestration intimates that a first and final dividend will be paid within the chambers of MacLean, Gardner & Aiton, C.A., 115, St. Vincent-street, Glasgow, on Thursday, Dec. 15.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not

returned to the Registry if satisfied in the Court books within twenty-one days.]

BARRON, Thomas Roadhouse, and BARRON, Ida Gertrude (his wife), 172, Bracken-road, Shiregreen, Sheffield, motor electrician. £13 5s. 10d. Sept. 20.

CLARKE, E. E., & COMPANY, Albert-road, Morecambe, electrical engineers. £23 10s. 4d. Sept. 21.

COATES, Edward, 9, Nelson-villas, Bath, electrician. £23 14s. Sept. 22.

MARSHALL, C. E., 6, Emu-road, Battersea, electrical engineer. £38 10s. 11d. Sept. 20.

MEARNS, Albert, 8, Kensington-street, Bolton, electrician. £11 19s. 6d. Sept. 21.

PERRINS, Mr. J., 68, Gower-street, Birmingham, electro plater. £10 7s. 8d. Sept. 20.

ROWE, Mr. M., 27, Augusta-street, Birmingham, electro-plate manufacturer, £15 5s. Sept. 20.

WALKER, Alfred Thomas, jun., electrician (and others). £12 3s. Sept. 22.

WHEELER, Thos. Charles, and WHEELER, Jane Ann (his wife), 12, Ramsey-street, West Hartlepool, electrician. £11 12s. 10d. Sept. 21.

Bills of Sale.

[The undermentioned information is from the Official Registry. It includes Bills of Sale registered under the Act of 1882 and under the Act of 1878. Both kinds require registration every five years. Up to the date the information was obtained it was registered as given below; but payment may have been made in some of the cases, although no notice had been entered on the Register.]

CASHNELLA, Joseph Ewart, Cheshunt House, High-street, Cheshunt, electrical engineer. Oct. 27. £250.

HIBBERT, Francis Harold, 117, Kingsway, Mortlake, electrical engineer. Oct. 25. £70.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

FULLER'S UNITED ELECTRIC WORKS, LTD., Chadwell Heath. Registered Oct. 22, £150,000 deb., to National Bank of Scotland, Ltd.; general charge. * Nil. Aug. 12, 1921.

SWIFT ELECTRICAL LTD., London, W. Registered Oct. 19, £800 deb., to J. H. Butler, 99 94, Woodland-gardens, N., merchant; general charge. * Nil. April 19, 1921.

Reduction of Capital.

COMPANIA DE ELECTRICIDAD DE LA PROVINCIA DE BUENOS AIRES (Limited and reduced). A petition was, on Oct. 12, presented for confirming the proposed reduction of the capital of the above-named company from £825,000 to £562,500, and is to be heard on Tuesday, Nov. 15. Ashurst, Morris, Crisp & Co., 17 Throgmorton-avenue, London, E.C., solicitors for the company.

Benn Brothers' Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"The Cabinet Maker": "Furniture at the Metropolitan Museum of Art"; "Washington Relics in Sulgrave Manor."

"Chemical Age": "Theories of the Oppau Explosion"; "Physiological Value of Hydrogenated Oils"; and "British Association of Chemists Annual Meeting."

"Farm and Home": "The Cow at the Dairy Show," by Prof. James Long; "Varieties of Wheat"; and "Handy Tools for Pruning."

"The Fruit Grower" (Imperial Fruit Show Number): Descriptive account of the fruit exhibits and trade stands, with illustrations, and list of awards.

"Gardening Illustrated": "Colour Arrangement in the Garden"; "A Well-planted Rock Tank" (illustrated); and "Furnaces, Boilers and Shading for Greenhouses."

"The Gas World": "Coke Oven Managers discuss the use of Silica Brick"; "Supply of Benzole for Motors"; and "Coke for Motor Vehicles."

"Hardware Trade Journal": "Stock-taking and Stock-scraping"; "The Effect of Lead in Gun Metal"; and "Retail Advertising" (continued).

Patent Record.

SPECIFICATIONS PUBLISHED

Abstracts from some of the specifications recently published have been kindly supplied by Messrs. Mowbray, Jones & Co., Chartered Patent Agents, 71 and 72, Abchurch-lane, London, E.C. 4.

COMPLETE SPECIFICATIONS

- 15780 FORT, R. T. Combined lighting and electric dynamo electric machine. (6/2/21.)
 15781 DE HONDT RADIO TELEPHONE & TELEGRAPH CO. Self supporting electric circuit. (1/4/21.)
 15782 SMITH, WHITEHEAD & VALL. Electromagnetic stop motions for textile machinery.
 15783 MURPHY. Ignition commutators.
 15784 HENRIKSEN. Apparatus for recording and checking telephone calls.
 15785 KIPP, E. A. & Co. Electro-magnetic clamping devices.
 15786 COTTAN & RUSSELL. Piezo-electric devices.
 15787 & 15788 FERRENTI & WALL. Alternating current meters, &c.
 15789 FERRENTI. Direct current meters of mercury motor type.
 15790 SUGIOWA. Generator.
 15791 DAWSON & FRYDA. Suspension device for overhead conductor wires for electric railways, &c.
 15792 MOSS. Enclosed electric cartridge fuse.

June 9, 1921.

The mercury circuit contained in the combination space of the pump bowls above the two electrodes, the latter consisting of two receptacles filled with mercury, which receptacles are arranged relatively to one another in such a manner that the mercury can flow from one receptacle into the other.

15793 SUGIOWA & HANSEN. Apparatus for electrically measuring the temperature of a body.

15794 LEBLANC, S. Z., DE WALL, G., & FERRENTI, LTD. Alternating current electric meters. (17/1/20.) Divided application on 15787.

15795 LEBLANC, S. Z., DE WALL, G., & FERRENTI, LTD. Direct current electric meters of the mercury-motor type. (17/1/20.) Divided application on 15789.

15796 ALLEN, C. A. Electric valve or lamp relay and intervalve electric circuit. (8/5/21.)

15797 LONGBOTTOM, B., & GREENHALGH, E. Electric welding. (14/1/14.) (Cognate Application, 21745/20.)

15798 TUCKER, J. B. Electric switches. (21/10/20.)

15799 ECCLES, W. H. Electric relays. (17/4/20.)

15800 NEALE, J. Electro-magnets. (22/4/20.)

15801 LEBLANC, S. Z., DE WALL, G., & FERRENTI, LTD. Wireless direction finding apparatus. (22/4/20.)

15802 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). Protective devices for electric apparatus. (24/4/20.)

A thermal protective device for electrical apparatus adapted to be heated by all or a proportionate part of the current flowing in the circuit of the apparatus, the said device being provided with thermally related elements having different thermal characteristics which co-operate to produce a resultant thermal characteristic the same as that of the apparatus to be protected, and to cause opening or regulating of the circuit when the temperature in any part of the apparatus reaches a critical value under all conditions and values of current.

15803 SULLIVAN, H. W. Duplex and the like telegraphic systems. (24/4/20.) (Cognate Application 5810/21.)

15804 HOWELL, G. Sparking plugs. (27/4/20.)

15805 SHUTTLEWORTH, W. E. Holders or fittings for incandescent and like lamps. (30/4/20.)

15806 RAILING, M. J., & MANCHESTER, W. Electric tumbler switches. (6/5/20.)

15807 CHAPMAN, W. H. Means for drying ink and discharging electricity in printing. (17/5/20.)

15808 WRIGHT, G. M. Radiogoniometers especially suitable for use in wireless direction finding. (12/5/20.)

15809 BAKER, R. H., & PARSONS, S. W. Electric switches. (15/5/20.)

15810 BAKER, R. H., & PARSONS, S. W. Electric switches. (15/5/20.)

15811 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). Electric generating systems. (15/6/20.)

APPLICATIONS FOR PATENTS

JUNE 3.

15812 TEMPLE, Junction box for electric mains and protecting cover for terminals. (9/6/20, Italy.)

15813 TEMPLE, Fuse-box safety plug for low voltage cable installations. (15/3/21, Italy.)

15814 B. T. H. Co. (G. E. Co.). Electric switch operating mechanism. (15/3/21, Italy.)

15815 B. T. H. Co. (G. E. Co.). Contact fingers. (15/3/21, Italy.)

15816 ALLOY WELDING PROCESSORS, LTD. & JONES. Electrodes, welding rods, and soldering sticks. (15/3/21, Italy.)

15817 BERTHEND. Radio-telegraphic transmitting stations. (14/9/20, France.)

15818 RIGBY. Arc lamps. (15/3/21, Italy.)

15819 NAMBOORU VEDANGA KERN, MAATSHAPPEL ELEKTROSTROOM. Joining insulated conductors. (20/12/20, Holland.)

15820 AUTOMATIC TELEPHONE MANUFACTURING CO. Telephone systems. (17/6/20, U.S.)

15821 AUTOMATIC TELEPHONE MANUFACTURING CO. Telephone systems. (17/6/20, U.S.)

15822 RICHARDS. Signalling systems for use with electric staff system on railways. (17/6/20, U.S.)

15823 LEA. Electrically indicating combined effect of two independent measuring factors or elements. (17/6/20, U.S.)

15824 B. T. H. Co. (G. E. Co.). Electric measuring instruments. (17/6/20, U.S.)

15825 B. T. H. Co. (G. E. Co.). Switch contact fingers. (17/6/20, U.S.)

15826 GRESHAM & SULLIVAN. Electric heating elements. (17/6/20, U.S.)

15827 MIDLAND ELECTRIC MFG. CO. & BARBER. Switches and fuses. (17/6/20, U.S.)

15828 KING. Cutters for removing insulation from electric wires. (17/6/20, U.S.)

15829 METROPOLITAN-VICKERS ELECTRICAL CO. Motor control systems. (17/6/20, U.S.)

15830 SERRALL. X-ray tubes. (17/6/20, U.S.)

15831 MELLERSH-JACKSON (Bassard Railway Signal Corp.). Electric flashing apparatus. (17/6/20, U.S.)

15832 GARDNER & BULLY & CLOUGH. Electric locomotives. (17/6/20, U.S.)

15833 B. T. H. Co. (G. E. Co.). Magneto-electric machine. (17/6/20, U.S.)

15834 MOON. Electric connections. (17/6/20, U.S.)

15835 KRIPP, F. J. ART-GES. Electro-magnetic clamping device. (17/6/20, U.S.)

15836 BALDUCI. Multiple electro-mechanical relay for equilibrated poly-phase circuits. (17/6/20, U.S.)

15837 B. T. H. Co. (G. E. Co.). Power plants. (17/6/20, U.S.)

15838 AUSTEN. Electric water heater. (17/6/20, U.S.)

- 15782 SMITH. Electric heating appliance.
 15783 SAKES. Electro-magnetic apparatus for recording sound.
 15784 JAMES. Time controlled switching devices.
 15785 METROPOLITAN-VICKERS ELECTRICAL CO. Insulators. (7/7/20, U.S.)
 15786 DRENNAN. Electric cables as conductors.
 15787 ART. G. S. B. O. W. (G. E. Co.). Cooling apparatus for oil transformers. (9/12/20, Switzerland.)
 15788 WESTINGHOUSE CO. Automatic telegraph systems. (1/7/20, U.S.)
 15789 B. T. H. Co. (G. E. Co.). Combined plug receptacles and switches.
 15790 SCHÖNING. Illuminated advertising devices, &c.

- 15791 SMITH, WHITEHEAD & VALL. Electromagnetic stop motions for textile machinery.
 15792 MURPHY. Ignition commutators.
 15793 HENRIKSEN. Apparatus for recording and checking telephone calls.
 15794 KIPP, E. A. & Co. Electro-magnetic clamping devices.
 15795 COTTAN & RUSSELL. Piezo-electric devices.
 15796 & 15797 FERRENTI & WALL. Alternating current meters, &c.
 15798 FERRENTI. Direct current meters of mercury motor type.
 15799 SUGIOWA. Generator.
 15800 DAWSON & FRYDA. Suspension device for overhead conductor wires for electric railways, &c.
 15801 MOSS. Enclosed electric cartridge fuse.

June 10, 1921.

15792 PHILLIPS. Turbo-generator for road vehicles.

15793 BRITISH INSULATOR & CABLE CO., LTD., LEICESTER, & CO. Fitting for clamping and connecting cables, &c.

15794 HOLMES. Apparatus for reflecting electric arc of kinematograph lamp on a screen, &c.

15795 RICHARDS. Magnetic regulator for clock mechanisms, &c.

15796 DRAKE & KIRK. Brush holders in dynamo-electric machinery.

15797 HANDLEY. Electric fuses and fuse boards.

15798 HANDLEY. Electric terminals.

15799 HANDLEY. Electric switches.

15800 BROWN. Junction box for inter-communication telephone systems.

15801 & 15802 HYDE. Incandescent lamps.

15803 BAERLOCHER. Liquid electric motor starter.

15804 WESTINGHOUSE CO. & POLSKOWSKY. Telephone exchange systems.

15805 RUELAND. Electric irons.

15806 B. T. H. Co. (G. E. Co.). Flow meters.

15807 GARDE. Switches and switch holders.

June 11, 1921.

15808 AUTOMATIC TELEPHONE MFG. CO. Apparatus for use with train control systems.

15809 DITZEL, LTD., CRAIG & PEARSON. Electrolytic treatment of metalliferous materials containing tungsten or molybdenum.

15810 EASTERN TELEGRAPH CO. & PENNET. Electric signalling.

June 13, 1921.

15811 BAILEY. Bowls for reflected lighting.

15812 REBER. Resistance for regulating candlepower of incandescent lamps.

15813 CROOK. Accumulators.

15814 COHEN & NIS. Electric lighting device.

15815 B. T. H. Co. & CLOUGH. Electric motors.

15816 WOLFFMEYER. Interference tubes for phonographs and telephones.

15817 DIXON. Speed governors for motors.

15818 WHISTLECRAFT. Electric calling devices.

15819 KANDO. Alternating current power-transmission plants.

Prices of Metals, Chemicals, &c.

		TUESDAY, NOV. 1.	
Copper—		Price.	
		Inc.	Dec.
Best selected	per ton	£76 15 0	— 5 0
Electro Wirebars	..	£71 10 0	—
H.C. wire, basis	per lb.	0s. 11½d.	—
Sheet	..	0s. 10½d.	—
Phosphor Bronze Wire (Telephone)—			
Phosphor-bronze			
wire, basis	..	1s. 3¼d.	—
Brass 60/40—			
Rod, basis	..	0s. 8d.	—
Sheet, basis	..	0s. 10½d.	—
Wire, basis	..	0s. 11½d.	—
Pig Iron—			
Cleveland Warrants	per ton	£5 10 0	—
Galvanised steel			
wire, basis 8 SWG	..	£23 0 0	—
Lend Pig—			
English	..	£25 0 0	— 7
Foreign or Colonial	..	£24 0 0	— 2 6
Tin—			
Ingot	..	£156 15 0	— 10 0
Wire, basis	per lb.	2s. 1½d.	— 1d.
Salmoniac—Per cwt. 65s.-60s.			
Sulphur (Flowers)—Ton 115.			
.. (Roll-Brimstone).—Per ton			
£13.			
Sulphuric Acid (Pyrites, 165°)—			
Per ton, 29 17s. 6d.			
Rubber.—Para fine, 1s. 2d.; plantation 1st latex, 9½d. to 10d. lb.			
The metal prices are supplied by British Insulated & Helsby Cables, Ltd.			

The Editorial, Advertising and Publishing Offices of "THE ELECTRICIAN" are at 3, Bouverie Street, London, E.C. 4. Telegrams: "Electrician, Fleet, London. Telephone: City 9852 (5 lines). The subscription to "THE ELECTRICIAN" is £2 12 0 per annum in the United Kingdom, and £2 14 0 per annum Abroad. Advertisement Rates can be obtained on application to the Manager. Advertisement copy and blocks should be received on the Friday preceding date of publication.

THE ELECTRICIAN

ESTABLISHED 1861.

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1861—1921.

THIS week our space is mainly devoted to the celebration of an event. On November 9, 1861, the first issue of THE ELECTRICIAN was published, and it is therefore only in accordance with the fitness of things that the passing of these sixty years in the life of a technical journal should be marked in some suitable way. No more suitable way can be found than by sketching the development which has taken place in the electrical industry and the part THE ELECTRICIAN has played in that development.

A Tradition with Disadvantages.

For some reason or other there is more virtue in the periods of fifty and sixty years than in forty or seventy, or even in eighty or ninety. But for us, in this instance, the tradition is not without its disadvantages. If, as we have done many times during the past few weeks in the intervals of other duties, we reverse the time-machine and project ourselves back into 1861 so as to make that date a starting point in a survey of electrical progress, we find not only that we have gone back into the dim twilight ages, but that we have passed beyond the creation. In those days, to employ a *cliché*, electricity was not even in its infancy. As we know it to-day, it had scarcely succeeded in being born. A story is told of a traveller who wrote a book on Iceland. One chapter was headed: "Snakes in Iceland." The contents ran: "There are no snakes in Iceland." That very aptly represents the condition of electrical engineering in 1861.

An Epoch-Making Report.

The self-denying ordinance that the Diamond Jubilee of THE ELECTRICIAN should be celebrated by epitomising the state of electrical knowledge and development in 1861 and of showing both directly and by inference the effect that knowledge and development have had on subsequent pro-

gress naturally rules out much that is of great interest and value that might well be written. It rules out all the vast field of electricity supply for lighting, power and other purposes. The fundamental work of FARADAY had been accomplished, it is true, but the wide-spreading practical applications of his discoveries were as yet experiments in the laboratories of WILDE, SIEMENS and PACCINOTTI. In another field the failure of the Atlantic cable had turned the clear, penetrating intellect of KELVIN to the problems of electrical transmission, and the work which he and others performed for the Atlantic Cable Committee is not only of outstanding scientific value, but must be unique in the history of Government commissions. The mathematical investigations of KELVIN, CLERK MAXWELL, STOKES, RAYLEIGH and, may we add, HEAVISIDE without undue self-praise, and their profound effect on the development of wireless telegraphy had not been begun. In 1861 capital stations, three-phase transmission, even Electricity Commissioners would have seemed phantasies before which SHAHRAZADE's stories would have paled. In 1861 there was no electrical legislation limiting and curbing enterprise. These were, indeed, the dim, dim days of the industry.

Nevertheless, all was not stagnant. Indeed, in many ways the electrical (or, more accurately, the telegraph) industry was vibrant with energy. Some 90 000 miles of land lines existed under private control, and there were also some 11 000 miles of submarine cables—not all British—laid, only about 3 000 miles of which were in working order. On the principle that mistakes are more important than successes, the outstanding feature of those days was the Committee that was sitting upon the breakdown of the first Atlantic cable, and upon whose findings Mr. G. L. ADDENBROOKE so interestingly comments on another page of this issue.

The Genesis of "The Electrician."

IN these days of twilight, even of false dawn, THE ELECTRICIAN was started. If we search for the reason of its inauguration we find it in the need of those working at the growing applications of electricity for a journal of their own. This need, we are told in the first issue, rendered the establishment of a technical journal "almost a necessity." In other words, electricity was beginning its slow metamorphosis from a science into an industry, and one of the first signs of this great change was to be found in the realisation that neither the purely scientific journals nor the daily Press dealt fairly with electrical progress. In some ways, therefore, matters have not much changed since 1861. It may be added that this metamorphosis has been going on ever since. At first the change was of a glacier-like slowness, but the pace has gradually been accelerating until THE ELECTRICIAN, whose first love was, as it has always been, technology, is being forced to give more and more space to economics and commercial matters, because it is in those matters with which the majority of its readers are becoming increasingly concerned.

A Clearing-House of Ideas.

A JOURNAL which professes to cater, and succeeds, however feebly, in catering, for an industry whose ramifications are as wide as those of the electrical industry, must, above all things, be a clearing house of ideas, thoughts and deeds. That is a great function, and a very responsible function. During the long time it has been the aim of THE ELECTRICIAN to perform that function not without some share of success. It may be that THE ELECTRICIAN, to give personal attributes to the inanimate, has often fallen into error, that it has allowed others to publish misleading statements in its columns, that it has often been forced to change definitely expressed opinions that have shown ignorance of what it ought to have known. And it can only plead in extenuation that those responsible for its conduct have had to wield the pen of a pontiff with the brains of human beings, and that, given such an ill-assorted selection of equipment and driving force, the efficiency cannot fail to be low. But even this low efficiency has its uses, for by the clash of ideas and the publication of varying opinions progress cannot fail to be made, or, in a pregnant phrase that appears in the first volume of THE ELECTRICIAN: "One of the first qualifications for science is a continual reservation of the possibility of misconception in regard to the conclusions we arrive at."

Helping the Student.

THE ELECTRICIAN has, indeed, always aimed at meeting the requirements "of the student in a field of knowledge which is every day being extended, and which is, in all probability, destined to solve many of the most important problems connected with the well-being of mankind." We quote our issue of November 9, 1861. How far this ideal has been attained it is hardly for us to say, but, reading the congratulatory messages from eminent electrical engineers all over the world, we feel THE ELECTRICIAN has not entirely failed. Not one, but many of these messages, mention the constant perusal and consultation of its pages as part of a weekly round of duties, and we cannot help feeling impressed and more than a little touched at the influence which the journal has been able to exert on the development and trend of electrical progress.

The Journal and the Industry.

It is, however, well to be clear on one point: A technical journal can have little direct influence on either persons or industry. Its real—nay, its only—influence is indirect. It has its genesis in the thoughts and doings of all sections of the industry it represents, and what is published in its pages is only as clear a reflection as it is possible to make of those thoughts and doings. It is not surprising, then, that the files of THE ELECTRICIAN are a record of change. They chronicle the rise of an industry to an eminence which few foresaw and none prophesied the details. In sixty years the developments, as we show by implication in this issue, have been little less than astounding. But the end is not yet. During the next sixty years progress is not likely to lag behind what has already been done, and, though few of us now working in the electrical industry will be living to see that day, we do not doubt that THE ELECTRICIAN will be still chronicling and commenting on the events of that time. The way towards this fresh goal will not be easy either for the industry or THE ELECTRICIAN, but we do not doubt that the goal will be attained. To traverse the way is hard work, but it is work worth doing, for, to quote the first issue once more: "The study of electricity possesses much that is admirably adapted to discipline the mind."

Are We Building Too Well?

AMONG the technical points made by Mr. HIGHFIELD in his presidential address to the Institution of Electrical Engineers last week was the important one that electrical development must depend on cheap transmission and upon the production of apparatus which, though capable of performing all the duties for which it is designed, is marketed at the lowest possible price. Attention, Mr. HIGHFIELD considers, should therefore be directed to the means of connecting consumers' apparatus with the mains and to simplifying the design of switchgear and other subsidiary plant, even if this has to be done at the expense of a certain amount of security. This statement opens up a wide field of argument. It is axiomatic that we must place in the forefront of electrical development a continuity of supply as absolute as it is possible to make it. Nothing in the past—certainly nothing in recent years—has so helped the progress of electricity supply as the certainty that it is always available when it is wanted and nothing will do more harm to that progress than any falling away from this high ideal.

The Need for Greater Knowledge.

At the same time, we agree with Mr. HIGHFIELD that much apparatus is unduly robust. But the more knowledge we gain of the materials used in electrical apparatus and of the way in which they function the more we can reduce the margin in our designs and, at the same time, reduce cost without relinquishing any fraction of the security. The same point was raised in another way by Colonel CROMPTON in proposing a vote of thanks to Mr. HIGHFIELD. He said that a great deal of the industrial failure of electrical engineers was due to their having made their apparatus to last so that there was no need for renewals. Without taking this statement too strictly at its face value, there is much of interest in his further point that electrical engineers are now making equipment to supply a commodity which everyone wants and which everybody will continue to require in ever-increasing quantities.

Selling for Consumption.

It is, indeed, from this point of view that the future of the electrical industry must be considered. The selling of machinery with a more or less long life is, though necessary, but a subsidiary factor in our future development. What we are really selling is a consumable commodity, and the more easy and cheap we can make its consumption the better off we shall be. This point is emphasised by a statement in Mr. HIGHFIELD'S address that the greater efficiency of electric lamps and the consequently smaller demand has been one of the causes of higher charges for supply. But even now the consumer is apt to use too little light rather than too much. He should therefore be encouraged to avail himself of the higher efficiency of light production to obtain better illumination at the same cost rather than to maintain an inadequate standard of lighting on his present small consumption.

The West Riding (Aire and Calder) District.

THE decision of the Electricity Commissioners upon the schemes put forward for the reorganisation of electricity supply in the West Riding district, though a compromise of conflicting interests and principles, is probably the best and most equitable that the circumstances and facts permit. After confirming the district, as provisionally defined with some slight additions, and ordering the interconnection of seven of the principal generating stations in the area, the Commissioners have come to the conclusion that, owing to its natural and technical advantages, the proposed Ferrybridge station of the Yorkshire Power Company should be constructed without delay and linked up with the interconnected system.

More Co-operation Necessary.

It will be remembered that at the local inquiry two schemes were submitted by the Conference of Local Authorities and by the Leeds Corporation respectively, while certain representations were made by the Yorkshire Electric Power Company. The Commissioners have not found any of the schemes acceptable, but have divided the district into two areas, one of which will be supplied from the interconnected municipal stations and the other by the Power Company alone. As the negotiations for the purchase of the undertaking of the Power Company failed, the scheme of the Conference of Local Authorities is not feasible and, moreover, as the Commissioners rightly point out, the much-needed improvement in the supply of electricity in the district should be effected by the co-operation of all the authorised undertakers and authorities in the district and by mutual assistance under the control of a Joint Electricity Authority. We hope those most concerned will see the necessity of this and direct their efforts accordingly.

Formation of a Joint Electricity Authority.

ONE of the most significant of the Commissioners' conclusions is that a Joint Electricity Authority should be formed for the whole district. We agree that such an authority, if truly representative of all the interests in a district and provided there are clear-cut, definite principles upon which the representation on it is based, is the best means of securing adequate local control of the supply industry. The method of representation adopted by the Commissioners in the present instance is therefore of special interest, as it will probably form a precedent for similar cases in future. We notice that no indication is given of

the size of the proposed authority, but each of the four leading municipal undertakings (Bradford, Halifax, Huddersfield and Leeds) are allowed separate representation, and provision is also made for the joint representation of nine smaller boroughs, and urban council undertakings and also of local authorities possessing purchase rights.

The Representation of Interests.

FURTHER, there is to be representation of the West Riding County Council, acting on their own behalf and on behalf of urban and rural councils not owning undertakings and in whose districts there are no authorised distributors, and of the Power Company, as well as joint representation of companies owning authorised undertakings and of the railway companies. Thus there will be eight classes or interests represented on the Authority. If these suggestions as to the constitution of the Joint Authority are adopted generally it will settle some disputed points as to the character of the interests to be represented, and should make it easier to carry on negotiations for the reorganisation of the industry in other areas.

Powers of the Joint Authority.

THOUGH the district has been divided into two, the Joint Authority will, nevertheless, have extensive powers. It will control, in consultation with an advisory committee of engineers, the working of the interconnected generating station, and pool the results for the common benefit of the local authorities supplied; it will arrange for supplies to or from the Power Company's system, and will give effect to a scheme, which is to be prepared, for the most efficient use of existing generating plant and for providing transmission lines in that portion of the district which is to be supplied from the interconnected municipal stations. Certain adjustments of areas will have to be made, and the Power Company, or its subsidiary (the Electrical Distribution of Yorkshire), will have distribution rights in all areas not within the supply areas of authorised distributors, subject to the purchase provisions of the Electric Lighting Act, 1888, and other conditions. The Joint Authority, acting with the Power Company, must also submit within two years proposals for a system of distribution in these areas which are not within the areas of supply of authorised distributors where there is a reasonable prospect of such supply being remunerative.

Financial Powers.

OF course, the financial powers which will be conferred upon the authority will depend upon the enactment of a further Electricity (Supply) Bill. This is the only doubtful thing in the scheme. On the assumption, however, that such a measure will be passed, the preliminaries for the formation of the authority can be prepared at once, so that everything will be in readiness for the full exercise of its powers when that is legally permitted. It will be seen that the Commissioners have adopted an ingenious method of dividing the powers and duties of authorised undertakers between the municipal authorities and the Power Company, an arrangement which should effect a great improvement in the existing supply organisation in the district at a comparatively small public expenditure.

Motor Headlights.

MOTORISTS have been waiting with some curiosity for the results of the deliberations of the Departmental (M.O.T.) Committee on Lights on Vehicles. Two interim Reports were issued in 1920. The third Report, which is

now available, enters more fully into the problem of avoiding dazzle, which, it is remarked, can scarcely be completely eliminated in all circumstances. Experts, in fact, recognise the necessity for compromise between the requirements of the driver, who needs a powerful beam, and those of other users of the road, who are apt to be dazzled by its brilliance.

A Specification of Glare.

THE Committee has formulated a specification, which is presented in an appendix. The essential points in this document are a minimum range of forward illumination of 150 ft. and a maximum of 300 ft. (judged by the R.A.C. standard disc, which is described), a minimum width of 30 ft. and a maximum height of 4 ft. above the ground, and that the lower edge of the beam must impinge on the road not more than 50 ft. in front of headlight. Freedom from dark patches and reasonably uniform illumination or good gradation are also required. These conditions refer to the main driving beam, but conditions which have to be fulfilled by a field of diffused light are also specified. It is explained, however, that this specification is given for the guidance of manufacturers and motorists only, and is not to be regarded as a basis for legal regulations. Although over 100 devices were tested, some quite promising, none exactly fulfilled the specified requirements. So far as regulations are concerned, the Committee contents itself with two general clauses specifying that the headlight shall not give a range of forward illumination in excess of 150 ft. at any point more than 4 ft. above the ground, and that the front of the headlight viewed from any point more than 4 ft. above the ground is to have "a reasonably soft illumination throughout its whole surface without brilliant lines or points of light."

Limiting Glare.

THE new regulations are thus dictated by a desire to limit glare. They are admittedly couched in very general terms, but it is proposed that devices should be submitted to testing authorities, who will issue certificates of approval. Other remarks refer to swivelling lights and to inspection lamps, the latter being sanctioned provided they are not used when the car is in motion. We notice that the view is expressed in some quarters that the proposed action is timid, and that the essentials of the problem have been evaded. On the other hand, the problem of enforcing compliance (which, it is somewhat pathetically remarked, demands the co-operation of manufacturers and motorists), and the liability of hardship in respect of the very large number of existing headlights in use, if too drastic regulations were adopted, indicate the need for caution. No regulation requiring a minimum power in the main beam is proposed, partly in view of the large number of taxicabs, operating in well-lighted streets in urban areas, that operate with oil lamps. However, the statement of the more detailed requirements in the specification should have a good influence, and up-to-date motorists will doubtless aim at compliance with these rather than the less exacting official regulations.

Cheap Power for Irish Industry.

MANY of the troubles in Ireland at the moment rest on the fact that it is an agricultural country with practically no industries. This is mainly due to the fact that coal has to be imported. It is, however, a welcome sign to see an All-Ireland Conference, representative of every party, has been discussing the problem of the economic pro-

duction of power for Irish industries at the present time. The more this problem is discussed and understood the better for Irishmen and the better for civilisation and progress. We hope, therefore, that those who attended the Conference will not be content with academic discussion, but will make an effort to carry out one or more of the suggestions made by the speakers. For instance, Mr. TOMLINSON suggested the erection of a standard hydro-electric station on one of the more easily developed waterfalls in order to supply electricity in bulk to four or five towns within measurable distance. This is quite feasible, and would give a fillip to electricity supply in urban and rural areas. We also learn on the authority of the Fuel Research Board that the Irish peat deposits are alone sufficient to meet the country's power requirements for 250 years, and, though some experimental data have been collected on the utilisation of peat, little practical progress has been made. We hope, therefore, that the Conference will endeavour to bring to fruition a work that will do more good for Ireland than political agitation.

Another Argument for a Traffic Authority.

THE attempt of Lord ASHFIELD to make a condition of carrying out an extensive scheme of electric railway development in London the granting of a monopoly in omnibus transport to the Underground interests for a term of years has failed, the Government rightly refusing to accept the proposal. Nevertheless, we are glad to learn that negotiations with regard to the electrification scheme proper are still in progress, and we hope that they will be successful, so that it will be possible shortly to put the work in hand. The motor-omnibus question still, however, remains, and it is obvious that things cannot be left in their present position, for, while the General Omnibus Company has no legal monopoly, its operations are virtually uncontrolled by competition or otherwise. The result is that its policy is too often directed more for its own good than that of the public. This will not be improved by granting a monopoly, but is rather a further argument for the formation of a London traffic authority which shall, among other things, regulate services and scale of fares for all forms of transport.

Utility of Joint Industrial Councils.

A STRIKING example of the good work that can be performed by Joint Industrial Councils has just been given by the councils of the various branches of the electrical industry. Though there is, fortunately, far less unemployment in the electrical than in other industries, the Joint Council of the Cable Makers felt justified in calling a conference of the whole of the Whitley Councils and of the trade and commercial associations representing the entire industry in order to consider the subject of unemployment in all its aspects. The outcome of the conference was the preparation of a valuable memorandum, representing the unanimous opinion of both employers and employed, which, as stated in our last issue, was submitted to Sir ALFRED MOND, as Chairman of the Cabinet Committee upon Unemployment, and received sympathetic consideration at his hands. This is the first occasion on which the Joint Industrial Councils of any industry have taken concerted action on a matter which, though not directly connected with the wages or the terms of employment, is yet of great importance to both employers and workpeople, and its success shows to what excellent purpose these new industrial organisations can be put.

Retrospect and Prospect.

A SPEECH made extempore or from notes has the advantage that the effort required from the speaker for marshalling his thoughts in an intelligible form generates energy, which usually causes what he says to be transmitted to his hearers with sufficient intensity to actuate their receiving equipment to a greater or less extent. In a lecture delivered from a written manuscript this creative energy has been expended in the work of preparation and, unless the speaker is a first-rate orator or his subject is more than usually interesting, the matter, however good, may fail to tune any answering chords in the minds of his audience. On the other hand, when an account of an extempore address is read, phrases and arguments that seemed at the time brilliant then appear only meretricious, while the good qualities of the written lecture stand out more clearly on closer study.

An Important Guiding Principle.

The sense of disappointment which some felt after the delivery of Mr. J. S. HIGHFIELD's presidential address before the Institution of Electrical Engineers last week should not, therefore, deter those who are interested in the progress of the industry from making further study of its contents, or discourage the author with the feelings that his suggestions and diagnosis for future recovery and present ills have not received the attention they deserve.

Indeed, we heartily recommend that further study. The canvas is broad and crowded and the motive, as a result, a little obscure. Nevertheless, if we analyse it sentence by sentence and paragraph by paragraph an important guiding principle may be discovered.

Entering on a New Phase.

In more ways than one the Institution of Electrical Engineers has entered on a new phase in its career. The outward and visible signs of this entry are the granting of a Royal Charter and the acceptance by H.M. the KING of the office of Patron. The new status thus conferred should allow the Institution better to guard the interests of its members and more authoritatively to put forward their views on legislative and public matters that affect their well-being. And with these views and desires have occurred, as Mr. HIGHFIELD justly points out, a subtle change of outlook during the last few years. Almost against their will the governing body of the Institution, both collectively and individually, have been forced to take more cognisance of educational and industrial matters. The reasons for this need not be discussed; but it naturally follows that to ensure electrical progress these questions must be dealt with and decided, if possible, once and for all.

Education—A Cause and a Remedy.

A considerable portion of Mr. HIGHFIELD's address is devoted to education, both as a cause and a remedy for present discontent. How, in a word, Mr. HIGHFIELD asks, can we make work more interesting? The fault for the lack of interest that now exists does not altogether lie in remuneration, nor in over-effort, nor in the unpleasantness of many tasks, nor in their monotony. The remedy also is not simple. It may lie in team work, so that winding coils and working shifts in central stations may become "as though they were almost cricket"; or it may lie in the inculcation of greater skill into the hands of the operatives.

The Human Being a Machine No Longer.

We agree with Mr. HIGHFIELD that our present system of education is at fault in that it pays too much attention to the training of brain and not enough to training of the hand. And, at the same time—and here the electrical industry cannot fail to be of the greatest help—means must be found of getting rid of the use of the human being as a machine and of employing him as little as possible on certain unpleasant tasks which are necessary to health and civilisation. The early masons who laboriously carved the architraves and choir seats in our great cathedrals enjoyed their work, as the results amply show. Even to-day the skilled silversmith works as if he loved it. Cannot we once again raise skilled labour to its old standing, and by so doing give it its old interest? Skilled labour is mis-called at present. So much of to-day's work is deadening both to body and soul. All this, as Mr. HIGHFIELD truly says, is a problem of the first importance—a problem whose solution is not clear, but which must be sought in a sound and sensible education for the youth and a proper application of that education in the man.

Towards Individuality.

One of the results of any system of education of this kind will be an increasing acceleration from collectivism towards individuality. That movement has, in a sense, begun. Roseate schemes of State ownership have faded into the stern reality of the failure of attempts in that direction that have been made both during and since the war. Trade recovery and all the benefits that it will bring to both communities and individuals must come through private effort. Enterprise must be encouraged by the removal of restrictions and by freedom to earn profits.

This freedom for enterprise, as Mr. HIGHFIELD truly says, is especially necessary in the electricity supply industry. Without that freedom it cannot expand, and unless it expands the electrical industry cannot flourish, nor can the cost of supplying electricity be reduced.

Some Minor Matters.

Bound up with this large problem are many minor ones, on some of which Mr. HIGHFIELD touched lightly, and upon which we may also remark. The amendment of design to reduce cost, even if we have to discard something of security; the necessity for having powers to impose a 2 per cent. tariff; the increase in the maximum permissible charge, so as to give a margin between what can be and what is charged; the removal of the feeling of insecurity that permeates private enterprise in electricity supply, caused principally by the purchase clause, an enactment which Mr. HIGHFIELD thinks should be boldly swept away; the ethics and economics of purchasing foreign rather than British plant. These are all matters of importance on which no effort should be spared to obtain a solution.

Two Necessities.

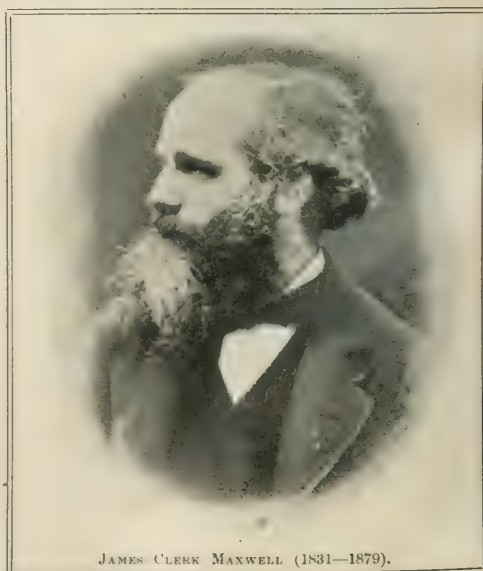
We think, then, that Mr. HIGHFIELD's message is this: That the time for fighting has past, and the time for a general pooling of interests has come. Or, as he himself says: "Progress in electricity supply rests first on a general determination to cease talking and get to work." This applies equally to supporters of the municipal and company ideas, to capital and labour, to the technician and the industrialist, to the employer and the employed. The future of the industry is bright if its present be dull, and its possibilities are illimitable. The necessities for realising that future are a determination to work together in the common interest and—a little courage.

FAMOUS ELECTRICAL PIONEERS,

DAVID EDWARD HUGHES (1831—1900).



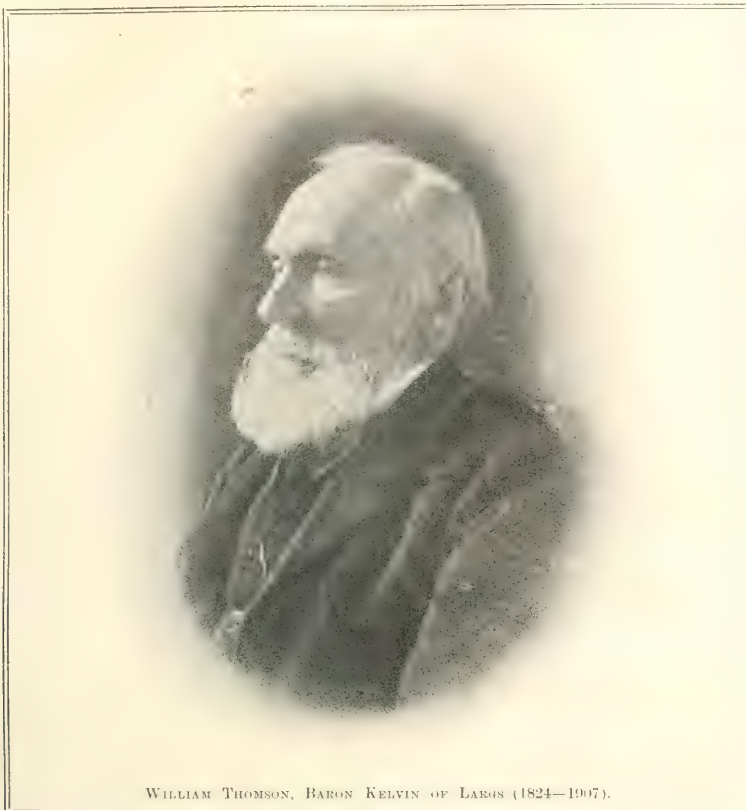
MICHAEL FARADAY (1791—1867).



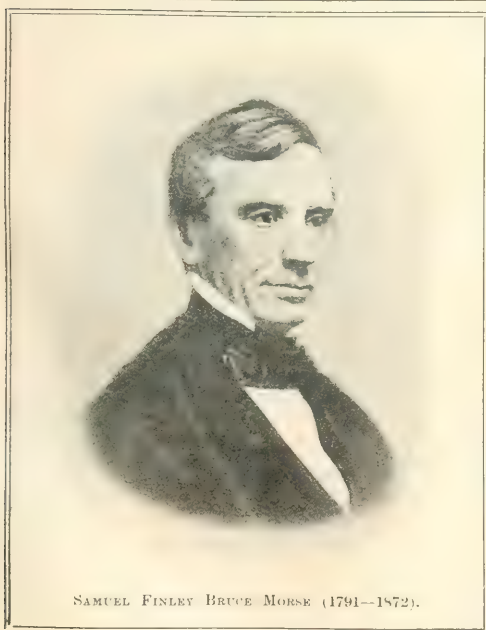
JAMES CLERK MAXWELL (1831—1879).

The photographs on this and the following page are reproduced from—

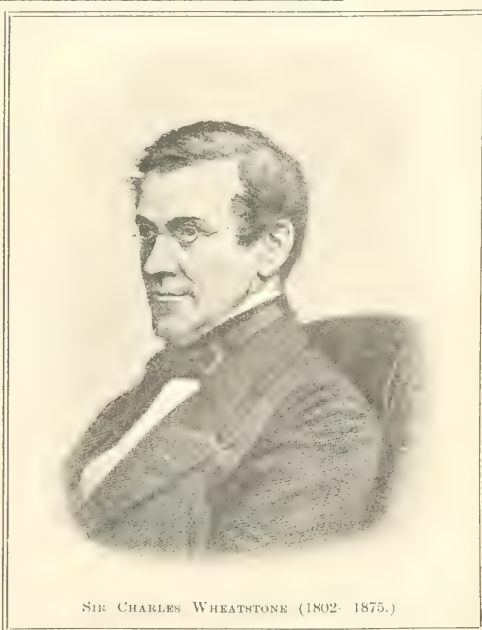
DISCOVERERS, INTERPRETERS, and MEASURERS.



WILLIAM THOMSON, BARON KELVIN OF LARGS (1824—1907).



SAMUEL FINLEY BRUCE MORSE (1791—1872).



SIR CHARLES WHEATSTONE (1802—1875.)

—Prof. J. A. Fleming's "Fifty Years of Electricity," by permission of the "Wireless Press."

ELECTRIC SCIENCE AND INDUSTRY IN 1861.

The Report of the Joint Committee on the Construction of Submarine Cables.

By G. L. ADDENBROOKE.

The Report of the Joint Committee appointed by the Lords of the Committee of the Privy Council for Trade and the Atlantic Cable Company to inquire into the construction of submarine telegraph cables was dated April, 1861, and was issued on June 21 of the same year. This Report, with its eighteen appendices, is, in my opinion, the most momentous compilation in the history of electrical science and enterprise, and has had the greatest effect on electrical industry. Had the findings of the Committee been adverse, it seems certain that human progress itself would have been seriously retarded. As this Report is now, I find, almost unknown, I will try to explain, as far as space permits, how I have been led to these conclusions.

Early Attempts at Telegraphy.

The idea of transmitting signals electrically arose in the eighteenth century even before Galvani and Volta's discovery of the electric battery, and was followed up for many years afterwards by inventors working on electrostatic lines. They failed because by generating a current of less than a milli-ampere with frictional machines at a tension of, say, 10 000 to 20 000 V, sufficient current could not be conveyed any distance to charge electroscopes or indicating instruments of that type to a voltage of about 500. Briefly, it was a question of insulation. After Galvani's and Volta's discovery about 1800 currents could be readily obtained of 1 000 times the former magnitude. Thus the leakage problem was simplified, but it was still impossible to generate these currents practically at sufficient tension to affect electrostatic instruments at a distance. It was not till 1827, when Oersted discovered that such a current would deflect a magnetic needle, that a new field was opened to inventors.

The Effect of Oersted's Work.

By coiling the conductor round the space containing the needle the effects could be further multiplied, say, hundred-fold; thus signals were practical if the arrival current was only a few milli-amperes, while the sending current could be, say, an ampere if necessary. Moreover, owing to the conductivity of copper or iron wire, 10 to 20 V was sufficient working tension for considerable distances, or, say, one one-thousandth the tension with frictional electricity. There was, therefore, only one one-thousandth the tendency to leakage, and the effect of the current arriving at the receiving end could be multiplied 100 times at least. With such a leg-up it might be thought that ordinary telegraphy would have romped ahead, but history shows it was not so.

The Insulation Problem.

Leakage was still such that signals were with difficulty readable at ten miles distance. The real problem was still the question of insulation. However, what was practicable was sufficient for a commercial start, and efforts were concentrated on the study of insulation. The efforts were of rather a rough trial and error character; but perseverance was gradually rewarded. Better insulating materials were discovered, as were better methods of manufacture and design, and in the following twenty years land telegraphs up to several hundred miles in length became practicable.

In the course of this work leading-in covered wires were often necessary; wires had to be carried through tunnels and in some cases to be placed underground, also for military reasons. The difficulties met with in making such covered wires and the history of early underground work are all described very graphically by Cromwell Varley and others in the evidence given before the Committee.

Rubber as an Insulator.

From this it would appear that at a certain date rubber began to be used as a covering for wires, but after a few

years' trial it failed for reasons which are fully described, and which appear to be of the same character as those which led to the failure of rubber electric supply cables half a century later. It was not till this failure occurred, viz., about 1846, that gutta-percha was introduced. It was found to behave in water as well as rubber, to stand alternations of damp and dryness much better, and was made harder. The results naturally led to the view that submarine cables were practicable.

The First Submarine Cable.

At last Brett, in 1851, after a failure in 1849, laid a gutta-percha cable across the Channel, which succeeded and continued to work till 1859, when it had to be extensively repaired from outside causes, but the gutta-percha insulation itself was from time to time found otherwise to be quite intact and unaltered. In 1852 a cable of 73 miles length was laid between Dover and Ostend. In 1854 five cables were laid in the Mediterranean up to 125 miles in length. This was the time of the Crimean War, followed in 1857 by the Indian Mutiny, which emphasised the value of rapid communications and turned men's minds to it. During the Crimean War, viz., in 1855, the Government had a cable laid from Varna to Balaclava 356 miles long.

Electrostatic Difficulties.

Up to this time everything in cable work seems to have been of rather a rough and simple character following the lines of land telegraphy, but leading electricians gradually became aware that as the length of the cables was extended they were up against new phenomena, and the rate of signalling seemed limited. So early as 1850 Werner Siemens had drawn attention to this phenomena in connection with subterranean lines in Prussia. In his evidence before the Committee, Latimer Clark says he first witnessed it in experiments in March, 1852. In 1853 they were shown to Faraday, who lectured on them at the Royal Institution in 1854, explaining that the effects were due to the cable becoming statistically charged like a Leyden jar, the earth being the outer coating. The phenomena became prominent in the Varna-Crimea cable, through which it was found impossible to transmit messages at the rate of more than five words per minute.

Kelvin's Investigations.

Faraday's lecture drew Lord Kelvin's—then W. Thomson—attention to the phenomena, which was in line with theoretical investigations he had been making for many years previously. He wrote, as he explains in his evidence, two letters to Stokes in October and November, 1854, which appeared as a communication to the Royal Society in May, 1855. In this he laid down the laws of electric transmission through conductors as influenced by their capacity, and showed how to calculate the inductive capacity of the insulator.

It was purely a theoretical explanation, because neither Lord Kelvin nor anyone else at the time knew what the specific inductive capacity of gutta-percha was. Faraday had given the S.I.C. of gutta-percha as 2 from some rough experiments, and in a later communication Kelvin notes this as the only figure available, though he says the correct figure might be easily found. But I think it is clear that no such investigation was carried out when the first Atlantic cable was laid. Subsequent experiment has shown that the above figure is only a little more than half the dielectric co-efficient, as it is now called, which is operative in such cables. Other experimenters soon found Kelvin's theoretical conclusions of 1855 to be accurate in practice, and thus was established the principle of electric transmission, not only through telegraph cables, but through all cables—a principle which is again now coming into

prominence in connection with long-distance, electric-power transmission cables.

Insulation and Capacity.

We now come to another aspect of the matter. Gutta-percha was a sufficiently good insulator, and, speaking generally, such testing as was done seems rather to have been directed to detecting faults than with any serious idea of getting a general standard of insulation. It was before the days of resistance coils of any definite standard of resistance, and voltages were reckoned simply as so many cells, usually Daniels. It is noteworthy that what is now called "insulation resistance" was then called "loss," and was measured by galvanometer deflection, the larger the deflection on an insulated cable the greater the loss, a method to which, with some variation, I reverted in my lectures at the Institution of Electrical Engineers two and a half years ago, though I did not know I was only following the early workers. From the evidence I gather that at this time, viz., about 1856, absorption had not been separated from capacity effects and there was still a good deal of confusion on the whole subject.

The Atlantic and Other Telegraph Companies.

Such was, briefly, the position when the Atlantic Telegraph Company was definitely established in 1856. It must be recollected that this was before the date of the 1862 Act, and all companies needing limited liability had to get a special Act of Parliament. Further, in nearly all these cases there were clauses by which the Government agreed to give considerable subsidies for terms of years on the cable being laid and so long as it worked; indeed, these subsidies were the primary basis on which capital was raised.

We have got so accustomed to telegraphy, telephones, and more lately to wireless that it is difficult to realise the position only sixty years ago. I can best recall it by an extract from Muspratt's "Chemistry of the Arts and Manufacturers," First Edition, which was published in parts about this time. In the section on gutta-percha, where the machines and methods of refining gutta-percha and covering wires are fully described and illustrated, this sober and scientific publication goes on to speak as follows:

It may be doubted whether the submarine lines of telegraph uniting different nations, islands and continents could have existed at this day without the valuable assistance rendered by gutta-percha. Its introduction into Europe contemporaneously with the inauguration of these magnificent projects by which the earth is being girdled by wires of living intelligence can scarcely be regarded otherwise than as an express dispensation of an overruling Providence to advance the progress of civilisation and human happiness.

The Boom and the Crash.

There was a boom, numbers of other enterprises were started besides the Atlantic Telegraph; 1856—1859 were years of feverish activity. And then the crash came. The Atlantic cable failed in the last quarter of 1858, there was great trouble with the Red Sea and Indian cable the following year; in fact, when the Committee was appointed they stated that out of 11 364 miles of cables laid over 8 000 miles were not working. Public confidence evaporated. The Government was alarmed, and it looked as if between £3 000 000 and £4 000 000 had been lost. It was under these circumstances that this Committee was appointed towards the end of 1859.

The Pioneer Committee

The names of the Committee who signed the Report are: Messrs. Douglas Galton, G. Wheatstone, W. Fairbairn and Geo. P. Bidder (appointed by the Board of Trade); and Messrs. Edwin Clarke, Cromwell F. Varley, Latimer Clark and Geo. Saward (appointed by the Atlantic Cable Company).

The Work of the Committee.

The Committee examined forty-four witnesses, including naval authorities, captains of cable ships, financial men and concessionaires, inventors, manufacturers, and finally engineers and electricians, the latter including Sir W. Siemens, Willoughby Smith, Sir C. T. Bright, Prof.

Hughes, W. Thomson (Lord Kelvin), Sir W. H. Preece, Fleeming Jenkin and Cromwell Varley. The book is the ordinary Government size, 11in. by 8in. The evidence occupies 260 pages, and there are, in addition, eighteen appendices in smaller type covering another 250 pages, including numbers of excellent illustrations, curves on large sheets of squared paper and numerous tables. No epitome could give any just idea of the mass of scientific engineering and general technical information embodied in this Report.

The Need for Decision.

Some conclusion had to be arrived at, and that quickly. Almost everyone concerned had to some extent their reputation and even their livelihood at stake. A very considerable industry employing a large number of men was at a standstill and its future uncertain. Three of the Committee themselves went into the witness chair and were examined by their fellows. The Committee had also a considerable sum for experiments, the results of which are given in some of the appendices.

The Foundations of an Industry.

Here are Fleeming Jenkin's original experiments on absorption, which is now again exercising us in the form of so-called dielectric hysteresis. There is also much fine work by Werner and William Siemens, in which the modern methods of cable-testing are clearly indicated. The able and far-sighted work of Cromwell Varley and Wheatstone is very striking. Here are the beginnings of standard resistance coils, the Wheatstone bridge, the mirror galvanometer, capacity and insulation testing, fault-finding and the construction of instruments on modern lines.

Amorphism to Capitalisation.

Electrical knowledge seems to have gone into this inquiry a set of disconnected threads, and in its course and completion to have come out a highly organised, quantitative and correlated whole. No wonder I find that later on the Report became known as the electricians' Bible. Reading it should be a liberal education to an electrical engineer. Compared with this Report, the few contemporaneous Royal Society and other Papers which disjointedly dealt with some of the scientific points involved are mere pale shadows. It seems to me that here were well and truly laid the foundation of all modern electrical engineering and to a considerable extent scientific progress.

Reviewing their work, the Committee finally say:

We desire in conclusion to observe that we are clearly of opinion that the failures of the existing submarine lines which we have described have been due to causes which might have been guarded against, had adequate preliminary investigation been made into the question. And we are convinced that if regard be had to the principles we have enunciated, in devising, manufacturing, laying, and maintenance of submarine cables, this class of enterprise may prove as successful as it has hitherto been disastrous.

The Report is an Influence on Science.

It is also important to point out that Maxwell was appointed a professor at King's College the very year this Committee was sitting. I see in the original Royal Society Paper, in which he first published his celebrated views three and a half years after the issue of the Report, he makes reference to it as the origin of some of his data. Having looked through some of the other electrical literature of the time, my belief is that he could not have matured his views and stated them with the simplicity and confidence which he does unless he had had such mass of detailed and authoritative experimental work at his disposal, as this Report presents.

It is clear that the Report and its recommendations must have been really the foundation of the scientific electrical instrument industry as we know it. The immense influence all this work had in preparing the way for the heavy electrical industry, the beginning of which we also see here, is very apparent.

It is significant that within a few months of the issue of this report THE ELECTRICIAN was first published with the support of some of the cable companies.

Sixty Years of Telegraph Progress.

By H. H. HARRISON, A.M.I.E.E.

SIXTY years ago this week THE ELECTRICIAN came into being, at a time when the electric telegraph loomed very large in the public eye. The first Atlantic cable had been laid, had worked and failed. A network of shorter cables were in existence, and the land lines of the prominent telegraph companies of the day already amounted to the respectable total of 90 000 miles of wire, about 20 000 route miles and between 5 000 and 6 000 public offices for the collection and delivery of messages. The dynamo and motor, with, of course, the electric light, had not yet burst on the commercial world. It is not surprising, therefore, to find that early volumes of THE ELECTRICIAN relate to such matters as fault localisation in submarine cables, methods of submerging cables and ingenious—though sometimes freakish—systems of duplex telegraphy.

The Telegraph Companies.

At this time at least four big telegraph companies were in existence, viz., the Electric Telegraph Company, the Electric and International Company, the United Kingdom Telegraph Company and the British and Irish Magnetic Company. The first two amalgamated with Mr. C. Varley as their engineer. The instruments in use were the single needle of Cooke and Wheatstone, the Morse inker and the modification of the American embosser due to John. The United Kingdom Telegraph Company used a few Hughes' printers, while the British and Irish Magnetic Company had adopted Bright's bell, an acoustic form of single needle. Land-line construction at this period consisted of fir poles with wooden arms or iron brackets to which earthenware or porcelain insulators of the double shed type were affixed. The wires of the period were of iron, poles were treated by impregnation and the butts were charred or roasted from the base to the wind and water-line. The practice of earth-wiring the arms existed then as now, and the regulation of the wires by tension ratchets was also carried out. The main lines followed the railways, and many of the telegraph offices were situated at the railway stations. In 1865 the second Atlantic cable was laid, and broke when 1 200 miles had been laid. The recovery of this cable and the successful operations with the third are matters of history too well known to need further remark.

The courage of the capitalists and the manufacturers and the persistence and ingenuity of the engineers are well known also, and the names of Kelvin, Charles Bright, Cyrus Field and the Telegraph Construction and Maintenance Company stand out for all time. The laying of an Atlantic cable nowadays would scarcely call for remark, and there are now no less than eighteen such.

The Siphon Recorder.

In 1867 Kelvin replaced the mirror galvanometer as a cable receiver by the siphon recorder, while 1870 saw the accomplishment of duplex transmission, rendered possible by the work of Muirhead and Herbert Taylor. The introduction of automatic transmitters controlled by perforated strip followed about 1889. The constancy of speed with auto-transmission has had a far-reaching effect on cable transmission. Not only can full advantage be taken of the curbing devices of Kelvin and Fleeming Jenkin, but, also, the adjustments made at the receiving end to shape or "square up" the signals remain permanent. A problem which engaged for many years the attention of cable engineers, viz., the automatic repetition of signals from one cable to another or to a land line, was solved by the invention of the Brown drum relay. This in turn is being followed by the non-contact making relay or amplifier of the Heurtley type. Not the least interesting nor of small importance was the invention of the vibrating relay by Konrad Gulstad, Engineer-in-Chief of the Great Northern

Telegraph Company of Copenhagen, who, in 1898, freely published the device to the world for all who would to use.

The Gulstad Relay.

In this device local-timed circuits cause the relay to vibrate at a rate which may be made equal to the "reversals" of the distant auto-transmitter. Thus dots which fail to come through are interpolated and the speed of a circuit may be pushed up. The line current does not do anything but control the movements of the tongue, all the energy necessary for reversing and making firm contacts being drawn from the local circuit. Pushed to the limit, the dots need not come through at all and speeds may be greatly increased. The relay is applicable with advantage to land lines also, and in America to-day most land-line relays are provided with the Gulstad auxiliary windings. It is also steadily finding appreciation in the British service.

Valve Amplifiers for Cable Work.

Amplifiers of the valve type are also being applied to cable work, but no results have yet emerged, except for a solitary German note on the subject. The capabilities of a modern amplifying device applied to a submarine cable are far in advance of the ability to take advantage of them. With supersensitive receiving devices the duplex balance requires refining to a degree which does not seem possible technically or commercially. Moreover, a long submarine cable stretching from continent to continent collects disturbances not apparent on the ordinary siphon recorder, and we can only reckon on an increase of cable speed of about 50 per cent. as a matter of routine, when such amplifiers are employed. The next step for the cable engineer to take is the design and submersion of the loaded telegraph cable, but there are a few problems!

Progress in Land Telegraphy.

Turning to land-line telegraphy, the telegraph companies were on Feb. 5, 1870, transferred to the State. In 1869, a year before this, the telegraph rates varied according to distance from 1s. to 3s. for twenty words. With State control a uniform inland rate of 1s. for twenty words, the address being sent free, was put into force. The expansion of traffic was remarkable, and but for the fact that too much money was paid for the companies' properties the commercial aspect of State telegraphy might have become very different to what it is. The advantages of unified control speedily became apparent in the advances made on the engineering side. Here are a few facts. Frischen had invented the differential duplex in 1854 and Maron the bridge system in 1863, to both of which systems the balancing condenser was applied by J. B. Stearns in 1868. In 1873 the Post Office had adopted Stearns' invention, and double-current duplex working became general. Duplex Wheatstone working had become an accomplished fact by 1877, and Wheatstone speeds rose from 70-80 words per minute to 250 words in 1890. In 1880, 180 Wheatstone sets were in use, and nearly 700 by 1919.

Improvements in Quadruplex Working.

Quadruplex working, introduced to the Post Office by Edison, had been improved out of recognition by 1884, and the Delany Morse multiplex system, introduced in 1886 and duplexed later by Mr. Pollock, was greatly improved by R. Hendrie and others. In all these developments, and when the Post Office Engineering Department consisted only of a few intellectual giants who were called "technical officers," the names of J. B. Chapman, Matthew Cooper, John Gavey, H. R. Kempe, John Chapman and C. C. Vyle stand out.

The year 1889 saw the acquisition of the Submarine

Telegraph Company with its eleven submarine cables worked by Hughes' typeprinters, and by 1893 duplex Hughes working between London and Paris and direct working between London and Vienna, Rome and other centres took effect.

Later developments in British practice include central battery simplex and duplex telegraph systems in 1905 and 1907, made more effective still by the Vyle polarised sounder.

Various Machine Systems.

Round about 1900 a number of inventors concentrated on machine telegraphy as a royal road to fortune. Examples of this tendency are the appearance of the Rowland Multiplex, an equal-letter, quadruple, duplex-printing system, the Buckingham Printing System, the Murray Automatic, the Siemens Photo Printer, and later the Murray Multiplex, the Siemens High Speed Automatic, the Western Electric Multiplex and the Creed Automatic. The Post Office already had at this time the Baudot printing telegraph in use, and only the Murray Multiplex, the Creed Automatic, the Baudot, the Siemens and Western Electric are to-day in use.

The substitution of keyboard perforators for the old three-key perforator of Wheatstone is becoming general. The era of machine telegraphy has set in. The Wheatstone system, which might almost be called the Post Office system on account of its evolution in the hands of Post Office officials, is rendered complete by the keyboard perforator and the remarkable printer of F. G. Creed. The general adoption of secondary cell working in the 'nineties has also played a part in the direction of efficiency. The gutta-percha underground cables in use from the earliest days of telegraphy have long since disappeared, being replaced by lead-covered, air-spaced cable with its superior characteristics.

Wireless Telegraphy.

Wireless telegraphy has not remained a State monopoly, though controlled and regulated by Government departments. Wireless systems of the electro-magnetic type were in use by the British Post Office at the time when Marconi (1896) came to this country. First by co-operation with Sir William Preece, and afterwards by means of a commercial company, the art was developed, until in 1901 the first signals were transmitted across the Atlantic. Ten years later the mercantile marines of the world had most of their ships equipped, and now wireless communication between remotely situated points is becoming a commonplace. From being a manufacturing concern the pioneer company is giving, to an increasing extent, world-wide telegraph service. The British Government has commenced the long-delayed project of an Imperial chain of stations linking the Colonies to the Mother Country, and the era of long-distance radio communication may be said to have arrived. Radio service is not without its problems, however, and interference is still so serious that in some directions a twenty-four hour regular service is not yet possible. High-speed transmission, while possible, cannot become general until the question of interference is settled. The machines necessarily involved cannot discriminate between perfect and defective signals, and in times of bad disturbance the speed drops to that of hand-sent Morse. The extraordinary development of the valve during the war both as detector amplifier and high-frequency generator have placed at our disposal peculiarly suitable means for the transmission of high-frequency energy and its reception, while the application of high-frequency methods to wire telegraphy have made the interlinking of wire and radio systems technically perfect. The use of printing systems on such interlinked circuits offers no special difficulties, and once the disturbance bogey has been overcome, great progress in communication facilities may be expected all over the world. The interlinking and the use of machine telegraphs have both been the subject of successful trials. Our progress in this branch of communication is due to a tremendous number of workers from

Hertz, Marconi, Lodge, Fleming, De Forest, Fessenden, &c., downwards. The world has never given John Stone the credit for his "receptor" and "rejector" circuits, which find wide application to-day in both wired radio as well as wireless.

The Genesis of Wired Radio

Intermediate between wire and radio telegraphy comes the new art of wired radio. This consists of a carrier frequency modulated by a variable lower and complex frequency impressed by the signalling means. All the elements of the system were known from the 'nineties, but the art lacked the high-frequency generator now, of course, so happily supplied by the thermionic valve. Results so far accomplished in America and Germany are very striking, and the multiplication of the number of channels on a single pair of wires enormously increases the carrying capacity of a telegraph network. Research is needed in order that suitable cables with extremely low dielectric losses at high frequencies may become available. The law governing transmission distance and energy required is not yet known. The ordinary attenuation formulæ for telephone transmission by usual methods if applied to high-frequency circuits give results so wide of experimental figures as to be worthless. A commercial comparison of the telegraph service of 1860 with that of the present day is hardly possible without access to official figures. In the early days the rates were such that the telegraph was used in emergency only. Moreover, there was no rival means of rapid communication such as is furnished to-day by the telephone.

Commercial Developments.

Modern commercial developments may be summarized as follows: Telegraph money orders, telegraph withdrawals from savings banks, night telegram letters, day cable letters, deferred cable messages, week-end cable letters, night delivery of telegrams, telephone-telegrams, the telegram being telephoned and subsequently sent on by post, telegraph facilities at special events and so on. The "rush" services of the cable companies may be instanced as an example of enterprise. British telegraphy stands in the front rank technically among administrations of the world, and if it is deemed to be not altogether a commercial success it may be urged that the proceedings which culminated in the transfer of 1870 hardly gave it a fair chance. In conclusion, the preceding matter will show how comprehensive the art of communication is rapidly becoming. In America some of the Universities have a course in what is termed "Communication Engineering," and telephone and telegraph engineers there are acquiring the habit of calling themselves communication engineers. Our Universities here might take a hint and grant degrees in communication engineering; the possession of such a degree would guarantee that the recipient had a solid and all-round knowledge of the subject. No fair-minded writer dealing with the subject of telegraphy over a number of decades can pass by without comment the amazing fertility of Dr. Werner Siemens and his firm. In and about 1870 they had designed and made keyboard perforators, metal storage transmitters, high-speed automatic systems, and they practically did the whole of the export trade of the world for many years until British makers of telegraph material sprang into existence.

The Influence of "The Electrician."

THE ELECTRICIAN throughout its career has always been the "weak current" man's paper. Developments in cable signalling, advances in wireless telegraphy and telephony and landline telegraphy and telephony are continuously recorded in its pages. The familiar buff-coloured cover can be found in cable stations all over the world, and the high-frequency method of measurement, which wireless telegraphy and telephone transmission problems have brought into being, can be found faithfully recorded in its pages.

Early Pioneering in Telegraphy and Telephony.

By Sir CHARLES BRIGHT, F.R.S.E., M.Inst.C.E., M.I.E.E.

In turning over his first volume of *THE ELECTRICIAN* the writer finds much that is suggestive of pioneering work in telegraphy, but it is proposed in this article to go back to the very earliest days, the scope being, in fact, rather closely confined to initial pioneering. That plan seems to be the most in keeping with the Diamond Jubilee of so elderly a journal as *THE ELECTRICIAN*.

Communications by Signal or by Speech from a Distance.

(1) *The Electric Wire Telegraph.*—The railway train and the steamship, together with the electric telegraph, constitute the three most conspicuous emblems of latter-day civilisation.* This became a truism in the 'sixties or earlier, and has remained so ever since. Like its fellow emblems, the telegraph was an outcome of many years of persevering effort on the part of a number of inventors and scientific investigators; like them also, it was perfected for practical use on both sides of the Atlantic by men of our own race and speech, such as Cooke, Wheatstone, Morse and Bain. The first telegraph line in the world—namely, that on the Great Western Railway from Paddington to West Drayton—was opened in 1838, the year of the first trunk line of railway and the first ocean steamer. Improvements and novelties in telegraphic instruments were at that time being made by inventors from all the leading civilised nations, e.g., Morse and Vail (as well as Royal E. House) in America, Breguet in France, Siemens and Halske in Germany and Schilling in Russia, to say nothing of Alexander Bain, Hughes and Jacob Brett in this country. Werner Siemens, again, led the way in employing gutta-percha as an insulating cover for wires under water. The first effective submarine telegraph cable was laid under the Straits of Dover by Thomas Russell Crompton in the autumn of 1851, the scheme having originated with the brothers Jacob and John Watkins Brett. The first cable successfully linking Great Britain with Ireland was laid (1853) by the late Sir Charles Bright. He it was also who, five years later and at the age of 26, first succeeded (on behalf of the Atlantic Telegraph Company) in demonstrating the feasibility—scouted at by most—of laying 2 000 miles of continuous cable at a two-mile depth under the Atlantic Ocean. Glass, Elliot & Co. (now the Telegraph Construction and Maintenance Co.) shared the manufacture with R. S. Newall & Co. This accomplishment was, from the engineer's point of view, even a more historic event than that of the first Channel cable or the first land line. By the year 1865 a good many shorter lengths of cable had been laid in different parts of the world, practically all by Englishmen. The knowledge and experience gained from all these undertakings, in the construction of cablest, and in their electrical working, paved the way for an ultimately complete and lasting success for the next Atlantic venture of 1865-6.

The Expeditions of 1865 and 1866.

In the interval the Telegraph Construction Company had acquired a staff of engineers suitable for undertaking the laying and repairing as well as the manufacture of submarine cables, and on this occasion—as, indeed, also since—the contractors undertook the laying, the companies for whom the cable was laid having their engineers, Messrs. Bright and Clark. The contractors' work was conducted by Mr. (afterwards Sir Samuel) Canning, assisted by Mr. Henry Clifford and Mr. John Temple, all of whom had served under Sir C. Bright on the original expedition. The expedition of 1865 was even less successful than the initial one of 1857-8, but in 1866 two cables were put through, the

most striking feature being the picking up and repairing of the 1865 line. Great credit was due here to the late Sir Samuel Canning. Prior to this Prof. Thomson (afterwards Lord Kelvin) had not only shown the electrical requirements—in which he was supported by the brothers Varley and by Latimer Clark—but had invented signalling instruments of an extremely sensitive character to put them into effect. The late Mr. Willoughby Smith had also advanced the electrical side of submarine cable work. From this date onwards lasting success was obtained. On the commercial side that great American, Cyrus West Field, on the one hand, and the late Sir John Pender on the other, will always stand out as great business leaders in connection with the Atlantic cable and the commercial development of submarine telegraphy in general.

The Siphon Recorder.

Since then the enormous network of land lines and ocean cables which has been created has placed the whole civilised world (together with many parts of the globe which cannot yet be dignified by that title) in electrical communication. To give even a summary of the systems and companies comprised in this network would be impossible here. Among submarine lines the "Eastern" and its associated companies on the one hand, and the "pooled" Atlantic systems on the other, constitute the most gigantic financial groups. Among those whose lines are largely—or, in the last case, entirely—overland, the "Western Union," the "Commercial," the "Great Northern" and the "Indo-European" are prominent. The old telegraph companies of the United Kingdom (of which the most important were the "Electric" and "Magnetic") were bought out by the State in 1869. Among improvements in telegraphic instruments effected since the pioneer days of the industry, the Thomson (Kelvin) siphon recorder, the Stearns, Muirhead and Taylor systems of duplex and quad-ruplex telegraphy, and the modern automatic transmitter, relay and signal amplifier are, perhaps, the most important. The development of a whole army of electrical laboratory and testing apparatus, as well as the improvement and elaboration of standards, have had a great influence on the progress of telegraphy—just as in the case of electric lighting and other branches.

The Telephone and the Microphone.

(2) *The Telephone and Microphone.*—There is decidedly less of adventure, so far, connected with the history of telephony than with that of telegraphy. Yet the telephone has, perhaps, a more secure—and even a greater—future before it than its elder sister in the art of electrically transmitting in words and signals to a distance. There are many other conceivable ways of telegraphing letters and conventional signals (electrically, visually or otherwise), some of which are now in practical operation. On the other hand, there is but one effective way discovered, or at present conceivable, of transmitting the human voice over long distances, viz., by telephonic or microphonic apparatus. A magnetically-actuated diaphragm at one end, and either the same or a microphonic contact at the other, together with some continuous conductor between, seem to be essentials. The names which come uppermost in the mind as those of pioneers in this marvellous application of electricity and magnetism to the exact reproduction of sound at a distance are those of Reiss, Elisha Gray and Hughes. Of these, the late Prof. David Hughes was the first who, by his *microphone* (exhibited before the Royal Society in 1878), demonstrated the true principle upon which his immediate successors (whether consciously or not) worked. His was the invention of a *savant*; he gave his results freely to the world. So much, at least, may be claimed on his behalf without stirring up the dry bones of a controversy with which we are not concerned. Among the first practically successful telephonic instruments must

* Indeed, it may be truly said that the application of electricity to the service of human intercourse has effected a change in political, commercial, and social relations even more complete than that wrought by steam locomotion.

† A Board of Trade inquiry on the subject (presided over by Capt. Sir Douglas Galton, K.C.B., F.R.S.) took place in 1860, and lasted over a year.

be mentioned those of Edison, of Berliner, of Dolbear, and of Gower and Graham Bell combined. But, as in the case of the two other best-known applications of electricity—namely, the telegraph and the electric light—the name of inventors and inventions during the great telephonic “boom” of 1881 to 1885 is legion.*

Formation of the National Telephones.

The formation of the National Telephone Company, that of the United Telephone Company, the concessions made by the Post Office to the telephone companies in 1884, the opening of telephonic communications between London, Birmingham and Liverpool, 1890, between London and Paris in 1891, and the gradual development of exchanges mark what are perhaps the most important stages in the history of telephony, so far as this country is concerned. But we are by no means so pre-eminent, either as inventors, as engineers, or as business men, in this art, as we were in that of telegraphy. In its practical application to life we still lag decidedly behind the people of the United States and Continental Europe. It would seem, however, that our position here is likely to be altered for the better.

Wireless Developments.

(3) *Radio, or “Wireless,” Telegraphy.*—In 1863 Clerk Maxwell worked out mathematically the theory of electro-magnetic waves in the ether and their relationship with light waves. In 1888 Heinrich Hertz (a distinguished German physicist) produced, demonstrated and described them. Then Righi (a noted Swedish professor) produced a radiator that was a development of the Hertz oscillator, whilst Branly (a leading French scientist) introduced the coherer for the reception of electric waves.

In 1894 Dr. (now Sir Oliver) Lodge exhibited at the Royal Institution a complete set of Hertzian wave apparatus, and transmitted electrical signals from one room to another without intervening wires, using a somewhat improved Hertz radiator and a coherer which was an advance on Branly's.

The first person to turn to practical account these ideas and the various apparatus here referred to for the definite purposes of commercial telegraphy was Mr. Marconi, his original patent being 12 039 of 1896. His radiator was very similar to that of Righi, but his coherer a decided improvement on Branly's. The main difference between Marconi's apparatus and that of Lodge was the connection with earth and the employment of an aerial wire supported on a high mast. There was also a kite at the top of the aerial similar to that described by Edison. By these means—together with increase of power and capital expenditure—Mr. Marconi gradually increased his range to very considerable distances, and unquestionably he has done more than any man in developing the commercial possibilities of that system of telegraphy which turns Hertzian waves to account.

The Heliograph.

(4) *Military and Navy Signalling.*—Under this heading the most conspicuous invention of the age previous to the application of “wireless” was the *heliograph*. The general principle of telegraphing in clear atmospheres by means of mirrors flashing the rays of the sun appears to have been known to the ancients, and to have been employed in the time of Alexander the Great (about 333 B.C.). It was reserved for the present generation, however, to develop a truly scientific application of this principle, and the credit for doing so is chiefly due to Sir Henry Mance, C.I.E., past President of the Institution of Electrical Engineers. He first brought out the portable heliograph in 1875. The whole system of *naval signalling* was revolutionised during Queen Victoria's reign, largely through the ingenuity of officers, among whom the name of the late Vice-Admiral P. H. Colomb will always be illustrious.

The Mirrors of Salisbury Court.

By W. G. BOND.

Editor of THE ELECTRICIAN (1895—1897.)

I drifted on to the editorial staff of THE ELECTRICIAN, so far as I can remember, in 1888, and left the paper in the autumn of 1897. The mode of my introduction was in itself a tribute to the value of the paper as an advertising medium, inasmuch as I found my way to the editorial heart by reason of an advertisement of my manifold qualifications which I had inserted in the space sacred to out-of-works.

The bait that caught the Editor was the unusual combination of a modest knowledge of science, a decided knowledge of French and German, and the ability to write phonetic shorthand at the rate of 90 words a minute—for one minute. The Editor in those days was W. H. Snell, a little be-spectacled, Japanese gentleman, very quiet and gentle in manners, but not incapable of sarcasm, and one who took his duties very seriously. In my eyes he was a bit of a magician, for was he not the Snell of Kapp & Snell transformer “fame,” and had he not had something—I do not remember exactly what—to do with the design or the calculations of the Mordey-Victoria disc alternator?

Hasty Promotion.

I had hardly got into my stride as a sort of glorified office-boy when poor Snell fell ill and, after a protracted struggle, died. Before this, however, I had succeeded in publicly putting my foot in it in a rather marked manner. It was the year of the meeting of the British Association at Bath, the year in which Dr. Oliver Lodge, as he then was, announced the confirmation of Clerk Maxwell's prediction by the discovery by Hertz of electric waves—waves which could be reflected, refracted and so forth. Late on publishing night a wire arrived containing the momentous news that electric waves several metres in length had been observed. The great length of the waves, however, rather bothered me, but neither the publisher (Mr. George Tucker) nor the foreman printer (Bunyard was his name, I think) nor the junior office-boy could assist me in my dilemma, and all the many eminent men of science then on the editorial staff had left the office, so I boldly altered metres to millimetres, and at one stroke diminished the unusualness of the news a thousandfold.

A Pretty Tough Job.

During the year of the editor's battle with ill-health I was in sole charge of THE ELECTRICIAN, and a pretty tough job I found it to fill the paper and keep myself out of the many pitfalls that beset the path of an amateur posing as an omniscient “pro.” But I had a splendid volunteer corps and a shrewd mentor in the person of Mr. James Laister, a member of the old Telegraph Service, who came in of a Thursday evening to smoke his pipe, supply editorial notes and spy out split infinitives and other defects of style or of journalistic tactics in the editorials of other people. I can remember more than one battle royal between my fatherly adviser and some eminent writer of a leading article, the one politely and patiently insisting upon the excision or toning down of some offending phrase, and the other fiercely resenting the alteration of a single comma in his contribution. During the trying years of interregnum I recall with gratitude the names of Silvanus P. Thompson, Albion T. Snell, J. A. Fleming and W. E. Sumner, who were ever ready to lend the boy-editor a helping hand.

Then came the editorship of A. P. Trotter, than whom there never existed a more chivalrous and inspiring chief. He not only gathered together a very large band of regular contributors who wrote under their own names, but he added to what I just now called our volunteer corps.

Exciting Days.

Those were exciting days. Discoveries and developments in science and industry were as plentiful as blackberries

* Should the reader desire further information he would do well to study the lecture by the late Sir Frederick Bramwell, Bart., D.C.L., F.R.S., delivered before the Institution of Civil Engineers on March 1, 1883, and reprinted in the Minutes of their Proceedings.

in September. There were battles in the law courts over patents, and on the floor of the Institution over everything. In one way it was a day of small things. Noisy little dynamos sparking away in dirty little basements, and tiny little companies lighting restricted little areas, and to ring a bell by Hertzian waves transmitted through a couple of brick walls and a hundred feet of air was greeted with loud applause by the audiences at the Friday evening discourses at the Royal Institution. Probably the present moment is, in fact, more exciting, speaking scientifically, but the rapid development of the industrial applications of electricity in the period I am talking of, *i.e.*, the last fifteen years of the past century, made life in the editorial office of an electrical journal distinctly strenuous, though probably not more strenuous than it is to-day.

Then my chief left (to take up shortly afterwards the position of Electrical Adviser to the Government of South

Africa), and I was inducted into the editorial chair in that noisy, evil-smelling back room on the first floor at No. 3, Salisbury Court, Fleet Street, London, E.C. Under me were E. Tremlett Carter and F. C. Raphael, who succeeded me in that order in the editorship of the paper of which we were all in our different ways so proud.

I cannot at this distance of time recall any original development during my editorship of barely two years. I was content to follow the Trotterian tradition. But *autres temps, autres mœurs*, and it was thought necessary, *inter alia*, to get a business hustle on, and so, in due course, I vacated the armchair, never to return to journalistic work again, except as a half-timer and for a very brief period.

Those seem spacious days compared with these, and the men seem bigger in retrospect, but doubtless it is all an illusion due to my comparative youthfulness in 1888-97 and to the magnifying effect of sentiment.

Silvertown and the Electrical Industry.

No history of electrical progress would be complete without some reference to the Silvertown works of the INDIA-RUBBER, GUTTA PERCHA, AND TELEGRAPH WORKS, LTD. Not only are they the Mecca of students' visits, and have so given many generations of budding electrical engineers their first insight into industrial processes, but they have been so closely connected with electrical progress of all kinds that their history is in itself an epitome of a great development. They possess yet another distinction. They are not wholly, or even mainly, electrical in character, and have therefore been able to view in a detached and semi-paternal way the moil and turmoil that has accompanied the progress to manhood of certain other electrical undertakings. But to our history.

The Early Days.

Silvertown is an outlying district in the borough of West Ham, forming part of an island cut off by the Victoria and Albert Docks on the west, north, and east, and by the river Thames on the south. In the year 1850 it did not exist, and even West Ham was a small and practically unknown suburban district with barely 18 000 inhabitants. To-day Silvertown has the population of a fairly large country town, and West Ham, created a borough about twenty-one years ago, boasts some 300 000 inhabitants.

In 1852 S. W. Silver & Company, the well-known outfitters in Cornhill, removed their waterproofing works from Greenwich to some land between Bow Creek and Barking Creek. The first purchase was a single acre, but seven more were soon added.

In 1855 a great change came over the neighbourhood by the opening of the Victoria Docks. They extended from their entrance near Bow Creek to within half a mile of S. W. Silver's works. At

as to justify the name of Silvertown being given to the district of which they formed the centre. Beginning with waterproof clothing and belting for machinery, the manufacture of other kinds of rubber goods, including ebonite, was soon undertaken. Ebonite is we need hardly say, hardened rubber, made by prolonging or intensifying the curing or vulcanising process. "The method of its manufacture was discovered," Col. Silver says, "in a curious manner. Hollow india-rubber balls are made out of sheet rubber, cut in two sections and inflated by oxalic acid in a bath of melted sulphur. During the process one of the balls fell unnoticed to the bottom of the bath. When found at the end of the week it had hardened into ebonite."

Ebonite, electrical engineers will agree, is an invaluable substance. Its qualities are hardness, elasticity, and non-porosity. It has replaced wood in numberless articles, because it does not warp with moisture. Before its discovery vinegar manufacturers had constant trouble from the corrosion of their metal pumps and pipes. Now all their utensils are made of ebonite, on which vinegar has no effect. On account of its resistance to chemical action, it is indispensable in the laboratory, and its electrical non-conductivity makes it invaluable as the basis of all electrical instruments.

The growth of Messrs. Silver's works was so satisfactory that in 1864 a prospectus was issued for converting the business into a company under the title of "Silver's India-rubber Works and Telegraph Cable Company, Ltd." Fig. 2 shows a view of the works about this time. On the Provisional Committee, amongst other well-known names, were those of Sam Mendel of Manchester and William Fenton of the Great Western Railway. Col. H. A.

Silver and Mr. J. W. Willans were the first managing directors, but they retired a year after the formation of the company, when Mr. Mathew Gray became sole managing director. The india-rubber and gutta-percha departments had been under separate management from the time that Mr. Hancock, gutta-percha manufacturer at Smithfield, amalgamated with Silvers, and brought his own engineers and workmen with him. The two departments were now put under the sole direction of Mr. Mathew Gray, and it is to his untiring energy and excellent capacity for business that the firm owes its present prosperous position. On the retirement of Mr. Gray, his eldest son Mr. R. Kaye Gray, a well-known figure in the electrical industry, was appointed managing director and, on his death in 1914, his two brothers Mr. C. H. Gray and Mr. W. E. Gray, became joint managing directors, a line of succession which can hardly be equalled by any other electrical firm.

Early Submarine Cables

Mr. Mathew Gray soon turned his attention to the manufacture of submarine cables, and in 1867, only a year after the laying of the first successful Atlantic cable, he obtained an order from the Western Union Telegraph Company of America for a cable to connect Key West, the southernmost point of the United States, with Havana. Sir Charles Bright, who laid the first though unsuccessful Atlantic cable in 1858, was the engineer selected by the company to carry out their contract.

This cable, which was the first to be made and laid by the company, is still working in spite of having been immersed thirty-one years



C. S. S. DACIA
THE FAMOUS CABLE SHIP "DACIA"

the same time the loop line to the north of the docks was made, and stations built at Tidal Basin and Customs House. The old line, for which a swing bridge was erected across the dock entrance, remained in use for goods traffic only.

The Genesis of Ebonite.

Between 1855 and 1860 Messrs. Silver's works had increased to such an extent and had gathered round them so many residents,

in the water. It was repaired as recently as 1899 by s.s. "Dacia." The "Dacia," built in the early 'sixties for the Mediterranean fruit trade, was acquired in 1869 by Sir Charles Bright. In order to increase her carrying capacity he lengthened her by 40 ft., cutting her in two and inserting that amount of hull at her waist. She was purchased by the Silvertown Company in 1870. At that time the "Dacia" was the doyen of cable ships, and her cable machinery, though designed and made so many years ago, was still as good as that of any cable ship afloat until her history was completed by a glorious end, for she was sunk by a German submarine in 1914 when carrying out work for the French Government off Madeira. A view of the ship is given in Fig. 1.

In 1870-71 followed the West India and Panama cables, which, owing to the rocky character of the sea bottom, gave a great deal of trouble in the laying. Yellow fever also attacked the ship, every fifth man on board succumbing to it. A more pleasant task was the laying of the Algiers-Marseilles cable for the French Government in 1871, and the Lizard-Bilbao cable in 1872.

About this time the company acquired s.s. "International," and fitted her with cable tanks and the requisite machinery. The first cable the "International" laid was in 1870, between the Channel Islands and the English coast. In 1899, having retired from active service for several years, she was sold to a Frenchman who tried to tow her to Boulogne; but a fresh breeze sprang up, the hawser parted, and the old ship went ashore at Beachy Head.

company in 1885. Though only a small vessel, she has done a good deal of useful work in water too shallow for larger ships and also in repairs.

The present appearance of the works is shown in Fig. 2. This photograph gives an excellent idea of the expansion that has taken place, and that same expansion is well illustrated by saying that the personnel employed in 1865 numbered 200 and at the present time is about 5000. While on this subject mention may be made of a striking event in the history of the firm—the well-known Silvertown explosion in January, 1916. Fortunately, this did very little damage to the works.

The Activities of the Firm.

The electrical activities of the firm are not, however, confined to telegraph cables. In the early days of electricity supply, that is about the year 1878, dynamos were built for the then existing British Electric Company and for Col. Crompton, who was one of the original makers of the Gramme machine in England. In 1882 several machines were made for the special purpose of lighting the Silvertown works, this lighting installation being at the time one of the biggest in this country. For a time this side of the company's activities continued to show considerable expansion, but Silvertown is not an ideal place for the manufacture of this class of machine owing to its distance from other centres, and the biggest machine made there did not exceed 100 kW in output.

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at the very spot from which she had laid one of her first cables. Her bare ribs now gaze regretfully upon the scene of her early labours.

In 1875-6 the West Coast of America cables, a total of some 1700 knots, were laid. On the way out the "Dacia" met, anchored in Smyth's Channel, the "Sunbeam," then on the voyage with which Lady Brassey has familiarised the world. The encounter is described in the pages of her book. Smaller cables in such different quarters of the globe as the Caspian Sea, the Gulf of Florida, and the Canadian coast followed, and then the company received an order for over 3000 nauts of cable to be laid on the West Coast of Central and South America.

The First Proper Cable Ship.

To execute this order the telegraph steamship "Hooper" was acquired from Messrs. Hooper, telegraph engineers, and rechristened the "Silvertown." She was the first ship to be designed expressly as a cable ship. The story is that the cable engineer responsible for her drew three circles representing the diameter and depth of the cable tanks he wanted, and the naval architect was instructed to build a ship around them. When launched she was, with the exception of the "Great Eastern," the largest cargo ship afloat, and her cable tanks were actually one-third larger than those of the leviathan. In the intervals between cable-laying the "Silvertown" has carried general cargo, and on one occasion brought from New Orleans the largest load of grain that has ever crossed the Atlantic. It was at the end of this voyage that a paltry 300 tons of sugar could not be found, till a supercargo stumbled accidentally upon them in one of her capacious pockets. During the Chilian Civil War in 1891, she was present at the bombardment of Iquique, and gave a temporary home to a number of Englishwomen and children who were driven from the town.

A fourth cable ship, the "Buccaneer," was acquired by the



PICTURES SHOWING THE DEVELOPMENT OF THE SILVERTOWN WORKS.

The lighting of a number of small towns was, however, undertaken, and of the larger cities Brussels is an interesting example of one of those places that owed its first electric lighting installation to the company. In more recent years the company's activities in the electrical department included the manufacture of petrol electric plant, of electric vehicles, of train lighting equipment, of telegraph and other electrical instruments, of switchboards and of searchlights. Mention in this connection must, of course, be made of the manufacture of batteries for the Leclanche cell was originally introduced into this country fifty years ago by the Silvertown company.

India-rubber Goods.

Mention must also be made of the manufacture of electric light and power cables. The 1000 V cables originally laid by the Brush Company in the City of London, which supplied sixteen arc lamps in series, were made by the Silvertown Company. These cables were insulated by cotton smeared with india-rubber and performed good service even with this somewhat meagre covering. About 1886, when the company had developed a good business in rubber-insulated high-tension mains, the great gift occurred between paper and rubber insulations for this purpose. It is now common knowledge that as regards insulating properties the two are on more equal ground than was at one time supposed, and that the poor service that a number of rubber cables gave was due to the rough mechanical handling they received before installation. As an example of this we may mention that certain high-tension alternating current rubber-covered cables at Cardiff, which have been in service for so long and are in fact still in service, have given so little trouble that the engineer did not know of their existence, or so the story goes; while, in Newcastle, certain cables of the India Rubber Company's manufacture have been in use since 1889 and have never given any trouble.

Some Events in Cable History.

By GEORGE SUTTON.

(Chairman and Managing Director, W. T. Henley's Telegraph Works Company, Ltd.)

To write of sixty years ago means that one must, of necessity, draw upon the records of historians, for few living men could be expected to deal now with matters coming within their personal experience then. Some records have been left which will enable me to deal, I hope, in a manner embracing a measure of general interest, with the activities of the founder of this company in the years about that period. In doing so I am not helped by any records left by Mr. Henley himself, for he was a man who did not record the events of his time. That he was a man of indomitable energy and resource, abundant physical prowess and great inventive intellect, there is ample evidence to prove, but he was lacking in organising power.

Mr. H. R. Kempe has recently recorded in the pages of "The

Henley. From his evidence given before the "Joint Submarine Committee" in 1859—"Presented to both Houses of Parliament by command of Her Majesty" in 1861—it is clear that he commenced the manufacture of electrical instruments, of his own design, in the year Queen Victoria came to the throne, viz., 1837. He also undertook the manufacture of land lines, and had laid 5 000 miles by the date of the sitting of the Committee. He had made the 240 miles of submarine cable laid between Victoria and Tasmania in 1858, thirty miles for India in 1857, and ten miles laid in the Mediterranean. He was at the paying-out of the first iron-sheathed cable ever laid—from Dover to Calais—and he had been engaged to test and examine electrically the first Atlantic cable after it had failed. At the time of giving his evidence he was manufacturing 400 miles of cable, to be

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THE ILLUSTRATED LONDON NEWS

SEPT. 12, 1863

N E W T E L E G R A P H T O I N D I A .



THE KINNHAM AND THE ASSAY TAKING IN TELEGRAPH CABLE AT MR. HENLEY'S WORKS, NORTH WOOLWICH.

REPRODUCTION OF A WOODCUT WHICH APPEARED IN "THE ILLUSTRATED LONDON NEWS," SEPTEMBER 12TH, 1863.

Henley Telegraph" that Mr. Henley told him that he had, for three consecutive years, made a yearly profit of £80 000. For a "one-man concern," in those days, this must be accounted a distinctly remarkable achievement. But the loose and lackadaisical method on which he allowed his huge factory at North Woolwich to be run brought him to the verge of ruin, and it was only by his own superhuman efforts and the loyalty and hard work of a very few of his employees that he retrieved some of his almost lost fortune, and began anew.

Henley the Man and His Work

As evidence of the type of man he was, I quote from "The Manufacturers' Engineering and Export Journal" of May, 1892, a publication now defunct.

"It is related that when hindered from laying competitive wires by the old Electric Telegraph Company, which had monopolised the whole of the telegraph work, and had obtained nearly the whole of the overhead lines, Mr. Henley resorted to engineering trenches and laying underground wires from London to Carlisle and from Dublin to Belfast.

But I am running ahead of my story, and must go back.

Let me just briefly run over the early history of William Thomas

laid at his own risk, to connect the Balearic islands with Barcelona.

The Gutta Percha Question.

In the light of our knowledge to-day of the value of gutta percha as an insulator for submarine cables, it is interesting to compare the replies on this subject, of the three cable manufacturers of that day, Mr. Newall, of Newall Company, Gateshead; Mr. Glass, of Glass, Elliott & Company, Greenwich, and Mr. Henley.

Mr. Newall said: "I think from what I have seen lately that my confidence is entirely gone. I would never undertake to lay down another cable encased in gutta percha. The faults have been so great and so frequent that I have not the least confidence in it now."

Mr. Glass, in reply to the chairman's remark: "And that is evidence of your opinion of gutta percha as an insulator?" said, "Yes. We have had samples submitted to us of many other insulators, which certainly show a superiority as regards their insulating property, but we have no means of judging what the effect would be of dealing with those substances, particularly in laying the cable."

Mr. Henley, in answer to Professor Wheatstone's question: "What should you prefer above all things that you know?" said, "I should prefer pure gutta percha, in my opinion."

No other cable manufacturer existed in those days, and the Gutta

Percha Company of Wharf Road, London, made gutta percha cores for these three.

The Telegraph to India

We now come to one of the great links in submarine cable history, "The Telegraph to India." In 1862 the Indian Government decided to undertake on its own account the laying of a line to connect India and England, and, in order to make the submarine portion as short as possible and to avoid deep water, arranged to limit the laying of a cable to the waters of the Persian Gulf. The total length of the submarine cable was 1450 miles, divided into four sections. Mr. Henley secured the order for this cable on December 18, 1862, and it was successfully laid by Sir Charles Bright in 1863. In his book "Submarine Telegraphs," published in 1898, Mr. Charles (now Sir Charles) Bright—a son of the first Sir Charles—says of it.

"This was the first instance of any great length of cable being a complete and lasting success, and it was certainly due in a large measure to the many novel and improved methods introduced in its manufacture, and to the complete system of electric and mechanical testing here applied."

"By the date of laying the above cable, forming the first telegraphic connection between the United Kingdom, Europe and India—the science of constructing and laying submarine telegraphs was pretty definitely worked out, and no very striking departure in general principles has since been introduced; indeed, the pioneer stage may be said at this juncture to have reached its termination."

For this cable, sheathing machines of the horizontal type were used for the first time on record, and this class of machine has become universal and has been used ever since. In the earlier days the sheathing machines were modelled on the rope-making machines of that period, which were vertical. A reproduction of an illustration of the period showing the two cable ships loading this cable at Woolwich is given herewith.

On May 5, 1864, an agreement was signed by the Telegraph Construction & Maintenance Company, Ltd., which had been formed in the previous year by an amalgamation of Glass, Elliott & Company and the Gutta Percha Company, to make and lay a new Atlantic cable. I take the following quotation from the late Mr. Willoughby Smith's book "The Rise and Extension of Submarine Telegraphy," published in 1891.

"Mr. Henley had not succeeded in manufacturing a suitable core for the cables, consequently he had, much against his will, to make a virtue of necessity and enter into a working agreement with his rival, Mr. Glass, who was managing director for the Telegraph Construction & Maintenance Company, Ltd. Thus he became engaged in making the shore ends for the Atlantic Telegraph Cable."

Henley's and the "Great Eastern."

The shore end for the 1865 Atlantic Cable was laid in July from Valencia, Ireland, by Mr. Henley's steamship "Caroline," and an account of this appears, with illustrations, in the "Illustrated London News" of that date. As is well known, the deep-sea cable was laid by the "Great Eastern," but the cable broke, and it was not completed until the following year, when another cable was also laid by the "Great Eastern." The shore ends for both the 1865 and 1866 Atlantic cables were made by Mr. Henley at North Woolwich.

It was shortly after this that Mr. Henley experienced the financial difficulties to which I have already referred.

Newall & Company had retired from the submarine cable business, leaving the Telegraph Construction & Maintenance Company Ltd., and Mr. Henley, the two competitors for such work. The fact that Mr. Henley had to depend upon his great rivals for the core, no doubt operated against him, but this was not the only cause of his financial difficulty.

We still have with the company an engineer who was with Mr. Henley at that time, and who has now completed fifty-five years service with Henley's. From some notes made by him it is easy to see how the financial difficulties came about. It would be interesting to give a description of the great Henley Works of that day—works which Mr. Henley described as "the crown of my life," but I fear that I have already overstepped the margin allowed to me by the generosity of the Editor.

A Self-Contained Plant

Perhaps, however, there will be room to say that Mr. Henley manufactured everything possible himself. He had a rolling mill to make iron rods for the wire drawing, a plant for making steel ingots, a large iron and brass foundry, two bending furnaces, a galvanising shop, plant for corrugated iron, carpenters', pattern-makers', smiths', fitting and engineering shops, battery-making shops, stables, etc. All this in addition to large stranding and cable making plant. He made all his own wire, linings and owned a coal mine and a large iron works. He also had a number of cable ships, including the "Caroline," "La Plata" (lost with

sixty hands in the Bay of Biscay on November 29, 1874), "Africa," "Uruguay," "Investigator" and the steam yacht "Albion."

Transformation to a Company

The present company was formed in 1880, and Mr. Henley died in 1882. This was at the time when practical developments were taking place in connection with telephony and the application of electricity to lighting and power purposes. The new company, whilst continuing its business of constructing and laying sea-cables, kept in touch with the requirements of the times by manufacturing some of the very first telephone and electric-light cables, until to-day power and lighting cables have become its principal industry, although the construction of sea cables still bears an important place in the company's operations.

The North Woolwich and Gravesend Works.

Since the days of Mr. Henley the works at North Woolwich have been largely rebuilt and have, of course, been equipped with modern plant. Also, in order to cope with the demand of the more recent years for high power, paper insulated mains, etc., a large works were completed at Gravesend in 1906. At both works the plant is constantly being renewed and added to by new machines, largely the product of the company's own engineering shops.

Electrical Development and "The Electrician."

By Prof. ELIHU THOMSON.

THE ELECTRICIAN certainly occupies the unique position of having its history cover a period during which the electric art has practically grown from the very smallest beginnings until it has reached the gigantic expansion and development of the present time. At the time of its foundation there was, indeed, very little outside of telegraphy in which the possibilities of electric application were involved. With the single exception of the lighthouse magneto machines, the voltaic battery was the only source of electric current applied practically. Its chief uses were for telegraphy, and to do a certain amount of electrodeposition, as in electroplating and in electrotyping.

Paccinotti and Gramme had not created the type of dynamo-generator, which, in modified forms, became so important in the decades following, and not until about the end of the second decade of the life of THE ELECTRICIAN was there any considerable advance in the use of electricity for lighting, the greater development of which involved the use of the arc lamp on a large scale, as well as the development of the incandescent lamps, and the machinery for working them may be said to be fairly begun as much as twenty years after the foundation of THE ELECTRICIAN. These advances were followed in a few years by the introduction of electric motors on a very moderate scale.

It was nearly thirty years after the establishment of the journal before that great expansion in the use of electric power for the propulsion of tramcars and the operation of electric railways took place, a growth which has continued on an increasing scale ever since. Even to catalogue the directions in which the art has expanded in the intervening years would demand a considerable space.

In the earlier years those of us who were directing our attention to the future developments in electrical science and its application could readily picture to ourselves an enormous extension in making use of current waves, beginning with the low frequency waves characteristic of alternating currents, and involving limitless transformations with possible transmissions at high voltage, and then onward to the study and use of high frequency waves and effects, up to such frequencies as only leave a moderate gap to be filled between them and the lowest heat waves.

In the intermediate field came wireless transmission, as originally developed by Marconi, though foreshadowed many years in advance. In these later years, however, not only does electrical science concern itself with the motions of those almost infinitesimal things known as electrons, but actually constructs apparatus, sometimes called "electron tubes," utilising the various actions which take place in high vacuum with moving electrons, a branch of electrical engineering which promises to be that one which is to receive, in the next decade or so, a very great expansion. Already the one important application in amplifying excessively feeble signals in wireless transmission has been done wonders.

THE ELECTRICIAN is to be congratulated all along through this grand development in electrical science and its uses, on having been one of the most important means for recording and making known the progress of this work. Its function has been a very precious one, the more completely understood and appreciated by those who have witnessed through the long years past how well it has performed the task. It has earned, through long and excellent service, the best wishes for the future of electrical students and the electrical engineering fraternity at large.

Submarine Telegraphy, 1861-1921.

In reviewing the progress made in submarine telegraphy over a term of years, the mind turns naturally to a consideration of the number of miles of cable laid at the beginning and end of the term. In 1861, therefore, old records inform us that 12,500 miles had been laid. Owing, however, to imperfect design and a want of care in the selection of the route followed, difficulties in the matter of repair, etc., not more than 9 or 10 per cent. of this amount was any sort of practical use. The longest cable which had at that time been laid was that crossing the Atlantic 1,900 miles in length.

The mileage at the present time amounts to something like 300,000, and the proportion idle from interruption is probably well under 10 per cent. The longest cable now, which lies between Vancouver and Fanning Island, is 3,460 miles.

Cable Construction—Then and Now.

With regard to the construction of cables, in view of the fact that their signalling speed is a function of the amount of copper contained in a unit length, as confidence has been gained in their length of life the tendency has naturally been to increase this quantity of copper. In place, therefore, of the 130 lb. per nautical mile that the cable 2,000 miles in length had fifty years back, a modern cable connecting the same two points would probably have as much as can conveniently be handled, i.e., 650 lb. or 700 lb. per nautical mile, with, of course, an appropriate increase of weight of the gutta percha surrounding the copper.

Working Arrangements.

From the working point of view development is briefly summarised in what follows:

Fifty years ago cables of 500 or more miles in length were worked simplex, i.e., in one direction only. Signalling was carried out on what was known as the single needle principle. The receiving instrument consisted of a reflecting galvanometer, and the motions of a beam of light from this, under the influence of the varied signalling current impulses produced by manual operation at the distant end, were interpreted and read out by one operator and written down by a second.

There existed three obvious human limitations in this system in the matter of speed—first, that imposed by the manual dexterity of the sending operator; second, that dependent upon the discriminating ability of the operator engaged in reading or interpreting the movements of the beam of light; and, finally, the speed at which the third operator could write down what was read out by the second. Ability in these three respects was, as a matter of fact, very finely graduated, and the really good telegraph operator of those days was undeniably an artist in his own line. The average speed at which these operations were carried out was of the order of 125 to 150 letters per minute.

Man-Handled Traffic.

As an example of the extent to which traffic was man-handled in those days, and for some considerable time afterwards, it will be of interest to trace the course of a telegram headed *in cax* at Gibraltar for London. This would be signalled in the manner described above upon the cable to Lisbon, where it would be read off and written down; it would then be manually re-transmitted in the same way upon the cable to Portsmouth, where it was dealt with as at Lisbon. It would then be once more manually re-transmitted by the Morse system over aerial wires to London, where it was recorded on the Morse tape, and finally translated and written off for delivery. Thus in its transmission over 1,540 miles the telegram suffered no less handling, no fewer than eight times.

The Siphon Recorder.

In the later 'seventies there came the gradual introduction of the siphon recorder—a beautiful piece of apparatus, the basis of which consisted, as in any D'Arsonval galvanometer, of a coil revolving in a magnetic field moving in one direction or the other according to that of the received signalled impulse. This indeed constitutes the principle of the main receiving apparatus of the present day. This development was a very real advance, since not only was the employment of one of the two operators engaged in reception work dispensed with, but a permanent record of the signals was furnished which enabled work to be checked. A few years later the working of a cable on the duplex system, i.e., in both directions at the same time, became possible owing to a provision (for which the late Dr. Alex. Muirhead was largely responsible) of an artificial line possessing the requisite distributed resistance and capacity to balance the corresponding properties of the real cable. This was a very definite further advance, since the net traffic carrying capacity of such cables as were being worked up to the limit of manual transmission became practically doubled.

The Genesis of Automatic Transmission.

A period of relative quiescence then ensued until the early 'nineties, when attention began to be given to automatic transmission on the lines of the apparatus in use for many years previously on aerial wires, but differing from these in that the single needle or cable code system of signalling was retained as opposed to that of Morse.

The advantage following the introduction of automatic transmitters lay in the facts that (1) the personal equation was eliminated from the formation of the signals at the sending end, and (2) on the shorter cables a number of operators could prepare the perforated tape carrying the various commutators and permutations of current impulses incidental to the formation of the groups of signals attaching to a number of telegrams. This tape could then run through the automatic transmitter and signals sent at a speed considerably in excess of what a first-class operator could do manually.

The necessarily increased speed at which the signals arrived at the distant end was met by abolishing the transcribing of them, and substituting a method of gumming the recorder tape upon paper forms, which were, in their turn, handed to operators, who would at one and the same time decipher the signals and punch the perforated tape required for their retransmission.

Following the increase of speed consequent upon the use of automatic transmission there came a demand for an improvement in the definition of the received signals, which led to the reintroduction of the use of inductance in association with capacity in the receiving circuit as suggested, it is believed, originally by Cromwell Varley. Modern design of the inductances, however, afforded a material improvement in the value of such an association.

Effect of KR on Simplex Speed.

It is perhaps not too much to say that prior to this there was a definite limit of simplex speed determined by the KR (or product of total resistance and capacity) of the cable concerned; a correct association of capacity and inductance, and resistance in the receiving circuit admits, however, of a speed under the same conditions that is limited only by the sensitivity and other requisite conditions of the receiving apparatus.

Relaying Problems.

Up to this time very many efforts had been made by cable engineers to devise a means of effecting what had been a practice on aerial wires, viz., that of automatically relaying on the signal from one cable into another, thus avoiding the necessity for their retransmission by a manual agency. Owing, however, to the attenuated amount of energy available at the end of a cable and, prior to the use of inductance, the distorted character of the signal formation received, none of these endeavours met with much, if any, success. The problem was at last solved by an invention of Mr. S. G. Brown, which consisted of a rotating drum upon which contacts were effected on one side or the other according to the direction of motion of the moving coil to which was now attached a light contact-making pointer. No small amount of dexterity is called for in both the mechanical adjustment of this, as well as the association of capacity and inductance employed in the receiving system of which it forms, of course, the chief feature.

The "Human Relay."

It is not to be supposed that a certain amount of what was known as "human relaying" had been tried. In this the recorder read and re-transmitted manually by one operator, was limited in the extent to which it could be used imposed being that determined by the manual dexterity of the operator. Thus its use was confined to cases where the speed was of a corresponding order. The advantage of performing the same function automatically was that it did the services of an operator, and thus a balanced speed when necessary made possible. Thus its use in the course of some of the longer cables was in all cases where such a possible gain was to be obtained.

Advantages in Relaying.

Having been thus established, the type of relaying on a cable, or another, and various useful applications in connection with them, such as the use of relays for the purpose of correcting the distortions of the signal, the object of which is to correct the signals consequent on the distortion and to restore their original correct form. That devised by Mr. Angus Fraser, of Glasgow, in 1908, to whom very

much of the present automatic working is due, is the best known and most successful of these. The development of this apparatus led naturally to an extension of its functions, so that in place of relaying on signals it became harnessed to a mechanism which perforated the incoming signals on tape in readiness for their transmission by an automatic transmitter on to another cable. About the same time a highly ingenious automatic perforator for dealing with received Morse signals was invented by Mr. F. G. Creed. Following on and used in association with this was an equally ingenious machine which, actuated by the perforated slip, produced a typed record of the original message sent. A comparatively simple modification of Mr. Fraser's cable code perforator enabled it to perforate Morse signals from cable code signals, and *vice versa*.

The use of cable relays, which was primarily for the purpose of relaying on received signals, became therefore extended to a more general purpose, *i.e.*, to actuate by way of an automatic perforator a typewriting machine at terminal stations. Reference has been made to the attenuated amount of energy received at the end of a cable in signalling and the necessary delicacy of the apparatus used in the reception of the signals. The question of locally amplifying or magnifying these small received currents had been one which occupied the attention of cable engineers since the earliest days. Not much success was achieved, however, along these lines prior to 1910, when the idea, stimulated by a demand for increased speed and better-formed signals, was revived, and, since that time, various forms of magnifier have been introduced and put into use. The moving coil constitutes the basis of the large bulk of these, which have been electrolytic, bolometric, pneumatic, or actinic in principle. The most recent departure in this direction is the thermionic tube.

Modern Practice.

Adverting to the course of the telegram for London handed in suppositiously at Gibraltar in the early days, which was seen to have experienced manipulation at the hands of eight operators, its present course is that its contents are manually punched by an operator on perforated tape at Gibraltar, the perforated tape is passed through an automatic transmitter at a speed of 200 letters per minute on the Lisbon cable. On arrival at Lisbon the signals are relayed on to Porthcurnow, where they are again relayed on to London, and here, by way of another relay and automatic perforator, they become finally printed off by the receiving printer. The telegram therefore experiences man-handling once against the eight times of those days.

A purposely short distance has been used for an example. Had, however, the station been Singapore instead of Gibraltar a telegram would necessarily have experienced a vastly greater amount of manipulation. The degree of automatic working is being constantly extended, but, as an illustration of progress, it may be said at present that a telegram for the Far East is now carried automatically as far as Singapore.

Early Electrical Engineering Days.

By Col. R. E. B. CROMPTON, C.B.

My knowledge of the electrical profession practically dates from the time that I purchased a Gramme machine and a Serrin lamp for lighting the pipe pits of the pipe foundry that I had designed for the Stanton Iron Works Company in the year 1878. For this purpose I designed the first inverted arc lamp seen in this country, and showed it at work at the Albert Hall Exhibition of Electric appliances that took place at the latter part of the same year.

About two years later I made the acquaintance of Emil Bürgin, the Swiss inventor, and commenced the manufacture of his form of dynamo machine. At that time our work was chiefly in the supplying of arc lights for large buildings and open spaces, and we endeavoured to popularise the electric light by going round the country with portable sets of tackle for supplying arc lights wherever work had to be carried on at night. I supplied the late Sir Joseph Swan with arc light machinery. He was then a stranger to me. Later he sent for me and showed me privately his carbon glow lamp, and the friendship then formed, which continued until his death, led to the formation of the Swan Electric Light Company, which afterwards developed, by amalgamation with the Edison interests, into the Edison Swan Company, to which I was formally attached as engineer and contractor.

In those early days we thought of little else but selling electric light machinery, but transmission of power soon followed. I made a couple of Bürgin machines, which were used by Sulzer in Switzerland for power transmission at Rheinfelden, and about the same time Marcel Desprez carried out a similar transmission with Gramme machines between Creil and Paris. The Bürgin machines were then manufactured on a considerable scale, and later machines with improved Gramme or drum wound armatures were made and sold by us, indifferently for electric lighting or power purposes.

The Leaders of the Electrical Profession.

At that time the leaders of the electrical profession were those belonging to the older branch of telegraphy. Sir John Pender, who was connected with the early *ELECTRICIAN*, used to give annual dinner-parties to which we, the developers of the new form of electrical engineering, were invited, and these evenings were very enjoyable, and no doubt were one of the causes why Siemens Bros., the Electrical Construction Company, and the Silvertown Company, all telegraph and cable manufacturers, began to take an interest in our new developments.

It may not be remembered that Matthew Gray, who was then managing director of the latter company, was the first to turn his attention to insulating the wires we used for indoor distribution. I believe the insulated wire they supplied me for the great installation of the Law Courts, which was made in 1881, is still in use there, and is in good order, and seems likely to last for an indefinite period.

A Fire and Theatre Lighting.

The first really big electrical job I undertook was the central station in Vienna for lighting the Imperial theatres, as the late Emperor Francis Joseph, after the destruction of the Ring Theatre due to an escape of gas, gave orders that *all his theatres*, which comprised the principal theatres of Vienna, should be lighted by electricity. I was busily employed on that work during the early years of the industry, and it was then that I had much to do with the late Peter Willans, who first coupled his engines to drive our dynamos direct.

During the very short period between the introduction of Swan's incandescent lamps and the completion of the Vienna work a great stride was made in generating and distributing and storage plant, and within that period most of the appliances now used for electric lighting were introduced and began to be manufactured on a commercial scale.

The Only Noticeable Developments.

It was not long before the advantages of electric lighting on board ship became evident; this also commenced with arc lighting, later supplemented by incandescent lamps. From that day to this the only developments which are really noticeable have been the introduction of the turbine-driven generators; and the highly efficient metallic filament lamp followed a further development—the coiled form of filament lamp known as the $\frac{1}{2}$ W. Otherwise the apparatus manufactured and put into use forty years ago still, in many cases, is found to work as satisfactorily and efficient as any of the goods of the same class which are now manufactured, and which, if they differ at all, it is that the modern plant is not of such high quality as the old.

My own connection with the electrical industry has been chiefly confined to the development of power stations, means of distribution, and to the various appliances for utilising electrical energy; and in my capacity as Secretary of the International Electrical Commission, I have watched with great interest the development of this side of electrical engineering in the twenty-two countries which form the Electrical League of Nations.

Though I naturally have many friends connected with the later developments of wireless transmission and of the splendid inventions that have arisen therefrom, yet I do not consider myself qualified to speak of these otherwise than as an electrical man proud of this new side of our profession. When I find late pupils of my own, as, for example, S. G. Brown, turning out such exceedingly beautiful work as his gyroscopic compasses, his sound intensifiers, and the like, I feel that out of the large number of young men trained on the older branch of electrical work we have developed some of the leading men of the later branch.

Provincial and Local Telegraphs.

(From "The Electrician," Nov. 30, 1861.)

Our railway system has long been characterised as devoid of flexibility. It has been urged that it does not adapt itself to the wants of the country which it traverses; so it is with the electric telegraph; the telegraph follows the locomotive, and partakes of the inflexibility of the railway system. Why should not the electric telegraph be accepted as the precursor of a line of railroad? There are hundreds of opulent and flourishing towns and villages in England and Wales upon which an expeditious means of telegraphic communication would confer incalculable advantages. Must they remain without such a boon until they are in a position to secure to themselves a line of railway? From our great trunk railway lines telegraph wires might diverge right and left into the neighbouring towns and villages. Branch wires might be rented by those residing along their course—by the nobleman interested in the topics of the day, the producer anxious to know the state of the metropolitan and other markets, and the inhabitants of our rural districts. A vast amount of telegraphic intercourse would be the result, and with commensurate advantages.

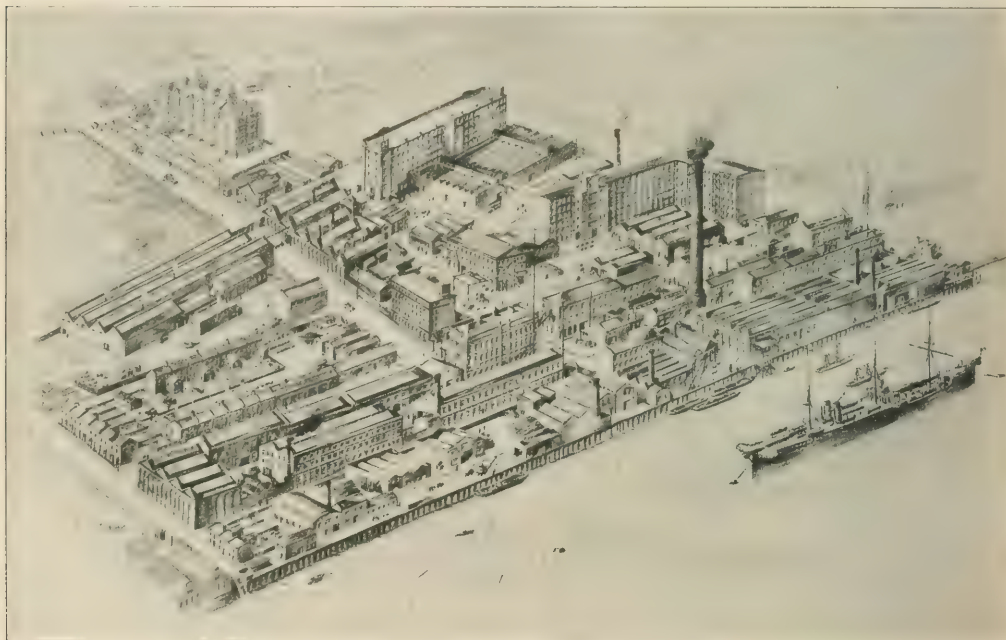
Sixty Years of Siemens.

In 1861 the works of Siemens Brothers were still at Millbank, where they were established by Mr., afterwards Sir William Siemens, in the year 1858, for the purpose of manufacturing small telegraph instruments, batteries, &c., and carrying out various experimental investigations in connection with refrigeration and regenerative furnaces. It was not until the year 1863 that it was decided to acquire land on the banks of the Thames at Charlton Pier, Woolwich, for the purpose of erecting a larger factory. The comparatively small buildings which were subsequently erected on that site for the manufacture of all kinds of telegraph instruments, apparatus and material, including submarine cables, are still standing, surrounded by the very large extensions which have been since erected. These works now occupy an area of over seventeen acres, as shown by the view which we reproduce.

In the early days of the firm's establishment at Woolwich the number of employees was about fifty, and as extensions have been

from experience that vessels of the ordinary type were unsuitable for cable laying, the result of which experience was the construction of the cable steamer "Faraday," which was built for Siemens Brothers by Mitchell & Company, of Walker, Newcastle-on-Tyne, and launched in February, 1874. The "Faraday" is at the present time still occupied in cable laying and repairing, and during her life has laid some 38 000 nautical miles of submarine cable. Among the submarine cables manufactured at the Woolwich Works, nine have been trans-Atlantic.

In about the year 1892 Siemens Brothers & Company, Ltd., determined that the time had arrived when an establishment devoted almost exclusively to the manufacture of electrical plant and apparatus should be driven by electricity, and it was during that year that a central station for this purpose was built at the Woolwich Works, which thus became one of the earliest factories of importance in Great Britain to be electrically driven.



SIEMENS' WOOLWICH WORKS TO-DAY.

made this number has increased until at times it has exceeded 4 000.

It was about the time that THE ELECTRICIAN was established in 1861 that Siemens Brothers & Company, were superintending the manufacture and laying of submarine cable which was to be put down between Malta and Alexandria, and one of the first contracts undertaken in the new factory at Woolwich was for the manufacture and laying of a submarine cable from Oran to Carthagen. About the same time Siemens Brothers were carrying out the construction and installation of that part of the overhead telegraph to India which passed through part of Russia to Tabreez and thence to Teheran in Persia, communication from thence being by the Indian Government telegraphs. The tender for the construction of the line to Teheran was sent in in April, 1868, and was accepted in June of that year, and this line, the total length of which was about 2 750 miles, was completed at the end of 1869. This undertaking placed England in direct telegraphic communication with India, and in its course the line comprised three submarine cables, one of which was laid in the Black Sea. This cable was destroyed by an earthquake, and subsequently this portion of the line was laid over land and completed on Jan. 31, 1871.

C. S. "Faraday."

It was in 1873 that Siemens Brothers undertook the construction and laying of a cable across the Atlantic. It had by then been found

Up to the year 1902 plant for the generation and utilisation of electric power had been manufactured at Woolwich, but in that year this branch of the Company's business had outgrown the available accommodation there and was transferred to new works which the Company erected at Stafford. The latter works, since the war, have been acquired by English Electric Company.

Siemens and Electrical Progress.

Throughout the period under review the firm of Siemens Brothers and the limited liability company, Siemens Brothers and Company, Limited, which was formed in 1880, have exhibited great enterprise in every branch of electrical engineering, both in the production of electrical cables and machinery for electric light and power and in cables, apparatus and line material for telegraphy and telephony, always following closely upon the latest knowledge acquired by their own careful theoretical and experimental research relating to all products of their manufacture. The Company was one of the earliest to give its attention to the manufacture of air-space telephone cable and loaded submarine telephone cable, as well as to improvements in all forms of telephone exchanges and switch gear, notably the development of automatic telephone exchanges, the manufacture of which at present forms a large portion of the Company's production and is steadily increasing.

In 1908 the Company established works at Dalston for the manufacture of incandescent electric lamps.

Mr. J. S. Highfield on Education and the Industry.*

To fill the position of President of the Institution of Electrical Engineers is at once a source of pride and humility, but pride turns to humility when it is considered how far behind opportunity must lag individual effort. It is the business of the President to produce an image—to give point and definition to the interests of its members. His task is rendered easier by the existence of the Territorial Centres and Sub-Centres, the Students' Sections, and the Wireless Section and Radiographers, the Electrical Development Association and Electrical Research Association, all contributing to the aims which the Institution had in view. The granting of a Royal Charter has also been a great step forward.

Education and Industrial Problems.

One outstanding feature of recent Presidential Addresses has been that all gave much attention to education and industrial problems. Circumstances forced such matters upon the attention of the engineer. The solution of the industrial problem was particularly difficult. Mr. Atkinson last year attributed discontent mainly to the fact that many people find their work uncongenial. Yet without work we cannot live, and it is necessary to do many unpleasant jobs. Much of the engineer's work is both dirty and monotonous, but one of the greatest alleviations is the knowledge that one can do one's work better than other people. Seeing that, at least, 80 per cent. of the working population must work with their hands, can it be said that our educational methods are correct? The most proficient hand-skill, and the most useful knowledge of some difficult industries such as farming, shipping and engineering, can only be acquired in boyhood. The founders of the engineering industry were men who enjoyed little book-learning in their early years. We have now provided ample opportunities for youth to acquire book-knowledge. But the simultaneous teaching of hand-skill and art at an early age should be carried further. Further there is the effect of education on character. Every student should leave college with a mental equipment designed for the acquisition of further knowledge.

Engineering the Bridegroom of Science.

No work falls to the lot of man more noble than that of the engineer. He links up the work of the army of original thinkers. Engineering is the bridegroom to the fair bride Science, and the material progress of the last hundred years is largely due to their happy union. Without this material progress, the means to enable 43 million people to live on these islands with increasing comfort, would not have been attained. This progress has been rudely interrupted, and it is certain that no rapid remedy is possible; only steady skilled application can produce any result. Much attention has recently been paid by electrical firms to better the training of their apprentices and technical assistants. Every engineer in a managing position should do everything he can to assist the education of his own men and of their sons. Scientific methods should be used, so that one generation may avoid the mistakes of those preceding it. Practical hand-skill, to be acquired only from hand-skilled men, is vital. There are no unskilled trades, but unfortunately there are many unskilled workers.

Rewards of Skill and Industry.

There should be due reward for skill and industry. Trade unions have done much good for their members, but they have done at least equal harm by forcing the principle of standard wages and by reducing output. Everyone should have the opportunity to earn a living, provided he will work, but this happy state of affairs is one most difficult of attainment. Each man should be willing to

help the next, and to rejoice in his good fortune. To attain success, the spirit of honourable rivalry should have full play. This cannot be, unless each man is free to work as skillfully and as hard as he desires, and to attain a due reward for his labour. Many members of the Institution have had ample opportunities of recognising the value of the proper skilled man who knows his work. They know—especially those who served in the Great War—what a good fellow is the average man, always gifted with a kind and sometimes with a lion's heart. Members of the Institution, and the Institution as a body, have done much to help the cause of better education. But the best results can only be secured when adequate profit enables facilities for education to be provided.

All progress in science and engineering depends on the ability of the individual to venture his profit or part of his profit in this way, in applying a part of his savings to new ventures. Electrical engineers are particularly interested in public companies. It is due to the thrift and enterprise of the shareholders in these companies that there is any electrical business. There is no more democratic institution than a limited company.

We hear so much of profit-sharing schemes that it is important to realise exactly what is shareable profit. Such profit is only a small part of the gross revenue, the amount remaining after such items as cost of raw materials, wages and salaries, rates and taxes, rent, overhead charges, depreciation, etc. have been met. Further there must be an adequate return in dividends to those who have ventured their money.

Electricity Supply the Foundation.

The great business of electricity supply is the foundation on which the whole electrical industry is supported. If electricity supply flourishes, manufacturers of plant, cables, lamps, motors and all necessary apparatus flourish. Electricity helps every manufacture and trade, and active trade causes a greater use and demand for all means of communication, telegraphs, telephones, railways, and shipping.

In the Report of the Electrical Trades Committee, dated April 18th, 1917, this point was strongly emphasised, and it was also pointed out that progress in electrical developments has been held up by prolonged consideration of their effect on public privileges and vested interests. This country suffered from irksome restrictions, while America, Germany, and other countries were eagerly availing themselves of the benefits of applied electricity. The really important problem is to get on with the work. A great part of electricity supply is carried on, and well carried on by municipal Corporations and Councils. It has been claimed that electricity should be more cheaply provided by municipal trading, since directors' fees are avoided and money can be raised on better terms. Both contentions are partly true. But the municipality can only borrow if it provides a sinking fund and reserve, which are charges against revenue and involves, on the average, an annual charge of 2 per cent. Both company and municipal methods have produced good results, but the company method is the better because it throws a more severe burden on management and thus conduces to higher efficiency. Amongst common errors of companies, however, is the fault of paying too high dividends at the expense of reserve, while municipalities commonly appropriate too large a proportion of profits for the relief of rates.

Scientific Interest in Finance Necessary.

Engineers should take a scientific interest in the finance of the works they control and design, so as to promote better management. They should recognise that savings are invested in enterprise only with the hope of profit and that those who finance industry carry a heavy burden. In this connection Mr. Highfield quoted the words of Lord Kelvin, who, on retiring from the chair in 1890,



JOHN SOMERVILLE HIGHFIELD (PRESIDENT, INSTITUTION OF ELECTRICAL ENGINEERS)

* Abstract of the Presidential Address of Mr. J. S. Highfield, delivered to the Institution of Electrical Engineers, November 11th, 1921.

reminded them that science could not be applied without the sinews of war. Lord Kelvin recalled the difficulties encountered in laying the first Atlantic cable, in which he was a shareholder. Many people do not know that this cable was actually completed and some important messages were conveyed across it in 1858. Then came disappointment, and, again, when half a cable was laid in 1865, and the Great Eastern four times nearly succeeded in fishing up the broken cable. But for Sir John Pender's action in guaranteeing £250 000 for the funds required for the completion of the two cables across the Atlantic many years would have elapsed before ocean telegraphy attained success. Lord Kelvin emphasised that the Institution had a double duty, to get all the good it could from science, and to encourage and satisfy those who paid for the work.

Reduction in Cost Essential.

Bearing this double duty in mind there is much technical work in front of engineers that will tend to the expansion of business. A reduction in the cost of transmitting electricity is of first importance. We are far from the end of invention in this matter. There is much water power available in this country, and especially in Wales and Scotland, as the work of the Water Power Resources Committee has shown. But the fullest use of these resources depends on cheap transmission. The cable makers have done much to help, and have succeeded, despite increased costs, in improving the design of cable so as to transmit electricity at little more than the cost before the war. The greater facilities for overhead lines given by the Electricity Act are useful in facilitating the provision of electricity in many rural districts, impossible by underground cables. Attention should be directed to the means of connecting the lines to the consumers' apparatus; switchgear and other subsidiary plant should be simplified even at the expense of security, in order to reduce cost. In view of the reduced wealth of the nation, we have gone too far in this direction. Many manufacturers satisfactorily run their mills and works on a single gas or steam engine, and suffer occasional stoppages, which they regard as inevitable. We can easily give greater security than this, without an undue amount of spare plant.

The Tariff Question.

On the management side of the business, there is the important problem of arriving at a satisfactory tariff. The maximum price in the Electric Lighting Orders was, with certain exceptions, 8d. per unit, and this price was subject to revision in most company Orders every five years, but not in the Municipal Orders. The introduction of the wire lamp, and its general use about 1910, halved the cost of lighting by electricity, and for a time the suppliers' profits fell off considerably. It was only through the growth of the power and heating loads that suppliers were able to provide electricity for lighting without adding to the price per unit. Further improvements in lamps have again reduced the cost of electric lighting, the lighting consumer has not paid his fair share of the increased cost.

Tariffs should be arranged so that two meters are not required, and consumers should obtain electricity for all purposes without the cost of double wiring, *e.g.*, by what is known as the "Contract System" or "Two-part Tariff." The Electrical Development Association have done excellent work in pressing that the "Two-part Tariff" should be made a legal tariff. Before the war, the "Contract System" was largely used, the alternative being a flat rate of, say, 8d. per unit. A maximum price of 8d. per unit is now impracticable, and the system has fallen into disuse. The logical thing would be to double the maximum price. This would enable the price for lighting to be raised to a reasonable figure and would avoid the necessity of overcharging for power and heating. It would also enable the "Contract" or "Two-part Tariff" to be put into use at once, with resulting benefit to the industry and to the consumer.

The Task of the Commissioners.

In future development we must depend for guidance on the Electricity Commissioners, who form a skilled tribunal in which increasing confidence is being placed. They have a very difficult task to perform, and all the help we can give them should, and will be given.

The difficulty of their task is enormously increased by the Act that gave them a constitution. It gave them too little freedom from political control. It equipped them with duties both executive and judicial. This combination of duties necessarily increases their difficulties, and, they should preferably concentrate on the judicial and advisory side of their work. Among the duties of the commissioners is the fixing of maximum prices. There seems a tendency to exercise too much control—to fix the actual selling price and not the maximum price. There has been delay in dealing with applications. We had all hoped that our Commissioners would be free from red-tape methods, but there are signs of that baffling material. In my own direct knowledge, several hundred thousand pounds

have been lost to the industry through delay, most of which would have been spent with electrical manufacturing firms for extension of plant and cables to supply waiting consumers with the electricity they desired.

These remarks are made in no carping spirit. The Commissioners desire, I am sure, to form an ideal Government office, but it would be a disservice to allow faults to remain unnoticed. Any public service must be subject to some form of control and there is a general belief that this control will be exercised with understanding and sympathy by the Commissioners. An obstacle to rapid progress has been the feeling of uncertainty arising from the Electricity Supply Bill as first presented. The feeling was created largely by the admittedly unfair proposals for purchase of works by new State Boards. This objectionable feature of the Act has been removed, but a feeling of uncertainty nevertheless exists, and can be dissipated only by clear proof that the existing rights of companies and municipalities will be respected.

Relations Between Companies and Local Authorities.

Next in importance is the recognition by companies and municipalities that they should help each other to furnish electricity to the public in the least expensive way. The address of the President of the Incorporated Municipal Electrical Association was a courageous and just statement of the proper relations between companies and local authorities, and if this advice is acted upon there should soon be substantial progress in electricity supply.

The third obstacle to progress is the purchase clause in Provisional Orders. The twenty-one years' clause in the Act of 1882 absolutely stopped progress for six years. The present clause severely hampers the industry, and it should be revoked unconditionally. No single change would do more to promote enterprise and to supply the public at the least cost. It would enable much obsolete plant to be scrapped which now must be kept. It would give heart to the director who desires to raise more capital and to push forward his business, but who dare not and cannot raise money, when he may be forced to sell the undertaking in a few years. There would not be the very necessary tendency to keep prices as high as possible, in order to provide a sufficient reserve to purchase new plant to continue the business, and to provide for an unknown future. Again, the waste consequent upon a change of ownership of a great public business is enormous, and results in an increased price to the consumer.

The difficulty about the change is that the right of purchase is a Parliamentary bargain. The local authorities are entitled to enjoy it, and the difficulty can be overcome by their good offices alone. But since their desire is to benefit the general body of ratepayers, and since cheap electricity is so desirable, they may consider the suggestion in the most liberal spirit and try to find a solution of the difficulty.

Export Trade and Foreign Purchase.

My excuse for dwelling on matters of money and trade is the present very serious state of business, and the urgent necessity to rebuild our export trade. The purchase of goods from abroad requires attention. Reasons for buying foreign plant are often sufficiently good. At the same time, it should be recognised that the price paid to the foreigner is not necessarily the whole sum paid; some portion of the price may take the form of increased payments in taxes and rates to provide for unemployment at home.

At the present moment profit is no longer earned by the great trading community of these islands, and, in consequence, many are wanting work and many are in distress. There is no general board, no managing director, nor can there be one, for this vast trade, and when even the Government seeks to fill the position they necessarily fail to produce any result but confusion.

As a trading community, we must reduce cost and increase output, and also, where possible, the reserve, and we must, as any trader has to do at times, reduce prices to re-open markets, even if an apparent loss results, and all concerned must shoulder their share of the loss.

Minding One's Own Business.

Each trade, and each trading association, must attend to its own affairs and restore its own profit, to lead to the common end of restoring national prosperity. Masters should instruct their men and make clear the conditions for success. They are taking more trouble in this matter, and doubtless the result will be a common understanding and co-operation between masters and men such as has not been known for years. They will go forward together it may be in poverty, but at any rate with the certainty of improvement.

The problem is urgent. Success may be long deferred, and for a complete solution the limit is infinity. Our own trade, I have no doubt will do its share of the work, and since the traders in electricity are generally in a better position than many others, their responsibility to push on with the work is greater. In this, I am sure our members and this Institution will take a leading part, adding to their own usefulness and to our Institution's splendour.

SOME EARLY "ELECTRICIANS."

The Technical, the Commercial and the Human in 1861.

Mrs. Ayrton, in the congratulatory message which we publish on another page of this issue, tells us that, to seek inspiration for her remarks, she began to look through the early files of *THE ELECTRICIAN*, but became so fascinated with what she found that it was a choice between continuing to read and omitting the message. Now, before receiving Mrs. Ayrton's letter, we had, for the purpose of this article, conducted a similar research, and had been caught in a similar way. Others may be similarly affected as the result of this issue, so, to prevent stagnation in the electrical industry, it therefore seems well that a short survey of what appeared in the issues of *THE ELECTRICIAN* which appeared some sixty years ago should be given.

Two Curious Phases of Development.

Such a survey rivets attention on two rather curious phases in the development of electrical engineering. These two phases are that, while there has been an enormous change, both in outlook and knowledge of electrical science and technology, yet we are still concerned with much the same problems as were the pioneers of 1861, and that the attitude of the general public and of the governing classes towards electrical progress is not very different from what it was then.

For the purposes of such a survey we must project ourselves into 1861, begin with a short summary of the state of electrical knowledge in that year, and recall the efforts of those pioneers living and dead who had worked to attain that stage of development, and whose work subsequently has been of the profoundest influence on our present knowledge and progress.

Faraday and "The Electrician."

No electrical celebration, and certainly no celebration in the life of a journal which has been connected with electrical science and industry for sixty years, would be complete without mentioning the name of Faraday. In 1861 Faraday was still living. He died in 1867. His great work on electro-magnetism had, however, been done some twenty-five or thirty years before, and he was at that time living in honourable retirement. It is a matter of interest, no less than of congratulation, that he was a contributor to early issues of *THE ELECTRICIAN*, and special attention may be drawn to an article from his pen on "Electrical Illumination for Lighthouses," which appeared in our issue of August 22, 1862. There are still some lighthouses that are not electrically lighted.

On the other hand, Davy, whose work on the arc lamp had not in 1861 come to fruition, much less passed into decay, was dead, as were also Oersted, Sturgeon, the father of electro-magnetism, Ampere, Ohm and Volta.

The Active Pioneers of 1861.

Among the active pioneers who were living in 1861, but who are long since dead, we must include the honoured names of Wheatstone, who died in 1875, Cooke, Clerk Maxwell, who died in 1879, Latimer Clark, Paccinotti, Gramme, Wilde, C. and Werner, Siemens, Henry, who died in 1878, Fleming Jenkin, Balfour Stewart, Morse, Thomson (Lord Kelvin), who died in 1908, and Alexander Muirhead who died only last year. But their names and work live and will continue to live. And the close connection of those times with the present day is evident when we instance such names as Edison and Elihu Thompson, from whom we are pleased to be able to print congratulatory messages on the Diamond Jubilee of *THE ELECTRICIAN*, as well as J. J. Thomson, Lodge, and Ferranti.

Early Telegraph Matters.

Turning from persons to facts, the position of telegraph science and industry in 1861, and then development from that time to the present day, are given in the articles by Sir Charles Bright, Mr. G. L. Addenbrooke, and Mr. H. H. Harrison, which we publish on other pages of this issue. It is, therefore, sufficient to say here that practical electric telegraphy, which in 1861 was the electrical industry in Great Britain, dates back to about 1837, when the first telegraph due to the enterprise of Cooke and Wheatstone was erected on the London and North Western Railway, between Euston and Chalk Farm. In 1845 a somewhat similar experimental line was laid down between Paddington and Slough, and, being the means of bringing a murderer to justice in a way which was then both strange and new, was the unconscious means of giving a much-needed advertisement to a means of communication which was then considered to be nothing more than a pretty toy. The first joint-stock company for telegraph communication purposes was founded in 1846 under the name of the Electric Telegraph Company. This was followed at an early date by other companies, until in 1868 about 16,000 miles of telegraph lines were in use. When *THE ELECTRICIAN* was first published this system of communication was still in private

hands, though the State was already flirting with the question of purchasing the system. As is well known, the purchase was actually completed some years later, in 1870. Technically, as Mr. Addenbrooke shows, the obstacles were great, and the need of some organ which should deal with electrical science and telegraphy from the telegraphists' points of view was met by the foundation of *THE ELECTRICIAN*.

A Twilight Period.

Telegraphy, with such accessory applications as electric bells, was the all-in-all of electrical engineering in 1861. Heavy electrical work as we understand it to-day was not in existence. Indeed, many years were to pass before the Willans engine and Ferranti alternator made their appearance, and still longer time before the work of Parsons and others culminated in the turbo-alternator as we know it to-day with all its vast possibilities. It is, indeed, very curious to note that 1861 was a sort of twilight period in electrical practice. How much the subsequent dawn was due to *THE ELECTRICIAN* it is not for us to say, but at the date of the foundation of the paper electrical opinion was not being directed in one line, a great deal of useful work was being spoilt by overlapping, and then a lack of that knowledge of past and present performance which is such an aid to new discovery. For while the great work of Faraday and the other early pioneers to which we have referred above had made the breach, the advance had not begun, though a great deal of what would now be called research work was being done, on the lines that the early work had suggested, with a view to discovering whether electro-magnetic theory and properties could not be applied to some practical use. All, however, was still in the laboratory stage, and it was not, in fact, for some years before it actually passed that stage. The history of this progress is well known, but one or two lines on the state of affairs in 1861 are perhaps necessary in any history of *THE ELECTRICIAN*.

Electrical Engineering in 1861.

That great invention of Faraday was the result of ten days' work in the autumn of 1831. Its results were profound. In the same year Pixii produced a machine for generating alternating current by the rotation of a permanent magnet in front of wire bobbins. In 1833 Saxton, and in 1835 Clarke, followed with the invention of direct-current magneto electric machines, while the compound magneto machine was invented in 1849 by Nollet, and a similar machine invented by Holmes was actually used for illuminating a lighthouse. The important work of Werner von Siemens, which later was of so much practical importance, reached a peak in 1856, when the shuttle-wound armature was invented, while one year before that the first volume of *THE ELECTRICIAN* appeared. Paccinotti devised his iron-ring armature and the well-known Gramme ring came into being. Some ten years before, H. Wilde had invented a similar magneto machine with a permanent steel field magnet for energising the field electro magnets of a larger machine, and the same pioneer, working in 1867 in conjunction with Siemens' and Wheatstone, discovered the self-exciting principle. A fine field only waiting for the abundant harvest.

The Objects of "The Electrician."

Turning now to the early volumes of the paper whose Diamond Jubilee we celebrate to-day, the first issue of *THE ELECTRICIAN* appeared on November 9th, 1861, and, as was then and is still usual, the new venture was launched in a leading article laying down the objects of the publication. The writer of this article makes the interesting point that the growing importance of the applications of electricity render the establishment of some such journal almost a necessity. Publishers of journals, like the ladies in the song, are never short of an excuse for their existence, but in this statement there lies more justification than in many other similar pronouncements. For the necessity for a technical electrical journal has grown rather than diminished, and, as Mr. Swinburne says in his congratulatory message, *THE ELECTRICIAN* has always been a necessity to him, and, we may add, to the electrical industry, as we hope it will continue to be. Another reason for founding *THE ELECTRICIAN*, and this also is not without its modern application, is that the needs, struggles and achievements of telegraphy, both scientific and industrial, were not being represented either by the daily or the more scientific Press in the way that their importance warranted. The telegraph industry unfortunately had been allowed to get into the hands of the politicians, and everything that was published about it had naturally therefore a political tint which prevented its real complexion from being seen. This state of affairs, as the writer of the early article wisely pointed out, is best combated by publicity, discussion, and the free interchange of ideas. *THE ELECTRICIAN*, the article concludes, "will therefore

supply a want that is greatly felt [all new journals do!] and thus be received by telegraphists as a welcome addition to scientific literature." This, even the *cliché*, is we feel, not less true to-day than it was sixty years ago.

The Birth of Electrical Measurement.

In 1861, apart from telegraphy, politics and technology, an important question which was exercising the minds of electricians was the subject of electrical measurements and it is interesting to find in the first issue of *THE ELECTRICIAN* the historic Paper by Mr. Latimer Clarke and Sir Charles Bright, which was read before the British Association, on the "Measurement of Electrical Quantities and Resistances." A leading article on this subject generally approves of the suggestions made by the two authors, but calls attention to the fact that the thousandth part of a volt should be called a milli-volt (*sic*) and not a kilo-volt as suggested. This suggestion has, of course, long since been adopted and may be taken, perhaps, as the first example of the influence of *THE ELECTRICIAN* on electrical doings. It is also interesting to note that the nomenclature of the two authors has been modified in other respects. Thus the unit of pressure or tension is now the Volt instead of the Ohma, the unit of current the Ampere instead of the Galvat and the unit of resistance the Ohm instead of the Volta. A certain amount of space in the same issue was devoted to the reproduction and to comments upon the report of the Joint Committee appointed by the Lords of the Committee of Privy Council for trade and the Atlantic Telegraph Company, and to inquire into the construction of submarine cables. This committee was charged with the investigation of all matters which had led up to the failure of the first Atlantic cable in 1857, and as Mr. Addenbrooke shows, its findings had a most important bearing on electrical progress. From this report it is interesting to learn that there were 3 7/4 miles of shallow water cable in existence and 8 2/3 of deep sea cables, of which the longest was that between Suez and Kurachi, 2,499 miles. The money article in the same issue states that the Bank Rate was 3 per cent. and that money was abundant.

Atlantic Cable Matters.

Atlantic cable matters continued to occupy the energy of those then conducting the paper throughout a considerable period. As an example of the line taken up, an early leading article deals with the evidence that was given in an attempt to show that the failure of the early cable was due to carelessness in manufacture, storing and laying, and the wise remark is made that no electric cable is stronger than its weakest part. An account of a telegraph soirée at Manchester gives us some enlightenment as to those who were interested in this important matter—and we notice among those present or exhibiting—such historic names as Preece, Henley, Wheatstone, Siemens and Halske, W. Thomson, Elliott Brothers and Fleeming Jenkin.

An early law case that is reported deals with an action brought by Baron Lionel Rothschild against a Telegraph Company for nuisance from telegraph poles on his estate at Acton, while in the same issue there is a paragraph on bread as an antidote to the effect of mustard, and another on the ignorance of two Irishmen who considered that a telegraph wire which was being laid across the Thames was something to do with a flying match—so that there was a certain universality of appeal which augured well for the future. Omissions we notice are that in those days there were apparently no economic problems or labour troubles, or perhaps an electrical paper was then able to appear without troubling much about them. From the earliest issues a large amount of space was given to correspondence—an interesting commentary on the vitality of the paper—though unfortunately for historians, a large number of the letters are simply signed with initials or pseudonyms and we begin to wonder whether the advantages of presenting views by that method are not over-rated. Perhaps in this case it was as well, for so truculent and aggressive did some of the correspondence become however, that the editors were forced to publish the protective remark "we are not answerable for the opinions and statements of our correspondents." That also is our policy at times—we think very wisely.

Early Insulation Problems.

The question of the best insulating materials to use and the effect of sea water and weather on them is one of the matters which is dealt with at some length. That is a problem which has not yet received a full solution. A leading article thinks that the suggestions for overcoming the difficulty by using uninsulated wires laid in the ground is worthy of consideration, but doubts whether the solution would have any practical effect owing to electrolysis corrosion. Indiarubber and gutta percha were the two great insulators. Paper was apparently unknown as was lead covering, though armouring, of course, was in existence.

The Human Side.

Turning to the more human side—a letter in the issue of December 13th, 1861, signed "Au Revoir" adjures *THE ELECTRICIAN* to be true to its mission; to encourage in its readers self-reliance, which it has certainly succeeded in doing, and to explain that there is no

theory of electricity competent to lead them forward. That is a great change, for now we do not suffer from lack of theories. It should encourage its readers, the writer continues, to seek for novelties in doctrine, and he points out that, while facts are useful in subserving the exigencies of a civilised community, we must, as lovers of knowledge, aspire to learn the nature of electrical forces and the laws which they observe. This is the more so, the writer concludes, because the science *THE ELECTRICIAN* has undertaken to serve has completed nearly fifty years of existence in active amateurship, but still thirsts for knowledge. In 1921 we continue thirsting, and the more we drink the more thirsty do we become.

Apparently it was hoped in those days that hard work and careful measurement would soon solve the fundamental electrical problems which were recognisable as being obstacles to further development. An early leading article remarks "that the foundation of a science is often indeed the most difficult part of the structure of knowledge when we are isolated from the help of kindred workers in Nature's great *arcana* and dependent upon books which perform must leave many things untold." As we know to our cost, and perhaps also to our advantage, the solution of one electrical problem brings many others into view and after sixty years have passed we may truly say that we seem to have done less of what there is visible to do than they had then.

The Death of the Prince Consort.

In another early issue the death of the Prince Consort is made the subject of a leading article, suitably bordered. This article pays a tribute to His Royal Highness's interest in the development of the new industries. In the same issue a second editorial article wonders whether the Atlantic telegraph, had it been in working existence, would not have relieved the nation of the enormous expenditure and painful expense and anxiety of waiting for the reply to the demand of the British Government upon America over, we imagine, the Alabama question. The point is made by a correspondent that telegraph communication with the Western hemisphere is essential. At the same time he rails at the slackness of the Government in this regard, pointing out that the whirling away of the first Eddystone lighthouse did not prevent another from being constructed. In this case, however, the Government wisely moved slowly and, taking expert opinion, made a success of what at first had been a hopeless failure.

Another early issue contains a short paragraph noting that the Government had determined to send to Canada a staff of telegraphists selected from among the most skilled men belonging to the establishment of the Royal Engineers. It is interesting to notice that one of the officers actually sent was Captain (now Colonel) Malcolm, a founder-member of the Society of Telegraph Engineers, whose congratulatory message we are pleased to publish to-day.

Subsequently a series of articles appears on the induction coil and the needs of students begin to be met in a special article which appears as a weekly feature. We notice in 1862 the price of fine gutta percha was 1s. 9d. to 1s. 10d. per lb, and of fine Para 1s. 11d. to 2s. per lb.

Who Invented the Telegraph?

In March, 1862, our predecessor descends to personalities in a discussion of the question as to who invented the electric telegraph. Apparently the lay Press both informed and uninformed had ascribed this invention to Wheatstone. *THE ELECTRICIAN* takes up the cudgels in favour of William Fothergill Cooke and makes out a case which it is hard to destroy. A series of articles entitled "Random Papers by a Practical Man" indicate that *THE ELECTRICIAN* was over widening its appeal, as it has since endeavoured to do, with a considerable amount of success.

In those days the daily Press were not, apparently, more informed on technical matters than they are now, and "*The Times* on Submarine Telegraphs" is the title of an article pointing out some of the defects of Press comment from a technical point of view. This perhaps is an error which has grown rather than diminished with the course of time.

Some Material Advances.

And here our survey must end. Not because we are finished, but for reasons of time and space. We have, we hope, said enough to interest our readers in these early volumes, and if what we have said encourages those who have time to do so to turn once again and delve into the history not only of a great industry, but of a not unsuccessful paper, we shall have fulfilled our object and they will not waste their time. Those who take this course will not fail to be struck with the advance that has taken place in sixty years in the arts of typography, illustration and make-up. Not only has paper manufacture enabled a clearness of reproduction which was unheard of in those days to be attained, but the invention of the half-tone block has enabled an illustration to be much clearer and more informative than was then the case, while our constant striving after sharper type and a better arrangement of articles has enabled us, we think, to reach the stage when each page of *THE ELECTRICIAN* is not only worth reading for its matter, but excellent to contemplate, owing to the way in which it is made-up.

THE DIAMOND JUBILEE OF "THE ELECTRICIAN."

Congratulatory Messages from Eminent Electrical Engineers.

From Prof. RICCARDO ARNO.

THE ELECTRICIAN is the most valuable paper dealing with the Science and the Technique of Electricity. I am, therefore, very pleased to be able to declare that my celebrated master, Prof. Galileo Ferraris, used to say to me: "Let us wait for THE ELECTRICIAN, and read it," when we were on the point of investigating or discussing a new theory or discovery.

This is also my personal opinion, because, for this kind of thing, there is nothing so necessary as the reading of the "Notes" of THE ELECTRICIAN.

From Mrs. AYRTON.

THE ELECTRICIAN has so fine a record behind it that I feel inclined to congratulate—not it—but the world in general on its having reached its Diamond Jubilee.

I set out to glance through the early volumes, hoping in a short time to gain some idea of what it had done before I became conscious of its existence; but the task was hopeless: my eye was constantly caught by some item so fascinating that I could not tear myself away; it would have taken weeks to carry out my purpose. Articles by Crookes, Rayleigh, Hopkinson, Dewar, Graham Bell, Hughes, Ayrton and Perry, Naudet, Helmholtz, Heaviside: how could one hurry through these?

I consider that the great debt that the scientific world owes to THE ELECTRICIAN is that, being a technical journal, it still never hesitated to publish series of articles on the purely scientific side of the subject, articles which, while immensely important, even indispensable, could yet in no way contribute to the immediate commercial success of the paper.

From Prof. A. BLONDEL, Membre de l'Académie des Sciences, Hon. Member of the Institution of Electrical Engineers.

J'ai appris avec grand plaisir que vous alliez célébrer le 60^e anniversaire de la fondation de votre excellente revue THE ELECTRICIAN. C'est avec raison que vous n'avez pas voulu laisser passer cette date sans commémorer d'une manière un peu solennelle cet anniversaire, car THE ELECTRICIAN est la plus ancienne des revues spéciales consacrées à l'électricité, surtout dans ses applications et le rôle de ce journal dans la progrès de l'électricité et de l'électrotechnique a été considérable depuis son origine jusqu'à présent.

Si, dans la première partie de sa vie, il a dû se consacrer plus spécialement à ce qu'on appelle aujourd'hui les courants faibles, parce que les courants forts ne jouaient guère de rôle dans la vie pratique avant l'année 1875, cette première période n'a pas été moins féconde si l'on songe aux grands progrès que l'industrie télégraphique et téléphonique a réalisés en Angleterre et aux Etats-Unis sous l'impulsion de savants géniaux comme Lord Kelvin et Heaviside et de merveilleux inventeurs comme Graham Bell.

C'est grâce aux travaux des deux savants que je viens de rappeler, fondés sur les admirables recherches du grand Français Ampère, père de l'électrotechnique et de l'électro-magnétisme, dont nous allons célébrer le centenaire de Faraday et de Maxwell, que l'Angleterre a pris et occupé pendant longtemps la première place pour la technique des communications sous-marines et qu'elle jouit encore d'une haute réputation bien méritée pour tout ce qui concerne la télégraphie et la téléphonie. Grâce à THE ELECTRICIAN, nous avons été constamment tenus au courant des progrès réalisés dans ces branches très importantes de l'électricité appliquée.

Mais votre journal a su comprendre dès l'apparition de l'éclairage électrique l'importance que prendrait le développement des courants forts et l'avenir illimité ouvert aux applications de l'électricité dans la vie moderne; vous orientant vers ces applications, vous leur avez fait dans vos colonnes une place toujours croissante; et, avec un remarquable éclectisme, vous avez su tenir vos lecteurs au courant non seulement des travaux, souvent très remarquables, publiés par les électrotechniciens anglais, mais encore de tout ce qu'il y avait de plus important dans les recherches faites dans tous les pays étrangers. A ce point de vue, THE ELECTRICIAN est devenu et reste depuis de longues années une des revues d'électricité les plus complètes et les plus intéressantes, celle où l'on est sûr d'être tenu au courant de toutes les découvertes nouvelles de la technique et de tous les progrès scientifiques qui peuvent avoir une influence sur cette dernière; car, et c'est une des grandes maîtrises de votre publication, vous n'avez pas cessé de vous intéresser aux questions d'ordre purement scientifique et vous leur avez largement vos colonnes. C'est ainsi que vos lecteurs ont été renseignés par vous sur tous les progrès intéressants de la télégraphie sans fil.

Tous les électriciens peuvent donc, en tout sincérité, rendre hommage à l'œuvre féconde qu'a accomplie votre revue depuis

son origine et aux grands services qu'elle ne cesse encore de rendre; je souhaite que pendant de longues années encore THE ELECTRICIAN conserve le même caractère de grande revue électrotechnique, impartial, excellent organe international de la science électrique.

From Mr. THOMAS A. EDISON.

I understand that on November 9 next your publication will celebrate its Diamond Jubilee, and I wish to extend my sincere congratulations upon its arrival at such a mature age as a notable exponent of a youthful but lusty industry.

Although the progress which has been made by electrical science and industry in the last sixty years has been marvellous and without parallel in history, I think we have only just stepped over the threshold and are entering into still more wonderful developments beyond the scope of prediction.

The grateful thanks and appreciation of those interested are due to THE ELECTRICIAN for the faithful service it has rendered during all these years, and I trust its days may be prolonged to record the ever onward progress of electrical science and industry.

From Sir J. A. EWING, K.C.B., F.R.S.

I gladly join in congratulating THE ELECTRICIAN on attaining its Diamond Jubilee. During sixty years it has witnessed and chronicled the growth of a new industry. But it has done more: it has been an influential factor in promoting that growth. Moreover, it has recognised that electrical engineering grows by applying to industrial uses a science which is itself immensely progressive. Thus the pages of THE ELECTRICIAN have recorded all salient features in the steady advance of our knowledge of electricity, and have encouraged technical readers to cultivate a scientific outlook. There is perhaps no branch of applied science in which theory has been so closely related to practice, and practice has done so much to assist the development of theory. While devoting itself mainly to technical applications, THE ELECTRICIAN has been far from neglectful of more abstract matters. I recall gratefully how thirty years ago it gave hospitality to my own articles on magnetism; this was only one example of the spirit that has characterised it. It has kept its readers informed of discoveries many of which have, at least at first, seemed remote from technics. Age has not withered THE ELECTRICIAN, and all students of electricity, old as well as young, have the best of reasons for wishing it a continuance of usefulness and vigour.

From Prof. GEO. FORBES.

In 1883, at Vienna, Sir John Pender, one of the owners of THE ELECTRICIAN, asked for my opinion on the manner in which that journal was being conducted. I said that since THE ELECTRICIAN had extended its sphere from telegraphy, for which it was started, to the new developments of light, power, chemistry, &c., it had gained the respect of all professional men by being thoroughly well informed, up to date and helpful, as well as straightforward and fair in its criticisms.

From Mr. J. S. HIGHFIELD, President of the Institution of Electrical Engineers.

It gives me much pleasure to congratulate you most warmly on THE ELECTRICIAN'S Diamond Jubilee.

To electrical engineers THE ELECTRICIAN has long been a treasured journal and it has taken a leading part in helping forward the electrical industry in all its branches.

Any journal read mainly by professional and scientific people must of necessity contain matter primarily of interest to those readers, but the progress of commercial application of any science is, after all, the ultimate aim. An invention becomes of use to the nation only when it is applied, and its application generally requires the assistance of those who provide the money and who have the special ability necessary for the proper use of money. Consequently it is of importance, certainly to those who are on the borderline between invention and commercial application, that they should become acquainted with commercial principles and, for that reason, the occasional articles you insert on this subject have been and will continue to be of great use.

I hope THE ELECTRICIAN will continue to prosper.

From Mr. EDWARD HOPKINSON, M.P.

Your present wide circle of readers and many who have been readers in the past, but who have ceased to play a part in the development of the electrical engineering industry, will join in hearty good wishes and congratulations to THE ELECTRICIAN on the celebration of the Diamond Jubilee of its foundation.

The sixty years, the passing of which is now commemorated, have seen all the great developments of electrical science in its

application to meeting human needs. The most striking feature of this development is the rapidity with which the discoveries of science have been applied to practical purposes, and this has been assisted in no small measure by the technical electrical Press, which has happily combined in due proportion the records of scientific advance, industrial applications, and financial and social results. In this combination THE ELECTRICIAN has always maintained a leading position.

From Prof. A. E. KENNELLY.

It gives me great pleasure to express my congratulations to THE ELECTRICIAN on the occasion of its Diamond Jubilee. *Sursam corda!* The many years of its activities have witnessed the wonderful development of electromagnetism in the service of man. During all these years, THE ELECTRICIAN has laboured to make this development widely known, and thus has shared in the development itself. We, its readers, hope those activities will continue unslackened and undimmed.

From Dr. GIBERT KAPP.

Scientific and technical progress in heavy electrical engineering dates from the eighties, after the collapse of the boom and the amendment of the original Electric Lighting Act. Up to the end of the century we had an enormous development in which this country took a leading part. The field is too large to attempt an exhaustive list, but a few outstanding features may be mentioned. The direct drive of generators by slow speed engines, the turbo-driven generator, the single and multi-phase alternator, the three-wire and three-phase systems, the transformer, the converter, the electric tramway, the electric furnace, the supplanting of the local steam or gas engine by the electric motor, the induction motor, transmission of power by alternating current, the storage battery and electro-chemical work generally, accurate electricity meters.

On this foundation, rather than on the discovery and application of new principles, work has gone on during the present century. We see gigantic generating stations, both thermal and hydraulic, long distance extra high tension transmission by cable and overhead lines, electrically worked main lines, countless applications of the electric motor to the special requirements of industry resulting in coal saving and the desire of supplier and user of electricity to adopt a rational tariff which will be to the advantage of both.

THE ELECTRICIAN has faithfully recorded these developments both from the scientific and technical point of view, and this is the best testimony to the service it has rendered to the cause of heavy electrical engineering.

From Sir OLIVER LODGE, F.R.S.

Since the early days THE ELECTRICIAN, along with the electrical engineering profession generally, has developed enormously, and devoted itself to the application of electricity in every direction. THE ELECTRICIAN has gone through the early dynamo days, assisting the heavy, as well as the telegraphic, side of the profession, and has survived into the days of valves and wireless telephony. Incidentally it took part in introducing units and exact measures into practice; long ago it familiarised the old telegraphists with the ideas of potential and self induction (so long and curiously resisted by one or two in high places); it furnished a channel for the stream of mathematical discovery of Mr. Oliver Heaviside. Under the able editorship of Mr. Snell it did a good deal to make known the pioneering work in Hertz waves, which ultimately became wireless telegraphy; and now, I suppose, it has reached a placid and profitable maturity, when the intricacies of technical development rather overpowered or submerge the advances in pure science, which, in greatly modified form, are still going on, but which are so multifarious that no one organ could cover the ground. On the whole, it seems likely that the discoveries and applications in the field of electrical energy during the next fifty years are going to be as striking and revolutionary as those that have astonished the public in the sixty years during which this organ of enlightenment has carried on its beneficent work.

From Col. E. W. MALCOLM, C.B., R.E.

Fresh applications of electricity to the use of the world are now almost of daily occurrence, and electricity, which in the day of my youth was feared by most, is now an obedient servant in almost every house. This wonderful advance is really the work of the Press—one side of which spreads the news of fresh uses and discoveries, while the other side explains the laws and the reasons, which govern the new applications.

Sixty years have passed since the foundation of THE ELECTRICIAN; these sixty years have been spent in doing what may really be called a great work for the world in publishing discoveries of all sorts in connection with electricity—explaining at the same time the new application of the laws which have brought the discovery about.

From SIR HENRY MANCE, C.I.E.

I have much pleasure in associating myself with the congratulations THE ELECTRICIAN will receive on the attainment of its Diamond Jubilee. During many years of exile THE ELECTRICIAN was an unfailing source of information and well served its purpose in keeping up one's association with the progress of electrical science throughout the world.

From Mr. G. MARCONI.

It gives me great pleasure to congratulate THE ELECTRICIAN on the occasion of its Diamond Jubilee, which completes a period that may be said to have witnessed the birth and development of all those valuable adjuncts to the comfort and efficiency of modern life, which are based upon the application of some of the electrical principles discovered within the last 120 years.

When THE ELECTRICIAN was first published very few of these applications were in daily use beyond the electric telegraph and electric bells. The modern dynamo, electric lighting, electric motors, the telephone, the transmission of power to a distance by means of electricity, electric heating, electric railways, and lastly wireless telegraphy and wireless telephony were undreamt of.

THE ELECTRICIAN has become perhaps the best-known periodical in the two hemispheres which devotes its columns to the numberless developments of electrical technology and its practical and commercial applications, while at the same time it is a medium for the publication of articles and discussions of a more purely theoretical and scientific interest. It has always been distinguished for the zeal it has displayed in the interests of the electrical industries which not only occupy such an important place in the national economy, but which have also afforded incalculable facilities for researches resulting in the progress of pure science.

From Ing. GUIDO SEMENZA.

Perhaps in our everyday life we do not fully realise how great is the importance of the technical press in assisting the development of science and technology.

The Technical Press is the faithful mail of learned people; it is the eye with which we can look into far away countries; it is the link which connects all the brains that are separately working on the solution of the same problems.

THE ELECTRICIAN is the pioneer of the Electro-technical Press. It therefore affords me great pleasure to be able, on the occasion of this celebration, to express to the men who have founded this journal and have succeeded in keeping it always at such a high level, the deep gratitude of all electricians.

From Mr. DANE SINCLAIR.

The celebration of the Diamond Jubilee of THE ELECTRICIAN gives an opportunity to its friends to express individually their high sense of appreciation of all the good work that has been done by this journal since its first issue.

I well remember how much I appreciated, as a young engineer engaged on telegraph work in the early 'seventies, the very valuable information contained in your columns; and all through the years since then your esteemed journal has, on many occasions, been of considerable assistance to me as a telegraph and telephone engineer.

Throughout its lifetime THE ELECTRICIAN has kept well abreast of the rapid development which has taken place in electrical engineering, and it would perhaps be unfair to select any particular periods or articles for special mention; but I cannot refrain from referring to the publication in your columns of the valuable work of Oliver Heaviside, which had a very high practical value for me personally, and has, therefore, left a deep impression on my mind.

I sincerely trust that THE ELECTRICIAN will, on the celebration of its centenary, have as good cause to deserve the encomiums of the profession as it has during the past sixty years.

From Mr. J. SWINBURNE, F.R.S.

From the beginning, or practically from the beginning, of the electrical industry THE ELECTRICIAN was almost a necessity to those who were doing the work.

The first development was telegraphy; this was before my time. THE ELECTRICIAN became a weekly need to me in the early 'eighties, when electric lighting was developing. Every electrical engineer used to take the electrical papers home to read over the week-end; and this was necessary if he wanted to keep up with the times. We were extraordinarily ignorant in those days; and knowledge developed very rapidly. The result was that textbooks—in so far as they existed at all—were always very far behind practice; and almost all technical information was obtained through THE ELECTRICIAN and its contemporaries.

From being confined to telegraphy and electric lighting the industry has developed enormously in other directions; but THE ELECTRICIAN has always managed to keep up its usefulness by picking out of the increasing mass of available matter the parts that are really of interest to the various types of reader.

"The Electrician" and Scientific Investigation.

By Dr. J. A. FLEMING, F.R.S.

I congratulate THE ELECTRICIAN heartily upon reaching its Diamond Jubilee. For sixty years it has maintained an unbroken record of the progress of electrical science in its pure and applied aspects. The back volumes are a mine of intellectual wealth to all who have occasion to consider or describe the development of any particular branch of the subject. I am fortunate in possessing all the bound volumes back to 1882, and on countless occasions whether in search of references to historical matters for the purposes of authorship or for reports, I have never failed to find in them all that I required.

In addition to giving us the current history of electrical science, THE ELECTRICIAN has been the means of affording to innumerable scientific investigators the opportunity of making known to the public original researches of the greatest value. In fact much advanced mathematical and scientific work, which perhaps otherwise might have failed to find suitable publication, has been first given to the world through the pages of THE ELECTRICIAN.

Many of the invaluable text books originally published by THE ELECTRICIAN Publishing Company ran their preliminary course as a series of articles in THE ELECTRICIAN. THE ELECTRICIAN has in this manner rendered the very greatest service to electrical engineering education.

I have myself recently published a record of "Fifty Years of Electricity," tracing the development of its great technical applications such as the telephone, electric lighting, and wireless telegraphy with which it has been my good fortune to be closely connected during nearly half a century, and in the compilation of that work I made countless references to back numbers of THE ELECTRICIAN to verify dates, incidents, names, and circumstances, and never failed to find it a source of accurate and helpful knowledge.

I strongly hope that its valuable work as a record of electrical discovery and invention may be continued, and that in due time it may celebrate not only its Diamond Jubilee, but its centenary and more.

"The Electrician"—1861-2061?

By FRANK BAILEY.

THE ELECTRICIAN made a wise selection in the date of its birth, and has lived through an eventful period covering years of gloom and despair in both submarine telegraphy and in electrical power, but fortunately relieved by ultimate success and development in all fields far beyond the wildest dreams of the enthusiast.

By getting itself born in 1861, THE ELECTRICIAN was able to deplore the electrical tragedy of the Atlantic Cable of 1857-8, killed by induction coils; and to encourage hope and faith in the improved design, handling, and operation of the successful cables of 1865 and 1866. The electricians of those days (not then including electric bell fitters) must have been grateful to their Journal for recording progress in the gradual lifting of the veil which made their profession the application of an exact science; and of the original pioneers we are fortunately able to honour a few—but, alas! very few—survivors.

When THE ELECTRICIAN attained the age of manhood, in 1882, a new infant was humming to be heard, flashing to be seen, and shocking those who nursed it: the dynamo—sometimes series, teaser, shunt, or compound wound, with or without any efficient response, but always with light and heat where not wanted. For nearly forty years the pages of the Journal have recorded the growth of this infant through all the stages of its development. The troubles of the 'eighties are forgotten, and we can now appreciate the magnificent response of the electrical designer to the call for generators of adequate power to be mated with the modern steam turbine. This progress has not been made without simultaneous improvements in the design and construction of cables and switchgear.

A Period of Wasteful Complication.

All this story is unfolded to us in the pages of THE ELECTRICIAN with consistent excellence of illustration and description. The effort to look back on past achievement is perhaps rewarded by encouraging a forecast of the years to come, and we must all feel some curiosity regarding the contents of future volumes of the Journal, when its Diamond Jubilee will be referred to as a period of wasteful complication relieved by weird ingenuity in engineering construction. The Journal will probably deplore the limitations of the "nineteen-twenties" as being content to boil water—not to make tea, but to make steam which, after further cooking, was partially used up in a turbine, and then passed into a condenser to be turned into water again, with a weary repetition of this monotonous cycle.

Possibly the Journal may refer to an intervening period in the

"nineteen-thirties" when, after the battle of carbonising temperatures, all coal was distilled, gas turbines ceased to fracture, and benzole flowed like water, until wisdom enlightened man and he dissected and tamed the Atom until its secret was unlocked.

We must congratulate THE ELECTRICIAN on attaining a glittering Diamond Jubilee—a distinction well earned after a strenuous service in the interests of progress.

Is Life a Boon?

By Sir DAVID SALOMONS, Bart.

I offer you my congratulations with the thousands which are reaching you on the jubilee of THE ELECTRICIAN. King David in passing, spoke of the "celebrated" three score and ten. This was man's reward. Nothing was stated as to the life of journals. Possibly King David was not troubled with such articles, therefore I may express the hope that your journal may reach its centenary, though your present staff can hardly expect to be working at that time. Since I have just reached the allotted period of life, it is fair to assume I have either become a fool or a philosopher! I prefer to play the latter part and to review the changes during the last sixty years; part of these changes is allied to electricity, though not strictly electrical. My theme is: Are we happier to-day with the great so-called progress made in science? A period of sixty years before your paper was born, was the time when the foundation stones were being laid for the sixty years to follow. We had Davy, Faraday, Wheatstone, Cook, Tyndall, Perkin, Kelvin (his early years) Cayley and a host of others in this country. Abroad, an army of workers also existed. A large proportion of the work then done was theoretical, to be applied later on. For instance, the electric arc, new elements found, aniline dyes, the theory of electricity greatly developed, also chemistry, electric induction, telegraphy and hundreds of others, but most of the discoveries were more theoretical than otherwise.

Is Matter a Delusion?

Now turn to your sixty-year period. The names of the great scientists are too numerous to give in such an article, but they are known to all your readers. What has been done? Faraday's discoveries are best seen in dynamos, motors, wireless telegraphy (the coil part), X-rays, combined with Crookes' discoveries, aeroplanes, motors (electric ignition), the extension of the telegraph system with submarine work, telephones, wireless "conductors," photography, electric lighting, medical electricity, radiography, radium and electric clocks, also electric railways. The above are but a few, but most in evidence in our daily work. The labours of Kelvin, J. J. Thomson, Einstein, Rutherford, Ramsey, Curie, and a long list besides have been virtually striving to show that matter does not exist, that human beings and all we see are pure delusions. That by drawing two lines with a pencil, we can live in the past or future. That round bodies are oval, that space is non-existent, that measurement is a farce, and that the world can be made as many dimensional as we please by putting the alphabet into equations.

Is Mankind of Any Practical Use?

Again, I ask, are we happier for all these gifts handed to us, free of expense?—in fact, the only cheap things I know of to-day, except "kind thoughts," and these are getting rare! I suppose all persons are constructed upon different models. I will consider my own case. When I was young, life went smoothly and easily. The amount of actual work done was about the same as now, but more efficient. To-day the continuous ring of the telephone, the vibration of some rotating machinery next door, the clicking of the type writer, living in underground tubes and lifts, the buzzing aeroplane overhead, the rushing along in trains, the hurried meals, continued strikes, everlasting warfare, the struggle to dispossess everyone of their hardly-earned property—here we have the picture of modern daily life, without adding a few more lists of the great benefits handed to us by the science of the last sixty years! Again, another question comes in; is mankind of any practical use whatever? I cannot answer this, though I do not see but that the world would spin as well without him! Anyway, modern life may be summed up in one phrase: "All are hurrying to the grave in the most rapid manner, without time to look right or left!" We cannot go back to primitive life without bringing into play war and pestilence; and modern science cannot be accused of neglecting this part of the business. I am a great exception, for I strive to get peace in my way—no typewriter nor telephone going where I work—and, interested as I am in the modern theories of life, I leave the application of them to others to practise, and still regard space infinite, and the world a three-dimensional one; lastly, I do not draw co-ordinates to live at times other than my own, and I advise all to be conservative themselves, but very radical in the laboratory.

"The Electrician," 1897 to 1906.

By F. CHARLES RAPHAEL, M.I.E.E.

Although a regular reader of *THE ELECTRICIAN* from the year 1889, I did not come into personal contact with the staff or the inner mysteries of Editorship until 1896, when I commenced duty on the editorial staff as "third man" and translator. I owed my introduction to Mr. Trotter and Mr. Bond to negotiations with them in the previous year for a series of articles on the Localisation of Faults in Electric Light Mains. Of Mr. Bond I will merely say that I found him a congenial and sympathetic chief; his accuracy, patience and good-humour were remarkable and never failed him even when correcting the rankest scientific solecisms of contributors. I revive the expression "scientific solecisms" deliberately after twenty-five years of disuse, for it won his heart when I happened to employ it in an Editorial Note, and he shall know now for the first time that I discovered the alliterative substantive only after an assiduous search in Roget's "Thesaurus." "Roget's Thesaurus of English Words and Phrases," it may be mentioned, was, in the small but excellent editorial library, the most useful book of all to the majority of us engineers who had become writers, not by instinct but rather by a concatenation of fortuitous circumstances. This last English phrase became at one time an editorial pet, but I forget who was the original perpetrator.

My Assistant Editorship.

In October, 1897, Mr. E. Tremlett Carter succeeded Mr. Bond in the editorial chair and I was appointed Assistant Editor. During his first two years of office, Mr. Carter worked with feverish energy. At that time, the first four or five columns of *THE ELECTRICIAN* each week were devoted to "Editorial Notes," and a "leader" occupied the two middle pages; Mr. Carter was a fluent writer and quite two-thirds of this matter came from his own pen. There was, however, plenty of work for all of us. The electrical industry was developing very actively. Almost every week a new electric light station or a new electric tramway had to be described—sometimes two or three—and in almost every particular, electrical engineering practice was undergoing rapid changes. In 1897 the 200 V (carbon filament) lamp had only just been introduced; the City and South London Railway was the only "tube" running; house-wiring in conduit was regarded as a new idea; wireless telegraphy was still in its initial experimental stage and, in the region of electrical science, important research was being continued both in this country and on the Continent, the period being between the discovery of X-Rays by Röntgen and of radio-activity, by—shall we say—Becquerel.

Towards the end of 1899, Mr. Carter, never a robust constitution, showed serious signs of failing health. A two-months' tour on the Mediterranean that winter effected no permanent improvement, and in 1902 he had finally to give up his work on the doctor's diagnosing his case as consumption. He died in April, 1903.

Some Members of the Staff.

During these two and a half years the bulk of the editorial work fell on my shoulders, often with the sole assistance of Mr. A. Webster, chief clerk and shorthand reporter on the editorial staff. Among the technical assistants were Mr. C. C. Monckton, who left on appointment as electrical engineer to the Government of Jamaica, Dr. W. H. Eccles (now a Vice-President of the Institution of Electrical Engineers), and Mr. R. L. Pearson, who later became Assistant Editor. Occasional anonymous contributors to our Editorial Notes were Sir Oliver Lodge, Prof. Silvanus Thompson, Prof. G. F. Fitzgerald, and Mr. Bertram Blount, and Mr. E. E. Fournier d'Albe continued his signed weekly review of Contemporary Electrical Science.

I was appointed Joint Editor of the paper in October, 1902, but after Mr. Carter's death, there was some considerable delay in confirming my appointment as Editor-in-Chief; I was certainly the youngest Editor *THE ELECTRICIAN* had ever had, and presumably it was thought that some of its ancient traditions might not be safe in my keeping. Ultimately my appointment was made definite in October, 1903.

Oliver Heaviside.

No article on the earlier and pioneer work of *THE ELECTRICIAN* would be complete without a reference to Oliver Heaviside, and this reminds me of the end of a discussion as to the advisability of accepting from him a third volume of "Electromagnetic Theory." Mr. Tucker was strongly in favour of its publication, and I agreed that if Heaviside could write a third volume, *THE ELECTRICIAN* Printing and Publishing Company must publish it. I had misgivings, however, as to the advisability of publishing it in serial form in the columns of *THE ELECTRICIAN*. Even John Perry, with a twinkle in his eye, had confessed to me some time previously, that Heaviside had got rather beyond his depth and he had had to give up reading him. We finally decided that I should ask the great Oliver to send a synopsis. In reply, I received a postcard: "The Lord will provide."

Early Days of Electric Lighting.

By the Right Hon. the EARL RUSSELL.

No applied science, with the possible exception of aviation, has developed so rapidly as electricity. Faraday's discoveries slumbered a long time: a few permanent magnet machines were used for electro plating, for lighthouse lighting, or for lecture demonstrations, but until the mechanical and commercial production of the self-exciting dynamo there was no convenient and readily manageable source of electrical energy. Nor could there be any general application of it until it was to be found on tap in every street. The commercial justification of this was the supply of lights for shops and private houses and, therefore, in the earlier days, every mind was turned to the problem, as it was then called, of the sub-division of the electric light. We had arc lamps with a minimum candle-power of 500, but how were we to obtain the humble reading light or the illumination of a bedroom? The first thing was the high resistance filament lamp, and I remember my cousin, Lane-Fox, working at this in 1878, about the same time as Edison and Swan were on the same lines. Iridium, cæsium, palladium, and other refractory metals were tried and great skill was shown in drawing them into filaments, but none of them would stand up to the work, and it required the carbon filament to solve the problem. It is curious that later development has gone back to metallic filaments of tungsten hardly known and quite unworkable in those early days. Then there was the further problem—in which Lane-Fox was undoubtedly the pioneer—of a system of constant potential: an idea entirely alien to telegraphists, and finding no acceptance or understanding from Sir William Preece, who was then our doyen.

THE ELECTRICIAN, which had, of course, been mainly a telegraph journal from the first devoted itself to the scientific side of the new industry, and a study of its pages reveals the development of invention and the growth of ideas which have now borne fruit in the universal availability of electricity and of its use in all the activities of life. The most modern developments for running factories received an enormous impetus during the war, and will go a long way to solve the lighting engineer's ancient bugbear of the peak load.

As one who began in earliest youth with the fox's brush and the Leyden jar, and who has endeavoured to keep in touch with every development down to the thermionic valve, the Jubilee issue of *THE ELECTRICIAN* is naturally a matter of interest.

Institution of Electrical Engineers.

As might have been expected, there was a very large attendance at the Institution of Electrical Engineers on Thursday, November 3rd, to listen to Mr. J. S. HIGHFIELD's Presidential Address. In the first place a Presidential Address in itself is an attraction. In the second place, this was the first meeting of general interest to be held at the Victoria Embankment since the building was handed back to the Institution from the Government, and absolutely the first meeting that has been held since the Royal Charter was granted. This document was, in fact, a sort of turn in the evening proceedings as it was exhibited on the table in the full glory of its red seals. It came out in the course of the proceedings that Sir John Snell and Sir James Devonshire had actually been present at the sealing. This function is so seldom attended by those interested in the documents sealed that it almost, if not quite, creates a precedent.

By the time Mr. LLEWELYN ATKINSON rose to make his opening remarks the lecture hall was, to use an Irishism, rather more than full and a large number of members, including an odd councillor or so, were standing at the back of the room. It is as well to leave the tea-room early on these occasions.

Mr. LLEWELYN ATKINSON announced that it had been decided to keep the library open on two evenings in a week until 9.30, or, alternatively, on one evening until then and on Saturday afternoon until 5 p.m. In order to ascertain which days were most favoured the library would be kept open every evening from November 14th until Christmas to find out which arrangement was the most popular. This is a direct result of the suggestions made at the informal meeting which was held last session, and may be added to that meeting for righteousness. The premiums and scholarships awarded for last session's work were then presented to those whose names have already been announced in *THE ELECTRICIAN*. We are glad to note that a rather higher percentage of the receivers were present than usual.

Mr. Llewelyn Atkinson then inducted the President-Elect, Mr. John S. Highfield, into the chair.

Vote to the Retiring President.

Sir JOHN SNELL, in proposing a vote of thanks to the retiring President, began by paying a tribute to the new President, whose fine courage and sterling good sense would be of great service to the Institution. Continuing, Sir John remarked that Mr. Atkinson's statesmanship and thoughtfulness would have made him most

useful as an electrical member of Parliament. That he was not such a member was a matter for general, if not personal, commiseration. (Mr. Atkinson was understood to dissent.) He referred to the granting of the Royal Charter and the acceptance of the patronship of the Institution by H.M. the King. Mr. Atkinson's untiring industry during his year of office had been fitly crowned by these two great acts. Our grandsons might well look back on 1921—the Jubilee year of the Institution—as an epoch-making year and, in that connection, the name of Atkinson might well become historical. His Majesty's gracious act in becoming patron of the Institution was only typical of his untiring efforts for the good of the realm and showed the active interest he took in a growing industry.

Mr. C. H. WORTHINGTON, in seconding the motion, said it was rare to find technical and common-sense ability combined with scientific attainments, tact and never failing devotion to the Institution in such a degree as were obvious in Mr. Atkinson.

Mr. LLEWELYN ATKINSON in briefly returning thanks for the vote, which was received with the heartiest acclamations, said that the events which had happened during the past twelve months were simply the culmination of years of effort. He had only been the instrument. He paid a tribute to the work of Sir James Devonshire, Mr. Rovell and the staff of the Institution.

Mr. J. S. HIGHFIELD then took the chair and proceeded to the delivery of his Presidential Address, an abstract of which will be found on another page of this issue.

Thinking Electrical Men.

Colonel R. E. CROMPTON who, on the conclusion of the address, proposed a vote of thanks to the President said that its effect was to make him think. Conditions nowadays made it necessary for us to be always ready with our best thoughts. Although it was not permissible to discuss the Presidential Address he agreed heartily with what had been said about the team work and the need for paying greater attention to manufacturing details. In the early days he had not been able to sell the stuff he made because it was too good. That is it did not wear out soon enough and he had often wished he had been a baker who could sell things to be immediately consumed. As a matter of fact it was now coming to that in the electrical industry because really, fundamentally, they were makers of the thing that everybody most wanted—electricity. Our comfort and future progress must depend on electricity supply to an extent that we hardly realised.

Mr. ROGER T. SMITH briefly seconded it and, after the vote had been carried with enthusiasm, the President made a short reply.

West Riding Electricity District.

The Electricity Commissioners have issued their decision on the schemes submitted for the reorganisation of electricity supply in this district. The inquiry was held at Leeds in May last, when schemes were submitted by the Conference of West Riding Local Authorities and by Leeds Corporation, while certain representations were made by the Yorkshire Electric Power Company, which applied for consent to the establishment of a new generating station at Ferrybridge. The Commissioners have now arrived at the following conclusions,

(1) The area provisionally determined is confirmed, subject to the inclusion of the urban districts of Hoyland Nether, Wath-upon-Deane, Bolton-upon-Deane, and Thurnscoe, and the rural district of Rical.

(2) The existing generating stations at Bradford, Halifax, Huddersfield, Keighley, Leeds, Thornhill and Wakefield should be interconnected.

(3) The existing generating plant at those stations, together with the extensions already authorised and the addition of another generating set in the Whitehall station of Leeds Corporation, will, when those stations are satisfactorily interconnected, meet the estimated requirements of the district for several years.

(4) Having regard to the advantages of the Ferrybridge site and to the anticipated developments in the eastern and southern parts of the district, the first stage of a new station should be constructed forthwith on this site by the Power Company and linked up with the interconnected system.

(5) The Commissioners think that the construction of a second new station is not required at present, and that all other matters relating to it should be left to the consideration of the Joint Electricity Authority.

(6) The negotiations between the Conference of Local Authorities and the Power Company for the purchase of the company's undertaking having failed, the scheme submitted by the Conference is not feasible. Moreover, the much-needed improvement in the organisation for the supply of electricity in the district should be effected by the co-operation of all the authorised undertakers and authorities, and by the mutual assistance which each can render to the other under the general control of an authority on which all interests will be represented.

(7) A Joint Electricity Authority should therefore be formed for the whole district as amended.

Division of the District.

(8) With a view to ensuring the most efficient use of existing generating plant and to avoiding unnecessary expenditure on trans-

mission lines in certain parts of the district, the district should be dealt with in two agreed areas, one being that which can be best supplied from the interconnected existing municipal stations (hereafter referred to as area "A") and the other being the remainder of the district which should be supplied by the Power Company, provided that all the interconnected stations are worked under one control and for mutual assistance.

With regard to area "A," the local authorities concerned and the Power Company should prepare a scheme to simplify the position as to rights of supply and transmission or distribution within that area, either by the acquisition on agreed terms of the Power Company's rights of supply in the said area (together with such parts of their transmission system, if any, as have been laid therein), or otherwise; and with regard to the remainder of the district, the powers of supply of the Joint Authority should be transferred to the Power Company.

(9) The Power Company, or the Electrical Distribution of Yorkshire, Ltd., as may be determined, should, if they so desire, have conferred upon them, by transfer from the Joint Authority, the distribution rights in all areas within the district which are not at present within the areas of supply of authorised distributors, subject (a) to the purchase provisions contained in the Electric Lighting Act, 1888; (b) to the existing right of local authorities or companies to apply for special orders to establish local distribution undertakings, the Power Company giving to such undertakings any public supply required; and (c) to provision enabling a local authority (being an authorised distributor) to purchase such part of the company's distribution system as may be included in any subsequent extension of that authority's local government boundaries.

The financial arrangements contemplated are (a) that the moneys for the construction of the Ferrybridge station and of the interconnecting transmission lines therefrom, as well as for the development of the district outside area "A," will be provided by the Power Company; (b) that the moneys for the construction of the lines interconnecting the other stations, and for the construction in due course of a second capital station, will be raised by the Joint Authority.

Draft Order.

The Electricity Commissioners have accordingly decided to prepare a draft order establishing a Joint Electricity Authority, and providing—

(a) For representation on the Joint Authority (1) of the Corporations of Bradford, Halifax, Huddersfield and Leeds respectively; (2) jointly of the Corporations of Barnsley, Batley, Wakehouse, Dewsbury, Keighley, Morley, Pudsey, Todmorden and Wakefield; (3) jointly of the Urban District Councils owning undertakings; (4) jointly of local authorities possessing rights of purchase of the undertakings of authorised distributors supplying in their areas, such rights being transferred to the Joint Authority; (5) of the West Riding County Council, acting on their own behalf and on behalf of the Urban and Rural District Councils not owning undertakings and in whose districts there are no authorised distributors; (6) of the Power Company; (7) jointly of companies, other than the Power Company, owning authorised undertakings; and (8) of the railway companies.

(b) For the administrative expenses of the Joint Authority not properly chargeable as part of the cost of electricity supplied, or to capital, or not met out of contributions from local authorities or other bodies represented on the Joint Authority, to be met by all the authorised undertakers in the district; and for any excess of expenses of the Joint Authority over their receipts, which may arise from the supply of electricity from the interconnected system to be met by the authorised distributors.

(c) For the control by the Joint Authority of the working of the centralised system of interconnected generating stations, such control to be exercised in consultation with an Advisory Committee composed of the engineers of the stations in question; for pooling the operating results of the interconnected municipal stations for the common benefit of the local authorities supplied; and for supplies to or from the Power Company's system.

(d) For giving effect to the agreed scheme in paragraph (8).

(e) For the inclusion of the outlines of the technical scheme to be undertaken by the Joint Authority and the Power Company.

(f) For the Joint Authority acting with the Power Company to submit within two years from the date of the establishment of the Authority proposals for a system of distribution in areas within the district which are not at present within the areas of supply of authorised distributors, where there is a reasonable prospect of such supply being remunerative.

(g) For the necessary financial powers being conferred on the Joint Authority, subject to the enactment of a further Electricity (Supply) Bill.

Pending the establishment of the Joint Authority, the principal local authority undertakers and the Power Company are to form a small provisional committee, with whom the Commissioners may consult with regard to any development of supply in the district.

The Entertainment Section of J. H. TUCKER & COMPANY'S ATHLETIC AND RECREATION CLUB held their opening social evening of the season on Saturday, the 30th ult., in the works canteen. The proceedings opened with a musical programme, with Mr. W. Y. Smith (Superintendent of the Assembly) in the chair, followed by a whist drive, a feature of which was a number of surprise prizes during the play. Mr. S. Greene (hon. secretary) acted as M.C., and an enjoyable evening was spent.

Electrical Power Engineers' Association.

The Southern Division of the Electrical Power Engineers' Association gave their third annual dinner to the members of the National Executive Council on Saturday, October 29, at the Hotel Cecil. Mr. J. H. Parker, the past President, being in the chair. In addition to the air of geniality which is so appropriate at these occasions, we are always impressed when attending E.P.E.A. functions by the intense feeling of loyalty to their leaders which is shown by the members generally. This is a factor which has played no small part in the attainment of the Association of its present influential position.

The Commissioners and the E.P.E.A.

Mr. A. F. E. B. in proposing the toast of the Association, said the Commissioners were fully aware of the desirability of keeping in close touch with all movements in the industry. They did not wish to be regarded as unapproachable, and they were with the E.P.E.A. in their main object of advancement of the industry. The necessity for the formation of the National Joint Board and the District Joint Boards

part to play in this development, which it was well that their members should recognise. For instance, renewal and sinking funds were universal in the case of plant, but in the case of men there was no such thing as provision for depreciation, for the simple reason that labour was cheap. He knew he was on, then, when he tackled the right of the employer to employ whom he liked, but the employees also have a right to say with whom they would work and to demand that an able engineer should have ample compensation if he were discharged during a temporary period of depression.

Opening of Blackburn Meadows Station.

The new Blackburn Meadows generating station of the Sheffield Corporation, which was described in our last issue, was officially inaugurated on Friday by H.R.H. the Duke of York. The Royal visitor, accompanied by Earl Fitzwilliam and Commander Greig, were received at the power station by the Lord Mayor (Ald. Warley), who presented the Town Clerk (Mr. W. E. Hart); Mr. S. E. Fedden, manager of the Electricity Department; Councillor A. J. Ward, chairman of the Electricity Committee; Sir William Clegg, and other prominent members of the City Council. With the aid of a pocket knife, handed to him by Mr. Fedden, the Duke of



THE "BEFORE-DINNER" LOOK AT THE E.P.E.A. DINNER.

was clear to anyone who had been trained in the electrical industry, for the low salaries and bad conditions of employment were matters that urgently required remedy. The proposal that each industry should look after its own unemployed and the establishment of more stable conditions of employment were other matters which the Association rightly had in hand.

Mr. W. J. OSWALD, in proposing the toast of the "Visitors," said the Commissioners like the E.P.E.A. were up against political opposition. He would like to see every professional man in the supply industry, from the chief engineer down to the junior engineer, a member of the Association, as this would tend to the advancement of the industry and be beneficial to the commercial life of the nation. The electrical Press had done much to help the Association along, and he pleaded for its continued support.

Mr. J. F. HESLOP, in replying to the toast of the "Association," said that the agreement with the E.T.U., into which the Association had entered, and about which there had been much comment in the technical Press, was an attempt, which they hoped would be extended, to place the industry on a constitutional basis and to reduce to a minimum the risk of disputes culminating in direct action. In the present period of stagnation the first cry was that wages must be reduced, and the second that wages boards must cease. The employers took upon themselves a grave responsibility when they advocated a scheme of disruption of those very important institutions that had been set up by the Government. Probably few of the general public realised the importance of the development in the combination of brain workers which had recently taken place. The E.P.E.A. had a very important

York cut the tape which marked the entrance to the station and entered the building.

The Duke's Speech.

After addresses by the Lord Mayor and Councillor Ward, His Royal Highness said he had listened with infinite pleasure to their interesting historic outlines of the city's great electrical undertakings, and to the description of the new generating station, which undoubtedly represented the highest standard in modern design and engineering efficiency. He heartily congratulated the Electric Supply Committee, the chief engineer (Mr. Fedden), and those associated with him, on their great achievement. As President of the Industrial Welfare Society, he noticed particularly the reference made to the special care taken for the safety of the operators, to the provision made for the comfort and welfare of the employees, and to the intention to extend the system of electric light to the homes of the working people. The enormous power station which he was about to open, with all its mechanical and scientific devices, graphically illustrated the last word in economy and must effectively cheapen production, improve trade, and thereby lessen unemployment. If, in order to meet competition in the markets of the world, manufacturers were forced to economise, it was, in his view, a better policy to seek a solution of the problem in scientific research than merely to fall back upon a curtailment of wages. If Britain was to maintain her proud position among the nations of the world they must contribute their quota of science, as in the past generation was done by such men as Kelvin, Watt, Stephenson and Hopkinson.

The Duke then formally declared the power station open.

Trade Conditions in the Electrical Industry.

As announced in our last issue, the Joint Industrial Council of the Cablemaking Industry recently called a Conference of the Joint Industrial Councils of the Electricity Supply and Contracting Industries, and also the Associations of Electrical Manufacturers and Wholesalers and the B.E.D.A. After exhaustive inquiries into present conditions and into unemployment in the electrical industry, the Conference addressed a memorandum upon the subject, with certain recommendations, to Sir Alfred Mond, as Chairman of the Cabinet Committee upon Unemployment, who received a deputation on the 2nd inst.

SIR ALFRED MOND WAS SUPPORTED BY MR. ARTHUR NEAL, M.P., and Sir John Snell, Chairman of the Electricity Commission.

Mr. L. B. ATKINSON, Chairman of the Conference (who was supported by Ald. Beaumont and Mr. Kelly) pointed out that the deputation, probably for the first time in the history of such deputations, represented the whole industry, through its Industrial Councils, thus including the workpeople as well as the employers, and that the memorandum was a unanimous expression of opinion. He proceeded to outline the subject, and dwelt at some length upon the present position of the electrical industry. The memorandum divided the question into two broad headings: (1) Steps necessary permanently to reinstate activity and employment in the industry; and (2) steps necessary to relieve temporarily unemployment.

Conditions of Permanent Reinstatement.

The following conditions and suggestions were submitted for the permanent reinstatement of activity and employment in the industry:—

Firstly, by closing down unproductive outlays by the State, except on the service of defence and national security and health.

Secondly, by assisting the electrical industry by removing uncertainties which are checking its development. This could be done by (a) defining as early as possible the Government policy with regard to the future of electricity supply; (b) by speeding-up adjudication on all schemes already submitted to the Electricity Commissioners; (c) by allowing to supply undertakings increased charges to meet the changed economic conditions, taking into consideration that the limitations upon profits and dividends which had recently been enforced were in some cases operating to the detriment of the industry; (d) by action at the earliest possible moment by the Government in clearing up the uncertainties under which the railway companies were labouring.

Unemployment Proposals.

MR. ATKINSON proceeded to outline the steps recommended for the immediate alleviation of unemployment. He said that inquiries had been made to ascertain the schemes of electrical development which were ready to be put into operation, but which were, for one reason or another, held up. The replies received from the majority of the undertakings showed that there was a large amount of potential work and additional employment which was being held up on account of (a) uncertainty with regard to future legislation or control in certain districts; (b) difficulty in financing extension works, which could not become remunerative until a considerable time had elapsed. The important suggestion was made that if Government assistance could be given towards interest payments and sinking funds were postponed for a reasonable period, it would then become possible to put in hand extensive and valuable works, ultimately becoming productive, and immediately to afford a large amount of employment. It was also pointed out that there appeared to be a good deal of uncertainty as to the extent to which such undertakings could apply for assistance in the payment of interest under the memorandum recently issued by the Ministry of Health.

The question of London transport extensions and railway electrification generally was also dealt with at length, attention being drawn to the difficulties existing in regard to carrying out schemes of electrification because of the uncertainty in connection with the precise form which railway grouping might be expected to take.

Sir A. Mond's Reply.

In his reply to the deputation, SIR ALFRED MOND expressed his appreciation of the work of the Conference, and his desire to apply practically some of the suggestions made. The paralysing effect of uncertainty as to the future action of Government relative to the electrical industry was appreciated, and the Transport Department were dealing with the matter. He referred similarly to the question of railway grouping. On the point of assistance towards payment of interest on municipal loans, he made it clear that the Ministry of Health Circular 245 applied to electrical undertakings. He agreed with the view that it was unreasonable to ask commercial undertakings to commence the operation of sinking funds immediately the works were completed and before earnings commenced.

The telephone extension proposals had received careful consideration by the Government, and he anticipated being able to make a useful suggestion in a few days.

MR. A. NEAL, M.P., added that the position of the smaller companies had been intended to be dealt with in the Electricity Supply (No. 2) Bill, and he would endeavour to see that the difficulty was removed, the principle having been agreed in other cases. A large number of recommendations of the Electricity Commissioners were ready for placing before Parliament early next session. He also thought that the question of uncertainty was exaggerated. The policy had already been laid down, though the final legislation necessary to give effect to it had not yet been carried through, but no delay would take place in pushing it forward.

Legal Intelligence.

ATTORNEY-GENERAL v. LIVERPOOL CORPORATION.

On the 3rd inst. Mr. Justice Russell commenced the hearing of this action, which was brought by the Attorney-General at the relation of certain Liverpool ratepayers, for a declaration that the Corporation of Liverpool had no power to carry on the trade or business of providing, selling, supplying, installing and repairing electric light fittings and wires and electric bell fittings and wires, or to use for those purposes capital moneys borrowed for their electric supply undertaking, or the receipts of such undertaking, or the proceeds of their rates, or any part of their city fund. The plaintiffs also asked for an injunction to restrain the Corporation from carrying on such trade or business.

MR. E. PAGE, K.C. (for plaintiffs), said that in 1896 the Liverpool Corporation purchased the undertaking of the Liverpool Electric Supply Company, Ltd., which had power to supply electricity to a large portion of Liverpool. The purchase was made under the powers given by the Liverpool Electric Supply (Transfer) Act, 1896, whereby it was provided that from the completion of the purchase the powers and duties of the company in relation to the supply of electrical energy should be transferred to the Corporation subject to the Electric Lighting Acts, 1882 to 1888. By a provisional order of 1896 the Corporation obtained power to supply electric energy for the whole of the City of Liverpool. By the Liverpool Tramways and Electric Supply (Garston Transfer) Act, 1902, the powers and duties of the Garston and District Electric Supply Company, Ltd., were also transferred to the Corporation, the urban district of Garston and the other areas having before that time been included within the boundaries of Liverpool. Each of the said companies had under its memorandum of association power to manufacture, hire, let, sell, or repair machinery, apparatus, materials, or things for the purposes of the supply of electricity. The Corporation had for some time carried on the business of supplying electric fittings, both by sale and hire, and of wiring premises for the supply of electricity; but the relators contended that under the Municipal Corporations Acts, 1882 and 1888, the Corporation had no power to carry on such business.

Defendant Corporation contended that under the Acts by which the transfer of the undertakings of the two companies was authorised the Corporation, taking a transfer of all the powers and duties of the two companies, had power to carry on the work of supplying and installing electric fittings. They denied having expended on the business any capital moneys borrowed, or the receipts of the electricity undertaking, or the proceeds of rates, or any part of the city fund. They also claimed that they were, under divers Royal charters, a common law corporation, and had all the powers of such a corporation, subject only to the limitations as to the use of their funds contained in the Municipal Corporations Act, 1882, and that under such powers they were entitled to do what was complained of.

MR. PAGE added that the Garston Electric Supply Company also acted as shopkeepers, and he contended that when they sold their business to defendants, though they got rid of the shopkeeping business, they did not hand it over to defendants.

MR. TWEEDY SMITH, solicitor for plaintiffs, gave evidence of his examination of the books of the Corporation, and gave instances of trading operations by defendants. In cross-examination (by Mr. Maughan, K.C.) he stated that the action was brought at the instance of the Electrical Contractors' Association. He was cross-examined at considerable length upon his criticism of the accounts, especially in relation to the allegation made that the figures shown as profits ought not to appear as such, owing to the absence of items which had not been charged under what he considered the proper heads. He added that the fittings department of the Corporation made very few bad debts, and that was one of the things that the electrical contractors in Liverpool complained of.

On Monday MR. TWEEDY SMITH was cross-examined upon his investigation of the accounts of the Corporation, and subsequently MR. H. J. CASH and MR. L. G. TATE gave evidence as to what was a fair percentage to add for "establishment charges" and the items included under this head.

MR. R. HARRISON WATSON (of John Hunter & Company) said there were forty members of the local branch of the Electrical Contractors' Association, and cited two recent instances of installation work carried out by the Corporation Fittings Department.

This concluded the evidence for the relators. MR. ARTHUR COLLINS was called for the Corporation. He said he had examined the accounts of the undertaking since 1911, and in each year, with the exception of 1913, the Fittings Department had shown a profit—there had been no loss; on the contrary, the general funds of the Corporation had benefited.

JAMES WITTEN, Corporation superintendent of electrical installations, said he was with the Liverpool Electricity Supply Company when the Corporation took over their business. That company used to sell all sorts of electrical fittings. When the Corporation took it over they confined installation work to the city of Liverpool. They continued the company's showrooms for five years, and then gave it up. They had now no showroom, and the Corporation did not carry on any line of business that the company did not carry on.

PERCIVAL J. ROBINSON, deputy city electrical engineer, said he was with the Garston Electricity Supply Company before it was absorbed by the Corporation. That company carried on a fittings business which was confined to its area.

After counsel had addressed the Court on the legal points, his Lordship reserved judgment.

Electricity Supply.

REDS Town Council has decided to ascertain from the War Disposal Board the purchase price of the electricity plant at the North Camp.

BATH Corporation have engaged Mr. S. E. Britton, of Chester, to prepare a report upon the possibility of using the city weirs for generating electric power.

LANCASTER Corporation has decided to oppose the scheme for the reorganisation of electricity supply in the North Lancashire and Westmorland electricity district.

WATTON-ON-NAZE Urban Council have applied to the Electricity Commissioners for sanction to raise the balance of the money necessary for purchasing the local electricity works.

The Primitive Methodists of HASLINGDEN have decided to install electric light throughout the church and Sunday school, and to install electric blowing apparatus for the organ.

INCE Urban Council are negotiating with Wigan Corporation for a supply of electricity to the Ince sewerage works, and it is probable that tenders will be invited to the machinery required.

Parts of AINSDALE (SOUTHWEST) are now lighted by electricity, and arrangements have been entered into with the Lancashire and Yorkshire Railway Company for laying cables underneath the railway at Ainsdale Station.

By seven votes to five the WELSHPOOL Corporation have decided to form a committee for the purpose of investigating the possibility of introducing municipal electric supply. Several directors of the local gas company, who are on the Council, were allowed to vote by the Mayor.

For the purpose of utilising the waste steam at a local sugar refinery, GREENOCK Corporation have agreed to instal plant of 1500 kW for the generation of electricity. The plant will remain the property of the Corporation, and it is estimated that after supplying the requirements of the refinery, between 700 and 900 kW will be at the disposal of the Corporation.

IRLAM Urban Council disapproves of the SOUTH-EAST LANCASHIRE ELECTRICITY SCHEME, on the ground that the scheme would retain the authority in the hands of the present suppliers, Manchester, Salford, and other large centres, and they alone would be the advisers of the Board. Other authorities would only have a representation of eight out of forty-eight.

ST. ANNES-ON-THE-SEA Council recently accepted a tender for the supply of cable from the boundary to the end of Clifton Drive, and fifty applications have been received from occupiers of houses along the cable track, and the staff have commenced to put in the connections under the supervision of Mr. J. H. Clothier, electrical engineer.

There is a prospect of electric supply being available at COALVILLE very shortly, as the Urban Council will have to extend the gas-works or introduce electric supply. The Council is therefore to seek the advice of an electrical engineer as to the introduction of electricity for parts of the area. Independent generating plant has recently been installed at Messrs. Stableford & Company's wagon works, and it is possible that a supply may be obtained from the firm.

The NEWPORT (Mon.) Corporation Electricity Department completed on Tuesday the laying of a supply cable under the Usk. The new cable, which is laid in a trench 8 ft. below the river bed, is part of a scheme of extension on which a capital outlay of £200,000 is contemplated, one of the chief objects being to supply electric energy to the large new ironworks of Messrs. Whitehead, of Tredegar. The firm will pay the Corporation a minimum of £8,000 per annum for power and a maximum of £20,000.

BRIGHTON Corporation electricity department has now completed the work of laying the cables and providing transformer plant for giving a bulk supply to Hove. The whole of the street electric lamps are to be kept alight from dusk until midnight, on condition that the additional cost, estimated at £1,800, is defrayed out of the anticipated surplus on the current year's trading of the electricity department.

Opposition was raised at the last meeting of the Council to a recommendation that the use of current limiters in houses erected under the assisted housing scheme be abandoned, and that prepayment meters be installed. Councillor Tindall explained that the limiters had been installed in twenty occupied houses, and in practically every case the grumbings of the tenants were loud and continuous; they would not have them. The Committee's report was then adopted.

The delay in obtaining a supply of electricity for the new CARDIFF municipal houses at Mynydd is causing a good deal of irritation, but the blame does not, however, rest with the Corporation. The City electrical engineer (Mr. New) has explained that the Corporation were only responsible for the internal wiring of the houses and that had been done. The Electricity Commissioners had suggested that electric current should be taken from the Rural District Council's supply, and that had been agreed to, but when they asked for sanction for the last 250 houses of the scheme that was refused, although the houses were wired internally. That led to some considerable delay, as the councils concerned naturally said that it was not worth while going on with part of the scheme, and stopped laying the cables. The sanction had now been obtained, and, as far as he knew, everything was proceeding smoothly.

Electric Traction.

At BURTON-ON-TRENT on the 3rd inst. a Corporation tramcar left the rails and was overturned, resulting in injuries to about a dozen passengers.

The STRIKE of the MAINTENANCE WORKERS of the Manchester tramways, electricity and gas departments has terminated, the men having agreed to refer the dispute to arbitration.

CLAYTON-LE-MOORS Council object to the application of the Lancashire and Yorkshire Railway Company for an extension of time in which to construct a light railway in the Clayton district, as an extension might lock the scheme up and prevent others attempting the enterprise.

DARLINGTON Tramways Committee will probably have to relay the greater part of the tramway track, at an estimated cost of £42,000. At present track repairs cost £1,250 per annum, but in view of the heavy capital expenditure involved in the work of relaying, further consideration of the matter has been postponed.

A correspondent in the "Railway Gazette" suggests the building of a DIRECT TUBE in London between VICTORIA and KING'S CROSS, with only one intermediate station at Piccadilly Circus, and so overcome the inadequate and inefficient existing connections. We quite agree with this description, but it is doubtful whether even the large traffic between these two important centres would be sufficient to justify the high capital expenditure necessary.

Viscount CURZON asked the Minister of Transport last week whether he had received application from local authorities for power to run system of ELECTRIC RAILLESS TRACTION vehicles along public roads; whether the operation of such systems could not be undertaken without specific Parliamentary authority; and whether, having regard to the necessity for creating immediate employment, arrangements could be made at once to sanction in proper cases the construction and operation of any such systems?

Mr. NEAL replied and stated that he was aware that certain local authorities were considering the desirability of substituting a system of railless electric vehicles for sections of their tramways, but power to give the sanction would require general legislation.

The PRIME MINISTER announced in the House of Commons on Monday that the Government had given consideration to Lord Ashfield's proposals for the EXTENSION of the TUBE RAILWAYS, and had informed him that they could not promote legislation to give the protection against competition asked for. At the same time they had suggested to him the desirability of proceeding with those important works for the extension and improvement of London traffic facilities, both from the point of view of their permanent value and the great assistance they would give in relief of the problem of unemployment. The matter was, he said, still under discussion with Lord Ashfield.

In connection with the above, the London M.P.s received on Monday a deputation from the Metropolitan Municipal Tramways Council, representing the local authorities of Bexley, Croydon, East Ham, West Ham, Erith, Ilford and Walthamstow, and the London County Council. Ald. Crow of West Ham, expressed on behalf of the deputation strong objection to the granting of an omnibus monopoly to the Underground Combine. He pointed out that the capital expended on tramways by local authorities in the London district was £15,352,785, and that last year as many as 855,805,772 passengers were carried.

Miscellaneous.

The death is announced of Lieut.-Col. PELHAM G. VON DONOP, formerly Chief Inspector of Railways, at the age of 70.

Prof. Soddy delivered the first of his two lectures on "THE BEARING OF PHYSICAL SCIENCE ON ECONOMICS" at Birkbeck College yesterday (Thursday).

The current issue of the JOURNAL of the SOCIETY of TECHNICAL ENGINEERS contains extracts from the technical, trade and daily Press on the policy of the Society, recently commented on in THE ELECTRICIAN.

The MODEL FORM of GENERAL CONDITIONS recommended by the Institution of Electrical Engineers for use in connection with contracts has recently been revised. Copies may be obtained from the Secretary of the Institution, Savoy-place, Victoria Embankment, London, W.C. 2, or from Messrs. E. and F. N. Spon, 57, Haymarket, London, S.W. 1, at 2s. 2d., post free.

We regret to announce the death of Mr. HERMAN SLOOG, M.I.E.E., M.S.E., M.Soc.C.E. (France), who died on Sunday at a nursing home after an operation. Mr. Sloop, who was only thirty-seven years of age, was hon. secretary of the Groupe Inter-Universitaire Franco-Britannique, the Société des Ingénieurs Civils de France, and the Office National des Universités et Ecoles Françaises.

We regret to record the death of Mr. A. E. MANOR, which took place suddenly in London on the 7th inst. Born at Glasgow in 1865, he was trained as a civil engineer. In 1882 he joined the Edison Company, and later he made a tour of Australia and South America. He held the appointment of electrician to the Chilean Navy for two and a half years, and on his return to England at the end of 1886, he was engaged on electric light installation work. Subsequently he became electrician to Messrs. Denny Bros., of Dumbarton, and in May, 1890, he was appointed general manager of the Fowler Waring Cables Company, Ltd. When he retired from this position he engaged in consulting work.

Institution Notes.

The inaugural meeting of the Manchester Section of the INSTITUTION OF RUBBER INDUSTRY took place on Monday.

Definite steps are at last being taken, according to the "Chemical Trade Journal," to hasten the formation of the INSTITUTION OF CHEMICAL ENGINEERS. At the Engineers' Club, London, on Nov. 9, a meeting is to be held, at which Sir Arthur Duckham will preside, for the discussion of the best method of its formation.

Following the example of London, the NORTH-WESTERN CENTRE OF THE INSTITUTION OF ELECTRICAL ENGINEERS are arranging for informal meetings during the present session. The first of these will be held at the Engineers' Club, Manchester, on Dec. 13, when the subject for discussion is "Supply of Power Station Auxiliaries."

At the next meeting of the DIESEL ENGINE USERS' ASSOCIATION on Friday, the 18th inst., at the Institution of Electrical Engineers, a Paper on "Some Recent Developments in Mechanical Injection Oil Engines using Heavy Oils," by Mr. Oswald Wans, is to be discussed. Non-members desirous of attending can make application for tickets to the Honorary Secretary, 19, Cadogan-gardens, London, S.W. 3.

The Council of the INSTITUTION OF ELECTRICAL ENGINEERS have decided to keep the library open in future on two evenings each week until 9.50 p.m., or alternatively, one evening a week and Saturday afternoons until 5 p.m. In order to ascertain which days are most favoured by members the library will be kept open every week-day and every Saturday afternoon until Christmas, commencing on Monday, Nov. 14.

The annual general meeting of the members of the INDUSTRIAL LEAGUE AND COUNCIL, of which Viscount Burnham, C.H., and the Right Hon. G. H. Roberts, M.P., are joint Presidents, will be held at the Central Hall, Westminster, S.W.1, on Wednesday next, Nov. 16. Conforming with the precedent established by H.M. the King in the direction of the need for national economy, the Executive Committee of the League has this year decided to depart from its well-known principle of holding a big banquet of employers and employed after the business of the annual gathering has been transacted.

Imperial Notes.

Melbourne Electric Supply Company have agreed to erect on their poles in South Melbourne h.t. mains owned by MELBOURNE CORPORATION, and by means of which additional supplies are to be given to Port Melbourne and Williamstown municipalities.

An ELECTRIC POWER BOARD is to be established for acquiring and carrying on the electricity supply and tramway undertakings of AUCKLAND (N.Z.) Council, and for undertaking the provision of electric power in Auckland and adjacent municipal areas.

A municipal generating station at TUMUT (N.S.W.) was opened recently. The plant comprises a 42 H.P. and a 12 H.P. Hornsby gas engines, driving 25 kW and 10 kW G.E.C. generators, the latter set is used for the night load. The system is three-phase 415/240 V.

The SYDNEY (N.S.W.) City Council is being sued by the Electric Company of Australia, who claim £50,000 damages, representing the loss suffered by the company by not obtaining the Council's promised order for turbo-generator plant, which has been given to Messrs. Thompson, of Castlemeane. The company's solicitors pointed out that on July 30, 1920, the Council stated definitely that they would renew the promise given to their predecessors, Messrs. Willans and Robinson, to place with them the order for the next turbo-alternator plant.

Telegraph and Telephone Notes.

The PRESTON TELEPHONE EXCHANGE, which now controls over 1,500 local lines, is to be equipped for automatic working.

The STRONG GALE of Saturday night has had a disastrous effect on the telegraph poles and wires, and in consequence the telegraphic traffic service, especially in the eastern counties, was badly affected.

At a recent meeting of AMALGAMATED WIRELESS (AUSTRALASIA) LTD., the chairman (Sir Thos. Hughes) said the company's proposal to provide a direct commercial wireless service between Australia and England had been favourably received by the Federal Government, but the Government did not proceed with it because of the publication of a scheme by an English committee to accomplish the same object. The English scheme was unworkable, because every message would have to pass over a chain of five stations.

The President of the United States expressed by wireless to the world on the 4th inst. the earnest hope that peace may presently become the fortune of all lands and peoples. The message, radiated from Long Island, near New York, marked the opening of the world's largest group of LONG-DISTANCE WIRELESS STATIONS. The Radio-Central, New York, as the new American wireless centre is termed, occupies an area of 6,400 acres. When complete it will be capable of conducting simultaneous and distinct intercommunication with five different parts of the world. The transmitters will have trans-Atlantic and trans-Pacific telegraphic ranges, and provision is also being made for the development of trans-Atlantic wireless telephony. The station is the property of and will be operated by the Radio Corporation of America. The circuit prepared for regular traffic with Great Britain will intercommunicate with the Marconi Company's station at Carnarvon.

Personal and Appointments.

VISCOUNT PEEL has been appointed Minister of Transport (unpaid) in succession to Sir Eric Geddes.

MR. C. W. MOFFITT has been appointed shift engineer at the Rathmines Urban Council's electricity works.

MR. D. G. DAVIS has been appointed power station engineer by the Clyde Valley Electrical Power Company.

MR. C. W. CLOSE has been appointed electrical engineer in charge of Walton-on-Naze Council's electricity undertaking.

MR. H. R. FORBES MACKAY, city electrical engineer of Sydney, N.S.W., is on a visit to England to study the latest improvements in electrical machinery, preparatory to advising Sydney Council regarding the equipment of their new power house.

Engineers scored three successes in the CHELMSFORD municipal elections, Mr. Tom E. Dann, works manager for Compton, Ltd., and Mr. A. Eddington, chief of the test staff at Marconi Works, obtaining seats in the South Ward, and Mr. H. B. Tilley, of the Marconi staff, in the North Ward, all being at the first time of asking.

MR. J. N. ROBERTSON, assistant sub-station superintendent of Glasgow Corporation Electricity Department, has accepted an appointment with the British Electric Transformer Company, Ltd., of Hayes, Middlesex. On the evening of his departure for London he was presented with an attaché case and set of silver brushes by the staff and employees of the electricity department.

MR. J. W. HAME's resignation from his position as chief electrical engineer and tramways general manager at York takes effect at the end of the month, and Mr. Nichols, the assistant engineer, will act as chief electrical engineer. The tramways and electricity departments are to be separated, and a tramways manager is to be advertised for. Mr. Hame has been invited to accept the office of consulting engineer until the Linton Lock scheme is completed.

The staff and employees of the Bolton Electricity Department have presented the Borough Electrical Engineer (Mr. W. J. H. Wood) with a mahogany pedestal writing table and chair and silver tray on the occasion of his marriage. The wedding took place at St. Martin's, London, on Nov. 2, the bride being Miss Marjorie Richardson, eldest daughter of Mr. H. A. Richardson, of Bolton. The happy couple are spending their honeymoon on the Continent.

Catalogues, Price Lists, &c.

In a four-page pamphlet issued by MESSRS. DEWHURST & PARTNER, LTD., 28, Hatton-garden, London, E.C. 1, the prices, outputs, weights and dimensions are given of their one, two, and three phase a.c. motors.

In an abridged catalogue of electrical accessories, which is being circulated by ELECTRICAL COMPONENTS, LTD., 90, Great Charles-street, Birmingham, a variety of lampholders, ceiling roses, cut-outs, switches, shades, cables and flexibles, conduits, and other fittings and accessories is listed and priced.

AN ELECTRIC CIGAR AND CIGARETTE LIGHTER has been placed upon the market by the B.E. Company (of London and Birmingham) Ltd., and in a leaflet issued by the company particulars are given of the three types of lighter which are available. One is for motor-car users, another type can be screwed to the mantelpiece or wall, and the third form is fitted with a non-rattle dashboard clip.

THE GENERAL ELECTRIC COMPANY, LTD., announce several interesting additions to their range of low and medium tension switchgear. Particulars of these new lines are given in a leaflet, No. X 2 656, just issued as an addenda sheet to section X and Y of their catalogue. This sheet, together with another leaflet (No. X 2 651), giving revised catalogue prices of all items in this catalogue, is being mailed to the trade. Any of the company's friends who desire to keep their catalogue up to date can obtain copies of the leaflets from Magnet House or any of the company's provincial branches.

A very neat, well-produced catalogue has just been issued by ELECTRIC FIRES, LTD., Norwich. The front cover contains a charmingly artistic design, printed in colour, and the list deals in a concise form with the various electric appliances manufactured at the company's Norwich works. There are different types of stoves for the home, office and factory. The models include the "Heatrae" standard fire bar, "Sunrise," "Sunglo," "Radium," "Meridian," "Cottage," "Baby Grand," and "Boudoir Grand" stoves; factory heaters, grillers toasters, boiling rings, hot plates, immersion heaters, &c.

Business Items, &c.

The offices of MESSRS. A. C. HANDS & SONS have been removed to 57, Shoe-lane, London, E.C. 1. Telephone, Holborn 215.

An electrical engineering department has been opened by MR. FRANK C. BATT, of the Gordon-road Works, Camberley, Surrey.

MESSRS. BELLING & COMPANY, Upper Edmonton, N. 18, have opened showrooms on the ground floor of No. 18, Berners-street, Oxford-street, W. 1, where contractors and others can see a full range of the firm's electrical heating and cooking appliances. The firm have issued a large poster illustrating a girl switching on one of their electric fires. It is produced in five colours, and should have a good effect in stimulating sales generally.

Tenders Invited.

UNITED KINGDOM.

MANCHESTER PUBLIC HEALTH COMMITTEE. Nov. 14.—Excavation work, supply and laying of heavy four-core a.c. cable, supply of switchgear, and wiring and fitting portion of Monsell Hospital. Specifications from the City Architect.

VARINGHAM ELECTRICITY AND TRAMWAYS COMMITTEE. NOVEMBER 15 (noon).—Motors and transformers. Specifications from the Borough Electrical and Tramways Engineer, and tenders to the Chairman of the Committee.

BENTLEY-WITH-ARKSEY Urban Council. Nov. 16.—Supply of electric lamps in gross lots. Particulars from the Surveyor.

BRISTOL GUARDIANS. Nov. 16.—Supply of electric fittings for three or six months. Tender forms from Mr. J. J. Simpson, St. Peter's Hospital, Bristol.

MANCHESTER EDUCATION COMMITTEE. Nov. 16.—Electric light wiring and fitting of Cavendish, City-road, Burgess-street, and Abbot-street municipal schools. Specifications from the Education Offices, Deansgate, Manchester.

GREAT NORTHERN RAILWAY COMPANY (IRELAND). NOVEMBER 16.—Year's stores, including electric lamps, fittings, cables, wire, &c. Tenders to the Secretary, Amiens-street, Dublin.

GREAT WESTERN RAILWAY COMPANY. Nov. 21.—Supply of three months' stores, including telegraph instruments, telegraph ironwork and tools, electrical apparatus, wires and cables, &c. Samples and patterns may be seen at the Company's Stores, Swindon, and tenders are to be addressed to the secretary, Mr. A. E. Bolter, Paddington Station, London, W.

METROPOLITAN ASYLUMS BOARD. NOVEMBER 23, 2.30 p.m.—Installation of electric lighting cables, &c., on the training ship "Exmouth," off Grays. Specification, &c., can be obtained at the Board's Offices, Embankment, E.C. 4.

SHEFFIELD HEALTH COMMITTEE. NOVEMBER 26.—Plant and machinery for refuse-disposal works, including cranes and grabs, d.c. switchboard, feed pumps and feed-water heaters, steam-driven electrical plant and condensers, electric motors and starters (contracts Nos. 9, 10, 11, 14 and 15), &c. Specifications from Messrs. Mortimore, Lyon & Company, Mansfield-chambers, Manchester.

WIMBLEDON CORPORATION. Nov. 30, noon.—Supply, delivery and erection of high-pressure sub-station switchboard at Raynes Park sub-station. Specification and tender form from Mr. H. Tomlinson-Lee, Chief Electrical Engineer, Electricity Works, Durnford-road, Wimbledon, S.W. 19. Tenders to the Chairman of the Electricity Committee.

WHITEHAVEN CORPORATION. Dec. 1.—Two water-tube boilers, with superheaters, economisers, pipework, &c., for the Electric Supply Department. Specification, &c., from the Borough Electrical Engineer and Manager.

AUSTRALIA.

VICTORIAN GOVERNMENT RAILWAY COMMISSIONERS. JANUARY 4, 1922.—*60 tons galvanised telegraph wires (contract No. 34 706); 23 steam meters and accessories for Newport power house (No. 34 611); and 150 electric train stops for power signalling (No. 33 546). Tenders must be accompanied by a preliminary deposit of half per cent. of total amount of tender, and local representation is essential.

VICTORIAN GOVERNMENT RAILWAY COMMISSIONERS.—Jan. 4, 1922, in case of Nos. 1 to 4, and Jan. 11 in the case of No. 5.—*Supply and delivery of (1) one eet electric pyrometer equipment (Contract No. 34 705); (2) electrical equipment for cargo shifter (No. 34 723); (4) one electric rivet heater and accessories for Newport workshops (No. 34 735); and (5) miscellaneous machines, including lathes, drilling, milling, screwing, and power press (No. 34 649). Tenders on proper forms must be accompanied by a preliminary deposit of $\frac{1}{2}$ per cent. of total amount of tender.

DEPUTY POSTMASTER-GENERAL, ADELAIDE.—Jan. 4, 1922.—*Supply and delivery of telephone apparatus and material, including cords, hand sets, supervisory lamps, plugs, jacks, &c. (Schedule No. 604.) Local representation is essential.

POSTMASTER-GENERAL'S DEPARTMENT, MELBOURNE.—Jan. 17, 1922.—*Supply and delivery of telegraph instruments, differential galvanometers, keys, relays, sounders, &c., to the stores branch. (Schedule No. 1 718.) Local representation is essential.

CITY ELECTRIC LIGHT COMPANY, LTD., BRISBANE.—Feb. 10, 1922.—*Supply and delivery of six miles of three-core 0.15 by 0.15 by 0.15 paper insulated cable suitable for 5 500 V with a non-earthed system. Tenders, accompanied by a preliminary deposit of £100, to the Engineer and Manager, Boundary-street, Brisbane.

NEW SOUTH WALES GOVERNMENT RAILWAYS AND TRAMWAYS DEPARTMENT (Electrical Engineer's Branch).—Feb. 22, 1922.—*Supply, delivery, erection and maintenance of one 5 000 kW 50 cycle turbo-alternator with condenser and accessories, at Zarrata-street power house, Newcastle. (Contract No. 5556.) Tenders, on proper forms and accompanied by a preliminary cash deposit, to the Secretary for Railways, Phillip-street, Sydney, N.S.W. Local representation is essential.

NEW ZEALAND.

WELLINGTON, CONTROLLER OF STORES, POST AND TELEGRAPH DEPARTMENT. NOVEMBER 21.—*750 red and 750 white switchboard cords (three conductor), to specification No. 87.

* Particulars from the Department of Overseas Trade.

WELLINGTON, PUBLIC WORKS DEPARTMENT. NOVEMBER 29.—In connection with Mangahao electric power scheme. *Section 12: Three water-wheels of 6 450 B.H.P., and two water-wheels of 3 225 B.H.P., complete with governors, couplings, and accessories; Section 13: Three 6 000 kVA and two 3 000 kVA alternating-current generators; Section 14: two three-unit exciter sets, each consisting of one 375 B.H.P. Pelton wheel, one 250 kW direct-current generator, and one 350 H.P. asynchronous motor; Section 15: seven 4 000 kVA single-phase transformers and accessories; Section 17: insulators for 110 000 V 50 cycle transmission lines; Section 18: lightning arresters for operation on two 110 000 V three-phase transmission lines; Section 19: switchboard, switches, and accessories.

SOUTH AFRICA.

MUNICIPAL CORPORATION OF HUMANSDORP, CAPE PROVINCE. NOVEMBER 30.—Machinery and plant. Section A: one water turbine and dynamo, switchboard with connections, battery of accumulators, and accessories for same; Section B: electricity supply main and public lighting; aerial distributing lines, street lamps, fittings and accessories, section boxes, service cut-outs, meters, &c.; Section C: ferro-concrete pipe line; Section D: reinforced-concrete tank; Section E: buildings and foundations. Further particulars from the Town Clerk, Humansdorp.

BULGARIA.

BULGARIAN DIRECTION OF POSTS, TELEGRAPHS AND TELEPHONES. Jan. 10, 1922.—Supply of sixty 50-line and fifteen 100-line telephone exchanges. Particulars and drawings may be obtained from the Bulgarian Legation, 3, Queensberry-place, S.W. 7.

Companies' Reports, &c.

The directors of the **UNDERFEED STOKER COMPANY, LTD.**, have declared a dividend of 10 per cent, tax free, for the year 1920.

The directors of **SIEMENS BROTHERS & COMPANY, LTD.**, have declared an interim dividend on the ordinary shares of 1s. per share (tax free) in respect of half-year to June 30 last, payable Nov. 30. The dividend is the same as in 1920.

The debenture holders in the **BLACKPOOL AND ST. ANNES TRAMWAYS COMPANY**, whose undertaking has been acquired by St. Annes District Council, have received a final distribution of 7.44 per cent. on arrears of 40 per cent. of interest. The capital of £148 935 was repaid a year ago, when the preference shareholders received 2s. and the ordinary shareholders 1s. per share, the only return for over twenty years.

The profit of **HURST, NELSON & COMPANY, LTD.**, for the year ended July 16 was £94 229, or £9 000 less than in the preceding year. The dividend has been maintained at 15 per cent. and 5 per cent. bonus, tax free; a sum of £20 000 is placed to reserve, £10 000 to reserve for ordinary dividend, and £5 000 to special reserve for equalisation of dividends on ordinary shares, the carry forward being £17 507.

The **STOCK EXCHANGE COMMITTEE** have granted official quotations to 45 000 £1 fully paid ordinary shares, 500 £1 fully paid 7 per cent. cumulative first preference shares, 440 £1 fully paid 6 per cent. cumulative second preference shares, and £84 090 4½ per cent. first debenture stock of the **South Metropolitan Electric Light and Power Company**, and have specially allowed dealings in 65 025 £1 fully paid new 6 per cent. (tax free up to 6s. in £1) cumulative convertible first preference shares of the **Lancashire Electric Light and Power Company**.

The net profit of the **MONTEVIDEO TELEPHONE COMPANY, LTD.**, for the year ended July 31, after providing for all charges in Montevideo and London, and making provision for taxation was £27 755. Interim dividend absorbed £6 514, leaving £21 241, plus £11 772 brought forward, making £33 013. After transferring £10 000 to reserve, the directors recommend a final dividend of 5 per cent. (tax free), making 8 per cent. for year, carrying forward £12 156. Profit on exchange for previous year amounted to £11 014, but this year there is loss of £1 006.

Mr. Francis Fitzgerald, who presided over the annual meeting of the **NORWICH TRAMWAYS COMPANY** last week, said last year's net profit (£3 933) was the poorest return since 1908. Larger expenditure was required for repair work, and track renewal was interrupted by the non-delivery of rails, points and crossings. He thought the cost of operation, which began to mount in the first year of the war, and which culminated in an increase of £82 000 in the last two years, had reached its limit. He looked to a continued decrease in costs for an improvement in their financial position so as to cover the sums required for renewals and reconstruction, and to pay a fair dividend on their shares.

The gross revenue of the **AMAZON TELEGRAPH COMPANY, LTD.**, for the year ended June 30 amounted to £63 143 and the working expenses to £35 018. After providing £491 for corporation profits tax to June 30, 1920, £6 155 for income tax, £10 391 for debenture interest, and £12 428 for the sinking fund, the directors recommend the balance (£5 790) should be carried forward. This is subject to corporation profits tax. Owing to the continued trade depression in Brazil, and especially in the Amazon Valley, due to the fall in the price of rubber, the receipts have decreased by £21 987, and the directors are in consequence unable to pay a dividend for the year. All instalments of subsidy from the Brazilian Government have been duly received.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Bankruptcy Information.

JARVIS, William Edwin Charles, now residing at 3, King Edward street, Darlaston, lately carrying on business as the Darlaston and District Electrical Engineering Company, at 48, King-street, Darlaston, electrical engineer. First meeting, Nov. 16, 11.30 a.m., Official Receiver's Office, 30, Lichfield-street, Wolverhampton. Public examination, Dec. 7, 10.15 a.m., Court House, Lichfield-street, Walsall.

Liquidators' Notices.

GUILDFORD ELECTRICITY SUPPLY COMPANY, LTD. (In voluntary liquidation.) Meeting of creditors at the offices of the company, 115, High-street, Guildford, on Nov. 11, at 3.15 p.m. Particulars of claims by Dec. 1. B. D. Holroyd, liquidator. Note.—This meeting is simply called to comply with the Companies Acts: there are sufficient funds in hand to pay the creditors in full.

HEADS (ELECTRICAL) LTD. (in voluntary liquidation). Meeting of creditors at 151-2, North-street, Brighton, on Thursday, Nov. 17, at 3 p.m. A. E. Orbell, liquidator.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

BELL, Thomas, 24, Lovaine-crescent, Newcastle-on-Tyne, magnet engineer. £23 4s. 6d. Sept. 16.

FOWLER, Alfred Vaughan, Sealcliffe, Fitzroy-avenue, Kingsgate, electrical engineer. £53 3s. Sept. 26.

KNOWLES, Frederick, and KNOWLES, Jane (wife), 206, Nutgrove-road, Thatto Heath, St. Helens, electrician. £12 11s. Sept. 28.

SHERWELL, E. G., 38, Bridge-street, Bristol, electrician. £19 10s. 4d. Sept. 28.

SKINNER, James, 92, Berkeley-street, Liverpool, electrical engineer. £12 19s. 6d. Sept. 29.

WALKER, Alfred, 107, Church-road, Tranmere, electrical engineer. £48 4s. 10d. Sept. 29.

WEAVER, Randle, and WEAVER, Ethel (his wife), 67, Willis-street, Ashted, Birmingham, electrician. £12 9s. 4d. Sept. 23.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

OSWESTRY ELECTRIC LIGHTING & POWER COMPANY, LTD. Registered Oct. 22. £1500 debentures (filed under section 93 (3) of the Companies (Consolidation) Act, 1908), present issue £800; general charge. *£2300. Oct. 12, 1920.

Deed of Arrangement.

DOUGHTY, John William, trading as Doughty & Company, 32, Queen-street, Manchester, and residing at 1, Peel-terrace, Stretford, electrical engineer. Deed of arrangement whereby the debtor covenants to pay trustees £12 weekly, commencing within seven days from date hereof, until he shall have paid sufficient to pay creditors in full. Secured by an assignment upon trust, &c. Trustees, A. Yearsley, 27, Brazennose-street, Manchester, I.A., and another. Liabilities unsecured, £1331. Assets, less secured claims, £2182. Filed, Nov. 3. Creditors include:—Electrical Supply Company, London, £13; Newman Electrical Company, London, £305; Callenders Cable and Construction Company, Ltd., London, £29; May & Padmore, Ltd., Birmingham, £25; Chloride Electrical Storage Company, Clifton Junction, £54; Star Lamp Company, Manchester, £42; A. Walters & Son, £36.

Bankruptcy Proceedings.

BRADBURY, John Edward Arthur, 11, Dean Park-road, Bournemouth, Hampshire, contractor and electrician. The statement of affairs submitted at the adjourned public examination of this debtor showed liabilities £9367 and assets £682, leaving a deficiency of £8685. Debtor attributed his failure to depreciation in the value of shares, and losses in connection with an electrical supply business with which he was concerned. The debtor started on a venture called the Electrical Goods Supply Company, and he was joined by another debtor finding £900. The debtor alleged that with the assistance in April of last year he lost quite £1205. After questions had been asked the examination was adjourned.

ENDALL, George Williams, trading as Endall & Company, Canal Motor Works, Canal Bridge, Church-street, St. Helens, Lancashire, electrical, mechanical and automobile engineer (B.P., 11/11/21). The statement of affairs submitted at the public examination of this debtor on Nov. 7 showed unsecured liabilities £1393, against net assets £358. Debtor attributed his failure to bad trade and illness. He stated that prior to February, 1915, he was employed in the engineering trade in Manchester for two years. He then went to St. Helens, and commenced as an engineer with about £15 capital. For two years he was fairly successful, but later he was obliged to obtain financial assistance to the extent of £200 from a friend, and this amount, together with interest, was still owing. In April, 1918, debtor removed to his present address, where he traded until January, 1920, when he took a partner into the concern, who brought in £500 capital. Debtor estimated that his stock and business effects were then worth £2000. The partnership only lasted five or six months, when debtor paid out his partner for £450. After questions had been put regarding some of his transactions, the debtor admitted that at the date of the dissolution of the partnership he was in financial difficulties, but there was some talk of turning the business into a limited company, but nothing was done in that direction. Debtor was ordered to amend his deficiency account, and the examination was adjourned.

Sixty Years Ago.

(THE ELECTRICIAN, NOVEMBER 9, 1861.)

STANDARDS OF ELECTRICAL MEASUREMENT. Under the auspices of the British Association for the Promotion of Science, a Commission has been appointed to recommend certain determinate units of electrical measurement for practical adoption among electricians. The necessity for such standards, to which the tension and quantity of a current and the resistance of a conductor, might be conveniently and intelligibly referred, has long been felt, and there is no doubt that their employment might greatly contribute to the degree of accuracy which is now beginning to be evidenced in the practice of electro-telegraphy. To be of any general utility, however, the proposed system of measurement must necessarily be sufficiently simple and easy of application to meet the requirements of telegraphists. Glancing at what has already been published in reference to this important subject, we fear there is some danger that a system may be devised, which will be followed exclusively by the eminent gentlemen at whose recommendation it is put forward. That this would be worse than useless, in a practical point of view, need scarcely be insisted upon. The methods of measurement at present in use among telegraphists, however imperfect and miscellaneous, had found favour with those who employ them and answer their purposes to a certain extent. There is little doubt that they might be perfected, or improved upon, in a general system; but they will certainly not be relinquished for any plan, however perfect in theory, characterised by abstruseness and difficulty in application. The step which has been taken to introduce definite standards of electrical tension, static and dynamic quantities, and resistance, was occasioned by the reading of the paper on this subject, by Mr. Latimer Clark and Sir Charles Bright, at the meeting of the British Association at Manchester this year. The object of this paper, which we reproduce on our columns, is obviously rather to offer suggestions than to explain a definite system, and we are, therefore, hardly justified in complaining of the absence of details, which would have been of the greatest interest to telegraphists. One of the standards of tension suggested is a cell of a Daniell battery, which, if the positive element be immersed in pure water, will probably be found sufficiently constant for all practical purposes. To form the unit of static quantity, the poles of this couple may be connected with two metallic discs of determinate area, separated by a certain thickness of a dielectric such as dry air. The passage through a conductor, in the space of one second, of the unit of the quantity accumulated upon the discs, gives the unit of electrical current. The mode of obtaining the whole of this quantity in the form of a current, during a definite period of time, is insufficiently explained, by a reference to the fact, first ascertained by M. Guillemin, and subsequently applied by Messrs. Siemens, that when a uniform succession of rapid discharges is sent through a galvanometer, the deflection of the needle is constant. The unit of resistance indicated is a wire which will conduct the unit of quantity and, we presume, no more, in the space of a second, under the tension of the single couple of a Daniell battery. The application of the French system of notation in the table is evidently faulty, the thousandth part of a volt being one millivolt, and not one kilovolt, as stated. An important feature of this system of measurement is the mutual relation and dependence of the various units.

B.E.D.A. Salesmanship Conferences.

A series of Salesmanship Conferences have been initiated by the British Electrical Development Association with the object of bringing together persons interested in the sale of electricity or electrical material to discuss, through the medium of short papers or lectures, the various aspects of lead building and salesmanship. All persons engaged in the industry and coming into contact with the public in the course of their work are eligible to attend and take part in these conferences, which will deal with commercial rather than technical aspects. They will also specially concentrate on the methods of popularising the use of electricity and on presenting the advantages of electrification to the consuming public. The first Conference of the present session will take place on Friday evening, Nov. 18, at 8 p.m., at the Institute of Chartered Patent Agents, Staple Inn-buildings, London, W.C. 2, when a discussion on "Salesmanship in Wiring and Installation Work" will be opened by Mr. E. H. Freeman. Mr. S. T. Allen will be in the chair. Admission to the Conference will be by ticket, to be obtained from the British Electrical Development Association offices.

Safeguarding the Industries Act.

The Administrative Committee of the National Union of Manufacturers have passed a resolution expressing satisfaction at the effective operation of Part 1 of this Act, and urging upon the Board to hasten into operation Part 2 of the Act with the object of safeguarding employment in industries in the United Kingdom.

Mr. Cyril Atkinson, K.C., has been appointed referee to decide complaints referred to him by the Board of Trade under Sec. 1 (5) of the SAFEGUARDING OF INDUSTRIES ACT, 1921, as to whether any goods are or are not goods chargeable with duty under the Act.

In consequence of representations by the Electrical Importers and Traders' Association to the Board of Trade, dry batteries, large cells and pocket lamp batteries are to be imported free of duty in future.

A number of questions have been asked in the House of Commons on the administration and effect of the Act, but little additional light has been thrown upon the subject. Capt. Wedgwood Benn was informed on Tuesday by the Parliamentary Secretary to the Board of Trade that as Part 1 of the Act became operative only on Oct. 1 and no Order had yet been made under Part 2, it was too early to express any opinion as to whether a flat rate of 33½ per cent. had been effective in checking the import of cheap German goods into this country.

NEWPORT (MON.) Tramways Committee have decided to grant free travelling to the blind. The Committee have also reaffirmed their previous decision to prevent motor omnibuses running into the town. The Committee are experimenting with a system of workmen's cars for men engaged in shifts starting and leaving work at ten o'clock at night, and the question of mid-day meal cars for workmen is also under consideration.

Prices of Metals, Chemicals, &c.

		TUESDAY, NOV. 8.		
		Price.	Inc.	Dec.
Copper—				
Best selected	per ton	£66 15 0	—	—
Electro Wirebars	..	£75 10 0	£ 0 0	—
H.C. wire, basis	per lb.	0s. 11½d.	—	—
Sheet	.....	0s. 10½d.	—	—
Phosphor Bronze Wire (Telephone)—				
Phosphor-bronze				
wire, basis	.....	1s. 3½d.	—	—
Brass 60/40—				
Rod, basis	.....	0s. 7½d.	—	—
Sheet, basis	.....	0s. 10½d.	—	—
Wire, basis	.....	0s. 11½d.	—	—
Pig Iron—				
Cleveland Warrants	per ton	£5 15 0	—	15s.
Galvanised steel				
wire, basis 8 SWG	.....	£23 0 0	—	—
Lead Pig—				
English	.....	£24 15 0	—	5s.
Foreign or Colonial	..	£23 15 0	—	5s.
Tin—				
Ingot	.....	£158 15 0	£2 0 0	—
Wire, basis	.....	2s. 2½d.	—	—
Salammoniac.—Per cwt. 65s.-60s.				
Sulphur (Flowers).—Ton £13.				
.. (Roll-Brimstone).—Per ton				
£13.				
Sulphuric Acid (Pyrites, 168°).—				
Per ton, 20 17½-64.				
Rubber.—Para fine, 1s. 2d.; plantation 1st latex, 10½d. lb.				
The metal prices are supplied by British Insulated & Helsby Cables, Ltd.				

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Arrangements for the Week.

FRIDAY, Nov. 11th (to-day).

PHYSICAL SOCIETY.

5 p.m. At the Imperial College of Science, South Kensington, London, S.W. Presidential Address on "The Structure of Crystals of Organic Substances," by Sir William Bragg, K.B.E., F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS.

(LONDON STUDENTS' SECTION.)

7 p.m. At Savoy-place, London, W.C. Opening Address on "The Future of Railway Electrification," by Sir Philip Dawson, M.P.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

7.30 p.m. At the Literary and Philosophical Society, Westgate-road, Newcastle-on-Tyne. Paper on "The Working of a Modern Telephone System," by Mr. C. Whillis.

INSTITUTION OF ELECTRICAL ENGINEERS.

(STUDENTS' SECTION OF SCOTTISH CENTRE.)

7.30 p.m. At the Royal Technical College, Glasgow. Address by Mr. Alex. Lindsay.

INSTITUTION OF ELECTRICAL ENGINEERS.

(IRISH CENTRE.)

8 p.m. At the Royal College of Science, Upper Merrion-street, Dublin. Discussion on the Report of the Fuel Research Board on the Winning, Preparation, and Use of Peat in Ireland, and on the Report of the Sub-Committee on the Water Power Resources of Ireland.

ELECTRO-HARMONIC SOCIETY.

8 p.m. At Cannon-street Hotel, London, E.C. Concert. (Ladies' Night.)

SATURDAY, Nov. 12th.

BIRMINGHAM AND DISTRICT ELECTRIC CLUB.

7 p.m. At the Grand Hotel, Colmore-row, Birmingham. Paper on "The Gyroscopic Compass," by Mr. H. F. Stevenson.

MONDAY, Nov. 14th.

INSTITUTION OF ELECTRICAL ENGINEERS.

(NORTH-EASTERN CENTRE.)

7.15 p.m. At Armstrong College, Newcastle-on-Tyne. Paper on "Telephone Line Work in the United States," by Mr. E. S. Byng.

TUESDAY, Nov. 15th.

INSTITUTION OF CIVIL ENGINEERS.

6 p.m. At Great George-street, London, S.W. Paper on "The Indian Railway Gauge Problem," by Mr. F. G. Royal-Dawson.

INSTITUTION OF ELECTRICAL ENGINEERS.

(NORTH MIDLAND CENTRE.)

7 p.m. At the Hotel Metropole, King-street, Leeds. Chairman's Address and Smoking Concert.

INSTITUTION OF ELECTRICAL ENGINEERS.

(NORTH-WESTERN CENTRE.)

7 p.m. At the Engineers' Club, 17, Albert-square, Manchester. Chairman's Address, by Mr. W. Walker, and Smoking Concert.

INSTITUTION OF ELECTRICAL ENGINEERS (SOUTH MIDLAND CENTRE STUDENTS' SECTION).

7.30 p.m. At the University, Edmund-street, Birmingham. Paper on "The Testing of Materials used in Manufacture of Electrical Machinery," by Mr. C. Dawson.

ILLUMINATING ENGINEERING SOCIETY.

8 p.m. At the Royal Society of Arts, John-street, Adelphi, London, W. Reports on Progress during the Vacation and Developments in Gas Lamps and Electric Lamps and Lighting Appliances.

WEDNESDAY, Nov. 16th.

INDUSTRIAL LEAGUE AND COUNCIL

7.30 p.m. At Caxton Hall, Westminster, London, S.W. Lecture on "The Great Essential in Industry," by Mr. F. S. Buton.

THURSDAY, Nov. 17th.

INSTITUTION OF ELECTRICAL ENGINEERS.

6 p.m. At Savoy-place, Victoria Embankment, London, W.C. Paper on "Telephone Line Work in the United States," by Mr. E. S. Byng.

INSTITUTION OF ELECTRICAL ENGINEERS.

(LIVERPOOL STUDENTS' SUB-CENTRE.)

7 p.m. At the University, Brownlow-street, Liverpool. Informal discussion on "The Relative Merits of Direct and Alternating Current in their Application to Industry."

FRIDAY, Nov. 18th.

INSTITUTION OF MECHANICAL ENGINEERS.

6 p.m. At Storey-gate, London, S.W. Paper on "The Machinery of Floating Docks," by Dr. E. H. Salmon.

JUNIOR INSTITUTION OF ENGINEERS.

7 p.m. At Caxton Hall, London, S.W. Annual General Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS.

(STUDENTS' SECTION.)

7 p.m. At Savoy-place, London, W.C. Paper on "Modern Hydro-Electric Practice," by Mr. E. E. Butten.

BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION.

8 p.m. At the Chartered Institute of Patent Agents, Staple Inn-buildings, London, W.C. Salesmanship Conferences. No. 1, "Salesmanship in Wiring and Installation Work," by Mr. E. H. Freeman.

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Notes of the Week.

Speeding up Electrical Progress.

IF we agree that the surest way of developing the electrical industry at the present time is to obtain as many points of contact with the public as possible, it is obvious that this may best be done by providing a service which shall be both attractive and cheap. We were, therefore, glad to see Mr. HIGHFIELD insisting on this point in opening the discussion on "Speeding Up Electrical Progress" at the first informal meeting of the Institution of Electrical Engineers this session. In so doing, Mr. HIGHFIELD joins the ranks of the optimists, of which we also are members, and confirms his enrolment by stating that if the demand for electricity all over the country is fostered by good service and honest efforts to cheapen supply, then there is a wave of prosperity just ahead of us. He also makes the point, upon which we, too, have insisted, that this contact with the public may be made both intimate and widespread by encouraging the use of small apparatus, such as irons and toasters, which can be supplied on existing house wiring through a single meter, though they would be charged on a two-part tariff.

Vexatious Restrictions.

THE subsequent discussion rather tended to deal with points of detail, but was hardly less interesting and instructive on that account. Mr. HARMER, whose iconoclastic suggestions we remember at previous meetings, found in Mr. HIGHFIELD's remarks a wholesale condemnation of the I.E.E. wiring rules. In this he was supported to some extent by Major RICH and by Mr. WREDFORD, the latter of whom spoke feelingly of the vexatious and illegal regulations of some of the supply undertakings. As we note elsewhere, the London County Council have their august eye on this point, and it is certainly to be hoped that restrictions which can be so described will be swept

away before long, as not only are they a real obstacle in certain cases, but for psychological reasons they hinder development. The Informal Meetings Committee are to be congratulated on opening their fourth session with such a successful meeting, and we have no doubt that their success and usefulness in the future will be equal to what they have been in the past.

Electric Furnace Regulation.

AS the use of the electric furnace develops it becomes of greater importance to maintain the load so given at as uniform a value as possible. In connection with this problem, experience has shown that none of the automatic regulators now in use fulfil all the necessary requirements. This is especially the case where the supply is three-phase, for, though the current flowing into the furnace may then be apparently constant, the regulators often act upon the electrode, and so unbalance the load. With a view to elucidating this problem, some interesting experiments were recently carried out at the Fitzgerald Laboratories in America, and were extended to a study of the effect of automatic regulation on the furnace currents. A single-voltage Siemens' type furnace was employed in which a charge of scrap iron was melted. The moving electrode was of graphite, 6 in. in diameter, and the furnace was run at a normal load of 60 kW. Thyristor automatic current regulators were employed, and their action was observed by means of cinematograph films running at slow speed. It was then found that apparently at certain periods a state of distortion occurred at regular intervals of time. For instance, when the electrode was close to the slag a heavy individual arc appeared on its inner edge and the regulator started to raise the electrode until this arc was broken. This caused a number of lesser arcs to move away to the outer edge of the electrode, leaving about three-quarters of the inner surface bare, so causing a rapid and large decrease in the current, followed by the lowering of the electrode by the regulator. As these arcs did not spread over the surface of the electrode until the surface of the slag

was nearly reached, they caused a large increase in current, and the cycle of events was repeated. We are glad to learn that researches into this question are still being carried on, as with the increasing use of electric furnaces on ordinary distribution systems it is essential that as close a regulation as possible shall be obtained in the interest of other consumers.

Effect of Cooling on Magnetic Properties.

IN the course of their valuable researches into the properties of steel, the Bureau of Standards, Washington, has recently been investigating specimens of eutectoid carbon steel by cooling them from a temperature of 800°C. in air, in lime, and at various rates in a furnace. The effect of these rates of cooling on the magnetic properties—that is, on maximum and residual induction, coercive force, permeability and magnetic reluctivity relationship, as well as on the resistivity and scleroscope hardness—are discussed in detail in a recent publication, and may be summed up by saying that the change in structure from an essentially sorbitic one to “divorced” pearlite causes a gradual shifting of the bend in the reluctivity line and a greater difference in the values of the real and apparent saturation intensities. There is still a great deal to be learnt about these matters, but the task is made easier by the useful information which is gradually being accumulated by the Bureau of Standards.

The Use of Iron as a Conductor.

SOME time ago we called attention to the use that was being made of iron conductors in Germany, even for such unsuitable purposes as trolley wires, in an attempt to get back to stabilised economic conditions as soon as possible. But, in spite of a shortage of copper and the high price which this shortage brings in its train, it is doubtful whether anything is gained in the long run by using iron for such purposes, except in certain special cases. This is confirmed by experience in rural districts in America, where electricity supply for economic reasons was originally given by means of iron conductors. It has been found, however, that, even though the original load may have been well within the capacity of an iron conductor, the use of this metal makes very difficult the development of the load in the way that would have, in ordinary course, been reasonably expected. In fact, the only way of dealing with such development is to take out the iron wire and replace it by copper or aluminium—an arrangement which not only leads to a greater expenditure in the long run, but generally means interruption in the supply for a shorter or longer time. It, therefore, seems that, attractive as it is at first sight, the employment of iron conductors is practically confined to services where the possibility of a load growth is small and where physical conditions put a definite limit on line lengths or loads. There has, so far as we know, been no great tendency to employ this metal in this country for distribution purposes, and, in view of the experience in both America and Germany, it is unlikely such attempts will be widely made.

Rubber Insulation for H.T. Mains.

THE failure of rubber insulation about 1850, and its failure again when used for high-pressure electrical mains half a century later, was mentioned by Mr. G. L. ADDENBROOKE as a matter of history in the article which we published in last week's issue. Mr. ADDENBROOKE asks us to state that he does not want it to be inferred

that he considers rubber unsuitable for high-pressure mains under proper conditions. On the contrary, it has been his view for some time that if the matter were properly taken up with skilled electrical and chemical co-operation it is not impossible, with rubber at about its present price, that a type of cable could be evolved which would stand very high pressures, and which, if lead covered, might be commercially valuable. That there is something to be said for this view is evident from other information on the subject. There is more than one case of rubber-covered cable laid over twenty years ago being still in use, while in this week's issue Mr. A. DAVIDSON states his preference for V.I.R. cables, under certain conditions, for use in iron and steel works. It, therefore, appears that even with modern methods of working, once the dangers of laying are overcome, there is no reason why such insulation should not give satisfactory service, and it certainly seems a matter which is worth investigation.

The Duplication of the Pacific Cable.

TELEGRAPH engineers especially will be interested to learn that arrangements have been practically completed for duplicating the Pacific cable. When this important work, which is now not without urgency, has been executed, the network of cable communication between Australia and Canada will not only be strengthened, but the risk of telegraphic interruption will be greatly minimised. It is satisfactory to learn that this project can be carried out without any financial assistance from the partner governments in the Pacific Cable Board, as the reserve fund, which is now about £1 750 000, is to be drawn upon for the necessary capital. This happy state of things is not a little due to the war, for the heavy traffic and the greatly increased revenue of the last six years has made it possible to feed the reserve with special contributions. Contrary to expectation, the two long sections of the Board's cable, that between Bamfield and the Fanning Island (this is the longest uninterrupted stretch of submarine cable in the world) and that between Fanning Island and Fiji, have not suffered a single interruption from natural or accidental causes since they were originally laid nineteen years ago. This is a fine record, and reflects credit upon the British manufacturers and contractors. Still, as time goes on the risk of interruption will inevitably become greater and a duplicate cable is, therefore, a necessary insurance against breakdown, while, at the same time, it provides a welcome margin for future traffic expansion.

Traffic and Finance.

THOUGH the net traffic receipts for the year ended March 31st last fell from about £643 000 to £620 000 compared with the previous year, owing to a diminution in the Government traffic of nearly 1 200 000 words, the decrease was not so much as was anticipated, and, as miscellaneous receipts showed an increase of about £6 300, the actual drop in revenue was only £16 500. The cheap week-end cablegrams service, which was primarily intended for social messages of a non-urgent character, is now being largely used for commercial messages. In addition, the deferred Press service has been restored, so that practically all the pre-war facilities are again available. A cheap and reliable news service between the various parts of the Empire is undoubtedly a matter of the greatest importance, and it is to be hoped that when the new cable is laid further facilities will be granted by the Board. During the past year only 7 700 000 paying words of international

traffic were handled against more than 9 000 000 words in the previous year, but the Australian and New Zealand traffic increased by 280 000 words.

The L.C.C. Tramways.

LIKE many other owners of tramways, the London County Council have discovered that it is much easier to increase their fares than the resulting receipts. Again, in the last upward revision of fares the stages were not fixed on an equitable basis, with the result that there has been a considerable drop both in the number of passengers carried and in the receipts from the 1d., 1½d., and 2d. fares. Consequently, it has now been decided to abolish the 1½d. fares and to lengthen the 1d, 2d. and 3d. stages to about 1·2, 2·4 and 3·6 miles respectively. It is anticipated that, while these reductions in fares will cause an immediate increase of passengers, there will be a temporary fall in receipts, but the revenue will, at least, recover to the present level by the end of the year, and the revised estimated results for the current financial year will still be realised, having regard to savings which are likely to be effected. In other words, the estimated surplus on the complete year's working will not be affected, though increased travelling facilities will be given to the public. Under present circumstances, we think the changes made not only justifiable, but distinctly good policy.

New Tramways Projected.

It seems that, after all, the London County Council will seek Parliamentary powers for the construction of tramway extensions in the ensuing session of Parliament, but on this occasion the proposals have a certain modesty. The construction of three short lengths of line only is projected, which should, if authorised, prove useful as connecting links to the present system and add to the travelling facilities in the suburbs. These include the construction of about half a mile of double line on the overhead system from Seven Sisters Road to Stamford Hill; about a mile of line, partly on the conduit and partly on the overhead system, in the Forest Hill district; while the third section would be equipped on the overhead system, and would provide, in conjunction with existing tramway routes, travelling facilities to areas which are at present inadequately provided for, and, besides, afford a direct means of communication between Norwood, Crystal Palace, Sydenham, Catford and Lee Green. It will also assist in serving two large housing estates in course of development at Bellingham and Grove Park. With street widenings, the total capital expenditure for the three routes is estimated at £344 916. The consent of the road authorities has not yet been obtained, but, in any event, it is not necessary for the trolley vehicle part of the scheme, and the Council's Bill is, therefore, likely to meet with a better fate than their grandiose ideas of 1919.

The Ban on Non-Union Wiring.

WE are glad to see that the reckless attempts made by the Electrical Trades Union to ban the non-union wiring of consumers' premises in London have received a grave reverse in the Divisional Court. The three judges, of which the Court was composed, unanimously decided that the North London Police Court magistrate was right in holding that the Hackney Borough Council had made default in not connecting up and supplying electricity to a consumer, whose premises had been wired by a master-man who was not a member of the E.T.U., and that the Council's plea of *force majeure* could not be allowed.

What is Force Majeure?

As the Council's only plea was that of *force majeure*, both the magistrate and the judges of the High Court devoted a good deal of time to an examination of the meaning and effect of the expression. The magistrate found the Council had made default in giving a supply of electricity, and that *force majeure* applied only to physical and material restraint. Mr. Justice DARLING, discussing this point, said the magistrate was right in law, for there was a difference between the meaning of the expression *force majeure* under a statutory obligation and under a contract. Reasonable apprehension of danger was not in itself *force majeure*, and in the present case the magistrate only said that if the jointers who refused to connect had been dismissed "the result would probably have been, &c." If he had said "the result would have been," his Lordship said he would have found that there was *force majeure*. We agree with his Lordship that it is "monstrous that this great undertaking should have to wait until a strike actually took place before they could say *force majeure* came into operation." If local authorities undertake the provision of public utility services, they must act not only in an impartial manner, but see that everyone entitled to and willing to pay for the service is supplied. Otherwise, there will be a great reaction against municipal electricity undertakings.

The Standardisation of Electricity Supply.

THE director of the British Electrical Development Association, Mr. J. W. BEAUCHAMP, has undertaken an investigation which will at least have the result of occupying his surplus energy for some time to come. Being anxious to ascertain the character of the system of supply and the pressure of the million domestic electric services now at work in this country, he has sent out a *questionnaire* to the supply authorities and, though half of them have not yet replied, an analysis of the information obtained has been issued and shows interesting results. Here it is in brief. The 181 replies received represented 349 000 consumers, of whom 60 per cent. took direct current and 40 per cent. alternating current supply. In the case of direct current 15·5 per cent. were supplied at 200 V, 21·8 at 220 V, 25·4 at 230 V, and 25·5 at 240 V, the remainder taking current at 210, 50 or 115 V, or some other odd pressure. Of those supplied on the a.c. system 53 per cent. were at 200 V, 11·1 per cent. at 100 V, and 25 per cent. at 230 V, the remainder being at 220 V, 110 V, 250 V, 105 V, 210 and 240 V, in the order mentioned. Of the a.c. consumers 70 per cent. were supplied at a periodicity of 50, 11·7 at 100, 6·1 at 40, 3·5 per cent. at 25 and 3·3 per cent. at 83 periods, about 6 per cent. being supplied at other periodicities. These figures are not complete, and, of course, cannot be but approximate calculations, as it is difficult to keep distinct and correct records of the domestic and other uses of electricity. Still, they show clearly the urgent need for the standardisation of supply systems and methods. As the reorganisation of the industry proceeds no doubt many of the freak pressures and periodicities will disappear, and things will become simpler for everyone, including statisticians like Mr. BEAUCHAMP, for which he will no doubt be thankful.

The Renewal of Fuses.

AN interesting point relating to the renewal of the main fuses on consumers' premises is discussed in a Report of the Highways Committee of the London County Council. Owing to accidents, these fuses, of course, require renewal

occasionally, and apparently some undertakers make a charge for the time and attendance of the workmen effecting the renewal. The Committee contend that, in virtue of Sec. 6 of the Electric Lighting Act, 1882, and of Nos. 24 and 26 of the Regulations governing the safety of the public, this charge is illegal, and consequently the County Council are recommended to make suitable representations on the matter to the Electricity Commissioners with the object of inducing the Commissioners to educate consumers on the point. We are disposed to agree with the Committee. At all events, the charges made in some cases are excessive, and a discussion of the matter can do no harm. It must, however, be pointed out that, though Safety Regulation No. 24 makes undertakers responsible for all their lines, apparatus and fittings on a consumer's premises being maintained in a safe and working condition, it does not directly state who is to bear the expense of repairs.

The Rates Bogey.

THE real reason for the opposition to the pledging of the rates for raising capital for electricity supply extensions is the fear that those responsible for the administration of joint authorities would embark on ill-considered schemes for the extension of plant and transmission lines, or upon laying distributing networks in areas at present without a supply of electricity, and so create a deficit which would have to be met out of the rates. While we sympathise with this view, we think that the fear is groundless, for on the whole it can be said municipal supply undertakings are run on business lines, and some recent decisions of the Electricity Commissioners, who are now the authority for sanctioning loans for electricity purposes, show that they are determined upon enforcing economical working. In fact, they are suggesting to local authorities that they should withdraw concessions hitherto enjoyed by consumers.

Restrictions upon Services.

FOR instance, it has hitherto been the practice of Winchester Corporation Electricity Department, when connecting a new consumer, to allow 100ft. of free service cable, reckoning from the middle of the footway adjoining the consumer's premises. This is longer than that allowed by sec. 27 of the Electric Lighting (Clauses) Act, 1899, which lays down that an owner or occupier within 50yds. from a distributing main can demand a supply, but the cost of laying an electric line for a greater distance than 60ft. from the distributor may be thrown upon the consumer. In view, however, of the high average cost per service, the Commissioners have disapproved of the existing practice, and in reply to an application for sanction to borrow £2 000 for mains and £2 500 for services they suggest that the Council should use their powers and call upon the consumers to bear the whole cost of the service lines which are laid on the consumer's premises. We think this is an unwise step, for it will hinder the development of the department, though it may be necessary to impose restrictions for a time. Exceptional cases, where the demand is in the opinion of the electrical engineer likely to be sufficiently remunerative are to be submitted for the consideration of the Electricity Committee, but otherwise the Commissioners' ruling will be obeyed.

Standard Specifications for Electric Lamps.

A NEW edition of the Bureau of Standards Circular (No. 13), entitled "Standard Specifications for Large Incandescent Electric Lamps," has recently been issued.

The Bureau of Standards is to be congratulated on their activity in this matter—for it is stated that the circular has been revised eight times since it was introduced about fourteen years ago, and as the new edition covers carbon, vacuum metal filament and gasfilled metal filament lamps, it is exceptionally complete. Interest attaches chiefly to the standard schedules of commercial ratings for gasfilled lamps. These, like the vacuum lamps, are now assumed to have a life of 1 000 hours, and the 1 000 W gasfilled lamps are rated at 19.6 lumens (initial) per watt. Such lamps thus approach very close to the "half watt candle-power" standard. The specifications prescribe limits of tolerance in detail, and include mechanical and physical inspection tests. Doubtless the effort made in the United States to standardise voltages at 110, 115 and 120 V, and 220, 230 and 240 V respectively, has materially contributed to the improved and more uniform quality of lamps manufactured.

Electricity and Iron and Steel.

TO-DAY we are publishing our fourth Iron and Steel issue at what, we hope, is the end of a period of depression—a period which, though short, has been of unexampled severity. The history and causes of this slump in trade are general knowledge, and it is therefore unnecessary to dilate upon them, except to say that they contain many lessons for the future guidance of electrical men. We hope this guidance will not be neglected, especially as indications, upon which reliance may be placed, lead us to suppose that the worst is passed. Given a sane policy and well-conceived actions by all parties, it should be possible by this time next year to chronicle a much happier state of affairs in what is the second most important industry of the country.

Progress Stagnating.

Conditions in the iron and steel industry during the past year have obviously made any wide extension of the electric drive impossible. In fact, there has been almost complete stagnation, though, as various articles, which we publish on another page of this issue, indicate improvement is now noticeable in certain places. As regards the employment of electric furnaces, progress has been negative. No new furnaces have been installed during the year, and of those that are in working order a large number have been out of use for economic reasons.

In fact, the slump itself is due to economic reasons. The world wants iron and steel both in the raw and in the finished states. So much does it require them that there would be demand enough, if the prices were right, to keep our furnaces and mills working night and day. And this statement applies with special force to the classes of steel for which the electric furnace is the best method of production. Unfortunately, in this branch of the industry the price of fuel has operated with a doubly harmful effect by forcing up both the cost of raw material and of the electrical energy required for heating the furnaces. But we are glad to see that the cost of the latter is falling, though we fear the fall will have to be much greater than has yet been the case before the general restarting of the electric furnaces available will be possible.

Electric Furnaces and Power Factor.

From this point of view, it is unfortunate that the electric furnace is not a good load. Its power factor seldom averages 50 per cent., and may be much lower. This

in itself is likely to have a retarding effect on the return of the tariff for this class of load to pre-war standard at a time when it is becoming more and more common ground that those causing low power factors should be made to pay for the annoyances they produce. This power factor problem is, indeed, one of some importance both to those who run iron and steel works and those who supply them with electrical energy. Besides furnaces, a large amount of other plant, if driven by a.c. motors—a practice which is coming increasingly into favour—gives a low power factor, though this can, to some extent, be counteracted by using over-compounded synchronous motors for driving pumps and other more or less continuously running constant load plant.

The Justification of the Electric Drive.

The history of the introduction of the electric drive into iron and steel works is of a familiar character. After a strenuous fight against conservatism, vested interests and genuine disbelief in its capabilities, sometimes assisted by early failures, it has now, as Mr. ROTHERA says, justified its use on the scores of economy, efficiency, low upkeep, flexibility and reliability. But to bring about the further development of the electric drive in the iron and steel industry there are still certain problems to be solved. Some of these are economic. Should a mill be designed for large outputs of a particular section and be used for producing that section alone? Or should each mill be capable of dealing with a large range of sections? The first is the American and the second the British practice. It is obvious that upon the policy chosen must depend the design of the electrical equipment, and it is therefore really a matter which has to be decided by the iron and steel manufacturer, though the electrical engineer can help in obtaining the result by pointing out the advantages and disadvantages of each method in particular cases. In general, it may be said that American practice calls for larger-sized motors; but this is no drawback, as it is satisfactory to learn that motors of an output exceeding those so far called for can be built, large though these are.

The Accurate Measurement of Power.

It seems clear that economy of production depends to a large extent on the answer given to these questions. The electric drive, among other things, has made possible the accurate measurement of the power used in the various rolling processes. For electrical reasons, if for no others, it is axiomatic that the mill must be so employed that over a period of weeks the motor is operating at the highest possible efficiency, *i.e.*, it is not being run light unduly or shut down for lengthy periods.

A Variety of Electrical Applications.

These statements apply, though perhaps in a less degree, to the other electrical equipment which is now finding an increasing place in iron and steel works. It may be justly said that no industry offers such a variety of methods of using electricity as does the iron and steel industry. It comprises not only the huge and special equipment for operating the rolling mills themselves, but the employment of other large motors for cogging mills, hoists, cranes and chargers, smaller motors for a variety of uses, and last, but not least, magnets for handling the material, especially in the hot state. How far this last application is now in practical use, and how great are the economic advantages of its employment, is obvious from an article on the very ingenious system of magnets which has

been installed at Dorman, Long & Company's works at Redcar by the General Electric Company that appears on another page of this issue. These magnets, it will be seen, not only cut down the amount of labour which is required for handling a particular quantity of material—labour which is inefficient because it can only be employed at intervals—but increase the amount of material which can be handled in a given time. Very little seems to have been written on the technicalities of the design of this apparatus, and it would be interesting to have some information on the subject.

The D.C. v. A.C. Discussion Again.

It is apparent that the old discussion on the relative merits of direct and alternating current for industrial purposes may crop up in a new form in connection with the employment of electricity in iron and steel works. The argument may be briefly stated thus: The undoubted advantages of the d.c. motor for most purposes, especially where variable speed is required, is admitted. On the other hand, iron and steel works usually receive at least a portion of their energy from public supply mains on a high-tension multiphase system, and if the h.t. alternating current motor could be used it would be advantageous to do so owing to the saving on copper, transformers and converting plant. That is as far as the matter can be taken at present. As Mr. ROTHERA says, the spheres of the two classes of machinery are well defined, and the circumstances of the particular drive determine the type of machine to be adopted. So that there is room for all, unless someone invents a three-phase commutator motor with the characteristics of the d.c. motor.

The Economic Use of Waste Gas.

In any discussion on the applications of the electrical drive to the iron and steel industry one important point must not be overlooked. The process of manufacture in that industry generates gas in considerable quantities. This gas can be efficiently used in gas engines with certain precautions and rather less efficiently under boilers. It has been so used in gas engines on the Continent for a considerable time. The information given by Mr. DOMBRAIN in the article which appears on another page of this issue is sufficient guarantee of that. In this country it seems to have been unaccountably neglected. But the proper utilisation of waste gas is a matter which should receive attention in these days, and gas-engine manufacturers should strain every effort to construct engines in large units suitable for the purpose.

We hasten to add that we do not, of course, advocate these engines should drive plant direct. They should be used for driving generators, which, in their turn, could be successfully linked into the supply system in the way that has long been done with exhaust steam turbines on the North East Coast.

Three Things Necessary.

We have said that a reduction in the price of iron and steel would mean at once a great and, in future, an ever-increasing demand. To bring about that price reduction the iron and steel industry might well turn its attention to three things: The increasing use of the electric drive, not the least that it allows the cost of each process to be accurately ascertained, a consideration of the further use of the gas engine in conjunction with the electric drive and the public supply system, and the possibility of a further employment of the electric furnace in turning out high-grade products. All these are worth considering from every point of view.

The Future of the Electrically-Driven Rolling Mill.

By L. ROTHERA, B.Sc., Assoc.M.Inst.C.E., M.I.&S.Inst.

The title of this article has been suggested by the Editor, and its answer properly lies in the realms of prophecy, which is dangerous country at any time, and especially at a moment when trade conditions are such that the steel and metal industry, as a whole, is itself uncertain as to what the future may hold.

Claims Justified.

Taking the title to cover only the question as to whether the motor-driven mill has been sufficiently satisfactory in the past to ensure a continuance of this form of drive in the future, the answer is emphatically that such is the case, and no instance is known of a motor being replaced by any other form of drive. Past experience has shown that the claims made for the electric drive on the score of economy, efficiency, low upkeep, flexibility and reliability have been fully justified. If, on the other hand, the development of the drive in the future is to be considered as coming within the scope of the title, this raises considerations of which many lie outside the province of the electrical engineer and appertain to the requirements and problems of the steel and metal trades.

Comparison of Manufacturing Methods.

The chief of these from the rolling mill point of view is the question of output. American practice is to allocate orders for a few similar sections to a particular mill, with the result that they can keep the mill running for long periods without changing rolls and obtain very high outputs. British practice has generally been to deal with a large range of sections in what is called "merchant" mills, and with small orders and frequent roll changes the output has been considerably restricted.

In periods of good trade the American method has the advantage of cheaper output, but before it could be adopted in this country it would entail a considerable re-grouping and reorganisation of the steel and metal industries, so that certain classes of work would flow to pre-determined mills. On the other hand, in periods of bad trade it is impossible to keep a mill designed for large outputs in operation, with the result that what orders there are available are taken by mills working on the British lines, which so can continue to work. The issue of these alternatives is still in doubt, and the decision will largely affect the mill motor of the future. An example of the difference in power required for the two alternatives will make this plain.

The Difficulties of Prophecy.

In the case of a wire rod mill, of which the older form is of the "looping" type dealing with an output of, say, 3 to 4 tons per hour, motors with a total horse-power of less than 1 000 h.p. would be required, either one or two motors forming the drive. If a large output continuous wire rod mill is installed to deal with 9 to 10 tons per hour a power of 3 000 h.p. to 4 000 h.p. would be necessary, made up in two or possibly three units. Probably the looping mill would be utilised for dealing with a wider range of sections than the continuous mill, and, in addition to the difference in power, would require a greater speed range than in the case of the latter, which in turn may influence the type of motor installed. Again, in the case of a cogging mill of 36 in. to 40 in. diameter, American practice would provide a reversing motor with a peak horse-power of 24 000 h.p., and would expect outputs of billets or blooms of 180 tons per hour, or over. A similar mill in this country would probably be fitted with a motor having a peak power of from 12 000 h.p. to 15 000 h.p., and the output would range up to a maximum of 80 to 90 tons per hour. It is difficult, therefore, to forecast the future size of the motor for an electrically-driven mill, but

the electrical industry is prepared to supply a motor of any power which may be called for, and, in fact, is in a position to deal with powers considerably in excess of anything that up to the present the mills have been able to absorb.

Cost of Production and the Electric Drive.

In last year's Iron and Steel Number of THE ELECTRICIAN the general trend of English rolling mill practice was given under the heading of "Notes on Rolling Mill Drives," and nothing has transpired since that date to modify the views then put forward; but the trade conditions which at present exist are causing special attention to be paid to the cost of production, and this has a reaction on the motor drive.

In early steam engine practice, when actual data on the power taken to roll the various sections was scanty, the size of engine adopted was largely empirical, and numerous instances are to be met with in the country where the original engine has been found to be too small and extra cylinders have been added or a higher steam pressure adopted to give the required output. Since the introduction of the electric drive many years ago data with regard to the actual power required to roll has been accumulating rapidly, and it is now possible to instal a motor of the correct power for dealing with any particular class of work, and the margin which used to be allowed to meet eventualities can be cut down to a minimum.

Uneconomical Methods.

The cost of the drive is consequently reduced to a minimum, but it carries with it the necessity on the part of the mill manager of fixing definitely the limiting sizes of material which he proposes to roll. This limit existed in the older days, owing to failure of the particular steam engine to deal with more than a certain size of product; but there has been a distinct tendency to assume that a motor should be able to deal with any range of products which can be rolled by the mill to which it is coupled, and the size of motor adopted has accordingly been chosen to meet the heaviest possible condition, which may occur only at very rare intervals, with the result that, for the general run of material, the motor has been over-powered, and has thus worked at a lower efficiency and has been more costly than is really necessary.

It becomes increasingly the function of the motor manufacturer to point out to an intending customer features which affect the size of the motor drive, and to work in conjunction with him in such a way that detrimental factors are avoided. These features can be briefly stated as the output required, the size of section to be rolled, methods of rolling and number of passes taken, i.e., the draughting.*

Increase in the Efficiency of Generation.

That a successful future of the electrically-driven mill is assured follows, apart from its inherent advantages, from the great advance that has been made in the efficiency of power generation since the earlier installations. In 1906, when motor-driven rolling mills were in their infancy, the maximum size of generating unit constructed at 3 000 revs. was, approximately, 1 500 kW, and the steam consumption per kW hour was, roughly, 17 lbs. Seven years later, in 1913, the maximum size of unit had increased to 3 000 kW at 3 000 revs., and the steam consumption had been reduced to about 13.5 lbs. To-day the maximum size of unit at 3 000 revs. is 12 500 kW, and a steam consumption of 10.25 lbs. can be anticipated. The cost of generation, based

* The influence of these various features are discussed in a Paper by the author, which appears in the "English Electric Journal" for October.

on the coal consumption, has consequently been reduced to about 60 per cent. of what it was in 1907.*

The concentration of power generation into central stations, with units of 30 000 to 50 000 kW running at slower speeds than 3 000 revs. per min., but with equal steam consumptions gives, in addition to the above reduction on coal consumption, a very considerable saving on the capital cost per kW generated, and makes it possible to sell power at a price which, except in a few special instances, renders the maintenance of small, inefficient steam-engine drives for individual mills unthinkable.

The Influence of Power Factor.

The question of power generation brings forward another point in connection with the electrical drive which will require increasing attention in the future, and that is the power factor of the load. Until recently not much stress has been laid by the power companies on this feature, but with increased length of transmission lines and heavy loading up of cables every effort has to be made to reduce the wattless component of the current, and in most instances to-day when a contract is entered into, a stringent clause is added with regard to the average overall power factor of the plant. Owing to the nature of a rolling mill load, the average power demand, in most cases, lies very considerably below the normal horse-power of the motor, as this latter is generally determined by the momentary overload required rather than from the heating values of the load. In the case of an induction motor drive the resulting power factor is necessarily low, and unless some definite means of improvement are employed an average in excess of 0.7 is not likely to be obtained. This is considerably lower than meets the views of the power companies, with the result that special apparatus is being increasingly installed to bring this value to the neighbourhood of 0.9, and there is little doubt that some provision of this nature will be obligatory in the future.

One of the simplest methods is the supply of a synchronous machine, either running idly or driving a generator for power purposes, by which a leading current can be taken. Alternatively, a drive on the "Kramer" or "Scherbius" system allows of power factor correction, in addition to speed regulation, whilst condensers and oscillating phase advancers are coming increasingly into favour.

There has been some tendency on the part of the power companies to call for a load of high-power factor without offering any advantage on the price of power purchased; but, taking into consideration the fact that the capital cost of the drive is increased by the necessary special apparatus, there should justly be some allowance on the cost charged for power, in view of the advantages which accrue to the power station.

The Chance for the Gas Engine.

One of the most interesting decisions of the future will be the use made of the available gas from blast furnaces and coke ovens in a large steel works. This will affect the form of power generation rather than the type of the rolling mill drive, but it can perhaps be touched on, as any factor which affects the cost of generation also affects the rate at which the electric drive is adopted. There has been a very considerable prejudice in this country against the use of gas engines for power generation, partly owing to their high capital cost, partly to the heavy upkeep charges and partly to the somewhat low maximum horse-power for which the gas engines have, up to the present, been constructed. Excluding any consideration of a gas turbine (to the development of which we are all looking forward), the necessity for full utilisation of available power would seem to render imperative the increasing use of gas engines. As is well known, at least twice the power is available from the gas when burnt in gas engines to that available in steam turbines when the gas is burnt under boilers, and

this, taken in conjunction with the development of the cheaper high-speed vertical gas engine and the better processes for gas cleaning (dirty gas being one of the most fruitful causes of wear and tear), will tend to remove the objections hitherto raised. It is only by making full use of gas available in gas engines that sufficient power can be generated to make a steel works self-supporting when converting its full make of iron into steel and rolling it to sections. That the disinclination to adopt gas engines is largely prejudice is shown by the examples on the Continent. During a recent visit to Alsatian steel works gas-engine power stations of 90 000 h.p. and 50 000 h.p. total were seen, which have been in satisfactory operation for many years. The maximum size of generator was about 4 000 kW, and the engines of the slow speed horizontal type.

Auxiliary Plant.

Whilst digressing somewhat from the strict letter of the title, the subject of auxiliary plant may be mentioned. Labour-saving devices are coming more and more to the fore, and many operations in a steel works previously carried out by hand labour are now being done by machinery. A recent interesting example of this nature is the handling of plates for shearing purposes, and a machine has been installed which, by means of one operator, will do the work previously requiring from twelve to fourteen men. Progress will undoubtedly be made along these lines, and many of the arduous tasks at present done by man-power will be undertaken by machinery.

There is no need in the present article to raise once again the relative advantages of direct-current motors as against three-phase motors for mill work. At the moment the spheres of the two classes of machinery are well defined, and the circumstances of any particular drive determine the type of machine to be adopted. Whether a high-voltage d.c. motor, such as is now being satisfactorily made for traction work, will ultimately displace the three-phase motor, or whether a three-phase commutator motor will be developed with the characteristics of the d.c. motor and displace the latter, or whether the existing d.c. and three-phase motors will continue to be used for many years, is a question on which it is impossible to say anything definite, and indications are not sufficient to warrant any assumption. From the electrical engineers' point of view, it is sufficient to know that no new rival has appeared, and of the forms of drive now available the electric motor steadily and rapidly gains ground.

Ball Bearings for Roller Mill Equipment.

In spite of the sceptics it may be said that, providing proper selection is used, the application of ball and roller bearings to rolling mill plants presents no particular difficulties as regards capacity to withstand the load. It is in fact mainly a question of designing suitable housing so that adequate protection is provided against dust and moisture. In some cases protection against temperature is also required, especially as the capacity of a ball bearing diminishes as the temperature increases.

An interesting example of the sound investment obtained by using ball bearings in iron and steelworks is given by both the power driven and idler rollers. For these purposes roller bearings are somewhat better than ball bearings, as they provide the maximum radial and thrust capacity in the smallest space, thereby enabling the shaft to be mounted in the very simplest manner with one bearing at each end. In addition economies resulting from a reduction in lubrication and maintenance costs are also possible, together with the very small amount of wear that occurs, all advantages which are obtained by using this class of mounting.

The same arguments apply equally to the application of ball bearings to hot saws, and to trunnion bearings in which latter application ball bearings have, we understand, given every satisfaction at temperature up to 300°F.

In addition it is hardly necessary to add that such mill equipment as motors, cranes, and turntables are all machines on which ball bearings can be satisfactorily employed, and that the mill engineer who wishes to obtain a maximum efficiency throughout his equipment cannot do better than to consider this aspect of the subject when slackness in trade makes plant overhaul both possible and advantageous.

* This is speaking relatively: actually, of course, owing to increased prices, the cost of generation is higher to-day.

The Coal Strike and the Development of the Use of Electricity in the Iron and Steel Industry.

By A. DAVIDSON.

There can be no doubt as to the war having been responsible for an enormously increased demand for electrical equipment for many purposes, amongst which the iron and steel making industry is by no means the least. Extensive additions to old and the installation of a great many new plants were undertaken, the primary object being to meet the abnormal demand for special materials created by the war. In those days maximum output was the watchword—cost of production being a secondary consideration. To-day we are faced with a reversal of these conditions, that is to say, cost of production has become of primary importance.

During the war period I fear many extravagant habits were contracted, which we have since found very difficult to discard, but discarded they must be, and every possible avenue of economy must be explored if we are to be able to compete in the markets of the world.

The Necessity of Electrical Applications.

Perhaps at no other period of our history, when just after the great coal strike, disastrous alike to capital and labour, and still confronted as we are with labour unrest on every hand, was it so essential for manufacturers to see that every possible advantage is taken of improved electrical and mechanical methods and appliances for the elimination of inefficiencies, whether in plant or labour.

There are still many sources of power lying dormant in the shape of so-called "waste," whether it be in blast furnace gas, exhaust steam, or surplus live steam—whilst much of the electrical energy necessary for the running of iron and steel works is being obtained from live coal, or bought at extravagant prices from some outside source. Imagine an average steel works requirements of, say, 20 000 000 kWh per annum, and it will not be hard to conceive what enormous economies might be made by the utilisation of energy which is at present being wasted. Or again, take the case of live roller gear and similar auxiliaries in rolling mills being driven by small steam engines, using at least 50 lb. of steam per 1 h.p.—can a greater extravagance be imagined?—and yet there are some works (fortunately not many) where such conditions exist to-day!

Coal Costs and Generation.

In some works generating stations, where nothing in the shape of so-called "waste" heat is available and live coal has to be used for steam raising purposes, it is staggering to compare the coal cost per unit to-day with the costs, say, ten years ago, and as the great proportion of the total cost per unit of such stations is the cost for coal, it must be apparent to all how very necessary it is that every economy is made use of, and it is surprising what improvements in this line can sometimes be effected. Long lines of steam piping almost devoid of lagging, condensers allowed to get too dirty, with consequent loss of vacuum, faulty steam traps, &c.—all tend to increase the coal consumption, and with coal at to-day's prices seriously to increase the cost per unit generated.

Saving Transformers.

When alternating current is employed at the works, this is generally generated, or supplied, at 3 000 to 6 000 V, and for many of the drives, such as condenser auxiliaries, air compressors, hydraulic and other pumps, &c., employing motors of, say, 70 h.p. and upwards, it is good practice to have such motors wound for taking the high voltage supply direct, and thus save on transformers and heavy copper lines. Speaking from practical experience the writer can assure his readers that the upkeep of such motors is practically no more than in cases where lower pressures are used. Of course, in using high pressure motors the housing conditions must be given more careful attention.

Lifting and Transporting Magnets.

Too much stress cannot be laid on the necessity of utilising magnets to the fullest degree. Magnets are

enormous money savers, whether it be for handling pig iron, scrap, plates, &c., for filling melting shop charging boxes, or for duty at the scrap breaking plant. The economy gained over any other method of handling is most marked.

Control of Reversing Motors.

The control of steel mill reversing motors has been the subject of much investigation during the past few years. For mill auxiliaries—generally operated by boys, hand control is now out of the question, not only owing to the waste of power, but more particularly owing to the enormous wear and tear to both the electrical and mechanical apparatus. The damage to pinions and shafts alone makes the use of these hand gears, when under the control of irresponsible boys, absolutely prohibitive. The current limiting contactor type of control for both a.c. and d.c. types has proved very satisfactory, while for a.c. work eddy-current controls will be found, for many purposes, to give excellent service. Where the contactor type is employed it will be found good practice to have the apparatus in groups wherever possible, housed in special buildings, where protection, as far as possible, can be obtained against dampness, metallic dust, &c. If the eddy-current type of control is used, then the best practice is to instal the equipment as near the motor as possible, in which case only short leads to bridge over between the motor slip ring and starter are necessary.

Cranes, chargers, &c., do not as a rule allow for sufficient space for the introduction of contactor gears for all motions. Continual vibration and shocks are also very harmful to such gears. It can, however, be often arranged to have contactors for the higher powered motors, say, main hoist and long travel motions on heavy duty overhead cranes. The writer has recently been interested in applying some contactor gears to every-day quick type of steel stock bay cranes—particularly on the long travel gears. The contactors in question replaced high-class hand controls, and the improvement is extremely marked, for not only is the acceleration decidedly improved, and wear and tear reduced to a minimum, but the danger of running into adjacent cranes is considerably reduced. Eddy current controls are not suitable for this class of work owing to the difficulty of speed regulation.

Power Factor Improvement.

Many large works are almost entirely equipped with alternating current machinery, and in some cases where the electrical load is made up to a great extent of intermittent reversing slip ring motors, the power factor becomes a serious question; a power factor as low as 0.6 being found at some such works, and it is often surprising what economies could be obtained at no great initial outlay by the introduction of some form of power factor improvement. This may be obtained by the use of static condensers, preferably fixed at outlying points. These not only relieve the generators, but also the step-down transformers, cables, switchgear, &c., or one or two large synchronous motors might be used for driving pumps, fans, &c., with excellent results. Rotary condensers fixed in the power station also give good results, but in this case only the generators are relieved. I venture to suggest that in many instances the capital expenditure necessary to increase the power factor, say, 15 to 20 per cent. will be repaid, owing to the extra efficiency obtained, in the first 12 months of working.

Motors and Auxiliary Drives.

It has been found wasteful to drive rolling mill auxiliaries by the standard commercial type of motor, for, by so doing, not only is the repair account unduly high, but the loss of output, owing to repeated stoppages, is serious. Motors for these purposes must be of robust design, both mechanically and electrically. All motors should be arranged with split-end covers, bearings, &c., the frames

for both a.c. and d.c. motors being also split for all sizes of, say, 30 h.p. and upwards. This splitting is of the utmost importance in obtaining economy, for the motors in many cases are buried away under the mill floor plates, or in other equally inaccessible positions, fixed on charging cranes and similar machines; and, in many cases, with only a bearing to change should the motor be of the unsplit type, riggers and fitters have to be employed to lift it, withdraw the coupling or pinion (which is never put on right again), and, after hours of labour and loss of output, the repair is carried out, whereas with split designs the electrical mechanic and his assistant might have done all that was necessary in half an hour.

Development of the A.C. Short-Circuited Motor.

Considerable progress has now been made towards the development of the special short-circuited type of a.c. motor suitable for operating live rolls, skids, &c. In this case not only are all the rotor starters eliminated, but the most simple and reliable of all motors is employed, and slip rings and commutators, two of the chief sources of trouble, are entirely eliminated.

For most continuous duties in a steelworks, such as those to be found in the machine and lathe shops, stockyards, fans, pumps, &c., it will generally be found that the standard commercial type of motor will fill all requirements. As the result of long experience, the writer cannot too strongly emphasise the absolute necessity of keeping down to a minimum the number and types of motors used, so as to reduce to a minimum the spares necessary. This necessity is equally apparent on the mechanical side with regard to standardised couplings, pinions, &c.

The Selection of Cables.

As cables for mill auxiliaries, chargers, cranes, &c., are often subject to great heat as well as to mechanical damage, special attention should be given to this part of the installation. After exhaustive trials the writer finds the best method is to employ single or multi-core V.I.R. wire-armoured cables for leads between the live rolls, motors and controllers; and for chargers, &c., where excessive heat as well as mechanical damage has to be guarded against, the best material to use is some form of steel braided flexible covering, the insulation being asbestos or some other heat-resisting material.

Large iron and steel works are nowadays a veritable network of cables and wires (underground and overhead), and considerable economies can be effected by ensuring that the correct section of copper and quality of cable is employed. In this connection it must be remembered that the user is not the buyer. Hence he is not always as careful as he might be in selecting the size and class of cable necessary for the works, and he forgets that what may be essential in the one case is extravagant in another.

As many steel mills are now entirely electrically driven, any failure of the electrical equipment means a serious loss. Not merely for the actual cost of the repair itself, but owing to the consequential damage caused by the stoppage of rolling operations. To reduce such stoppages to a minimum it is absolutely necessary that reasonable replacements and materials be on site, so that the repair may be expeditiously effected by the works electrical staff.

Signalling Systems.

A works electrical department has many special opportunities of affecting apparently small economies, which may in the aggregate amount to very substantial yearly savings. Take as an example the introduction of a simple telephone or system of electric disc signals as a substitute for the numerous boys who are employed as messengers between melting shops and rolling mills, heaters and rollers, stocktakers and shearers, &c. Such a change, which can be made at a trifling cost, would effect a considerable saving, and in addition provide an infinitely safer means of transmission of information.

Co-operation Essential.

It is obvious that the maximum maintenance economy can only be obtained where there is whole-hearted co-

operation between the electrical and mechanical sections of the organisation; that is where each realises his dependence upon the other. It is generally admitted that in the past a very arbitrary line of demarcation has been drawn between them. Most of us have experienced the actual stoppage, or delay of a repair, pending a settlement as to just how far one Trade Union or class of labour would go on a given piece of work. It ought to be realised that in such a case an employer's loss is not confined to the delay in effecting the repair of the particular piece of work in hand, but embraces the consequential loss of reduced output. It will then be seen how essential it is that all such difficulties are removed, if we are to get the best results from our plant. In selecting chargemen and foremen, those responsible should endeavour to secure men possessing tact as well as the necessary ability for their position, because in practice it will be found that many such little troubles as are outlined above can be avoided by a judicious handling of the men.

The Electrical Repair Shop.

During recent years a more generous appreciation has been shown of the needs for an up-to-date electrical repair shop. Whereas we used to find a corner of the fitting shop or an outbuilding allocated to the electrician, in modern plants we now see good shops, well lighted and ventilated, with their own electrical and tool stores adjoining, completely equipped with cranes and necessary tools, thus enabling all necessary repairs to be carried out, and such new parts prepared as in the old days had to be requisitioned from the general engineering shops, thus involving loss of time and often friction. Such shops, if well manned and staffed with capable foremen and storemen, can and do effect great economy, having in mind the value of the materials handled therein.

General.

It may be that in the past our works electrical engineers, unlike electrical contractors, paid by results, have been satisfied with the knowledge that they were keeping all wheels turning, the question of cost being more or less a closed book. This is no longer the case: electrical matters now play a very prominent part in the manufacturing costs of a modern steelworks, and with the shortened hours of labour, high wages, and cost of materials, it behoves the works electrical engineer to watch every point, and economise wherever possible. He should keep a careful record of all generating costs, monthly stores, &c. If his mills are electrically driven, he should note the consumption in units per ton rolled; in this latter case it is surprising what saving in units can sometimes be effected, more particularly in the case of reversing mills, if suitable arrangements are made between the mill foreman and the attendant in the converter house, so as to allow for switching out when the mill is likely to stand for a reasonable time. Some of these converter sets, employing fly-wheels up to 60 tons, waste an alarming amount of energy if allowed to run unduly under no load mill conditions.

Many of us have witnessed the wonderful extension of electrical appliances to the iron and steel industry during the past twenty-five years, but I think there can be no question that we must regard ourselves still as mere pioneers, because it is easily realised that there are virgin sources of supply of cheap power not hitherto touched, but which when harnessed are bound to result in enormous electrical development. It therefore behoves all who may be directly interested in this important branch of our industry to seize every possible opportunity of effecting economies on the plant at present in use, and thus help to justify its extension as the most economical form of power.

In such a short article on this most interesting subject it is barely possible to approach the fringe of the problem to which the writer would like to draw the attention of the interested individual, viz.: Economy, but if what has been written will in any way result in further economies being effected, this brief report will have achieved its purpose.

The Electric Furnace in Melting and Refining.

By JOHN B. C. KERSHAW, F.I.C.

The special Iron and Steel issue of *THE ELECTRICIAN*, which appeared on November 5, 1920, contained a valuable article by Mr. W. S. Gifford upon the "Position and Prospects of Electric Steel in Great Britain." Although no definite forecast of any rapid development of the industry in this country was made, the tone of that article was hopeful. The writer no doubt believed, with many others, that the year 1921 would witness some degree of recovery from the bad effects which the total suspension of Government orders and the 1920 slump in trade had had upon the demand for the products of the electric furnace in the steel and special alloys industry; but the cumulative effects of the trade depression, which increased as the winter months passed by, and the disastrous coalminers' strike of last May and June were unforeseen at that date, and these together have caused 1921 to be the worst year ever known in the history of the English iron and steel industry.

Little Progress.

Blast furnaces and steel plants all over the country have been forced to stand idle, and, with little or no demand for

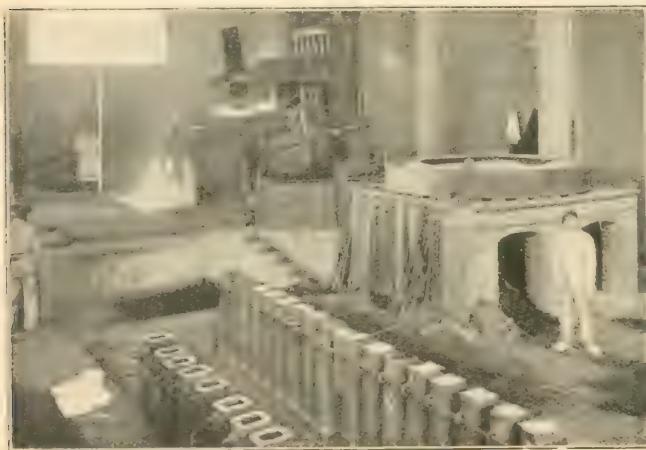


FIG. 1. VIEW OF THE LATEST TYPE OF HERCULET FURNACE.

the high-class ingot steels and alloys which had been made in the electric furnaces at Sheffield and elsewhere during the war period, the past year has witnessed little or no progress in this branch of the industry. It is only now, after twelve months of stagnation, that some signs of revival in the iron and steel industries are apparent.

This annual review article therefore cannot record any increase in the number of furnaces installed or in the tonnage of electric steel produced in this country, and the figures given by Mr. Gifford last year for the total numbers and tonnage capacity of the furnaces at the end of the war period, namely, 100 furnaces and 200 000 tons for their maximum output, can still be accepted as approximately correct for the electric steel industry of this country. It must be understood, however, that during 1921 most of these furnaces were out of commission owing to the lack of orders and to the high prices of fuel. Some recovery of trade has now set in in the Sheffield district, but it may be noted that the return to even moderate prosperity of this branch of the iron and steel industry depends chiefly upon two factors, namely, cheaper fuel and adequate supplies of cheap raw material.

The Influence of Cheap Fuel.

As regards the former, it is useful to recall the fact that in 1913 electric power was supplied to the firms engaged in the industry in Sheffield at a flat rate of 0.6d. per unit, or, alternatively, at £4 per annum per kVA of demand, plus 0.25d. per unit consumed. The latter tariff enabled a minimum price of 0.38d. per unit to be reached for demands based upon a 100 per cent. load-factor; but at 50 per cent. load-factor (a figure which can hardly be exceeded as an annual average in steel-furnace operation) current would cost 0.5d. per unit on the "demand" tariff. Unless the load-factor exceeded 30 per cent. or 35 per cent., the flat rate therefore was the more economical, and was, of course, generally adopted.

Owing to the various increases in wages granted to the miners during the war, and to the very marked falling-off in the output of coal per man which followed its close in 1918, the flat rate of 0.6d. per unit had been raised to 0.6d. plus 125 per cent. by the middle of 1920; and, according to one of the leading Sheffield steel-makers, "this high cost of electric power had put the use of the electric furnace entirely out of court, except for very special steels."

Tariffs and Prices.

The South Yorkshire coal proprietors, however, in August last, reduced their price for small coal and slack to 7s. 6d. and 10s. per ton in order to try and get rid of the immense stocks which had accumulated during the trade stagnation of this current year, and the writer is informed that the Sheffield Electric Supply Department have now reduced their price for power from 0.6d. plus 125 per cent. to 0.6d. plus 75 per cent. This concession has been made in order to assist the starting up of some of the electric furnaces which are now idle, and, as it will effect a reduction of about £1 per ton in the cost of the steel production, it ought to accelerate the revival of the Sheffield electric steel industry.

In 1913, before the price of coal and electric power had been raised to such uneconomic levels, scrap-steel was being melted and refined at Sheffield in the "Electrometals" type of furnace at a

total cost of £3 per ton, this total being made up of the following items:

	Per ton of steel.
	s. d.
Electrodes	4 0
Lining, roof, fettling	6 0
Slag materials	2 6
Labour (assuming automatic electrode regulation)	6 0
Tool	1 0
Total—Materials and labour	19 6
Electrical energy, 825 kW hrs. at 6d.	£2 1 3
Total—Materials, labour and energy	£3 0 9

The Importance of Cheap Power.

The fact that the cost of electric power represented two-thirds of the total cost of refining, even at the pre-war rate of 0.6d. per unit, shows how very important it is for the future of the electric steel industry in this country that the present reduction in the cost of electric power to the steel-makers should be followed by others until the 1914 standard of 0.6d. per unit is once again approached.

As regards the power required for the melting and

refining of steel when employing cold-scrap as raw material, this varies from 550 to 825 kWh per ton of metal obtained in the ladle. The power consumption is practically the same for all the leading types of furnace, the variations being due to the amount of refining necessary after the charge is melted.

The following details of the actual work of a 3 ton Heroult furnace, producing metal for light and medium steel-castings in 1920, may be given here:

	No. of heats.	Steel poured.	Price per unit.	Units per ton of steel in ladle.
		T. c. q. lbs.	Pence.	
May	77	220 6 1 0	1.402	637
June	91	263 19 3 0	1.466	665
July	94	283 5 3 0	1.425	659
September	91	268 8 0 9	1.333	630

Modern Tendencies in Electric Furnace Design.

As regards the lines along which progress in design is occurring, the tendency in the United Kingdom is to

easy to regulate the E.M.F. and to obtain uniform heating of the charge when two or more electrodes are used. The Thury system of automatic regulation of the arc-gap is also very generally employed, both here and in America.

The types of furnace which have found most favour in this country are the Heroult and the "Electrometals," the latter being the English name for the furnace, which was developed by Grönwall, Linblad and Stalhane at the Electric Iron Smelting and Refining Works at Ludvika, in Sweden. At the date of the Armistice the writer had record of fifty Heroult and twenty-six Electrometals furnaces which had been installed in the United Kingdom, and the majority of these installations are believed to be still intact, though not many of the furnaces have been in operation during 1921.

Details of Recent Furnaces.

As regards development in design, the latest Heroult type of furnace is shown in Fig. 1, and from this it will be seen that no important changes in its construction have been introduced in recent years. This absence of

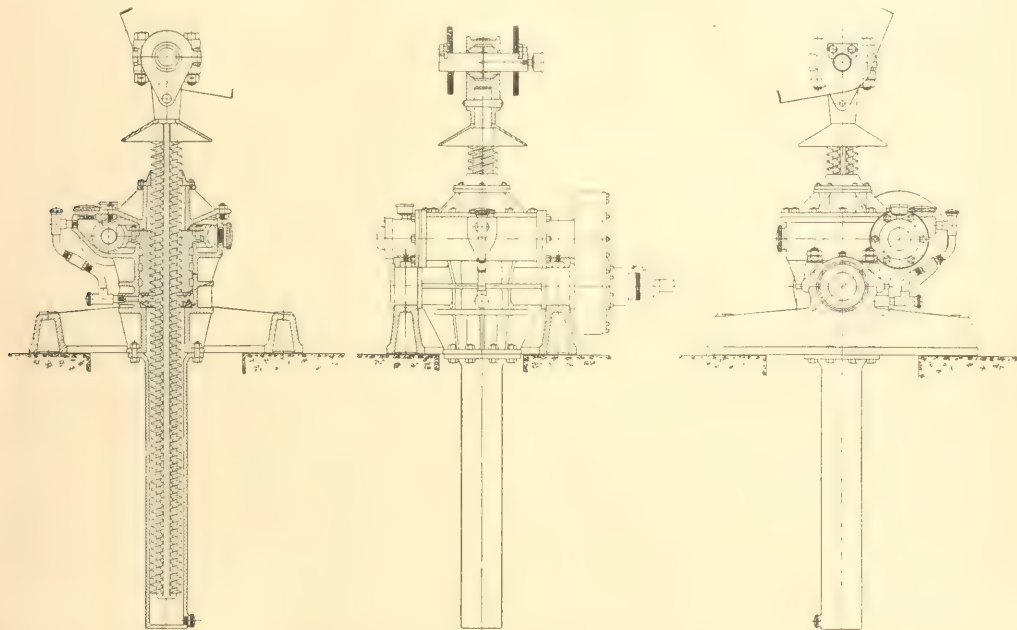


FIG. 2. TILTING GEAR FOR "ELECTROMETALS" FURNACES.

increase the power of the transformers rather than to follow the Germans and Americans by the erection of larger furnaces.

In this country the small furnace of 5 to 7 tons has been found the most useful and economical, since the usual application has been for the melting and refining of cold scrap. In Germany and France, on the other hand, the custom has been to use the electric furnace for the final refining of molten metal from the Bessemer converters or open-hearth furnaces, and, as these are usually constructed to hold 25 tons of steel per charge, the electric furnaces are necessarily constructed of the same size. In the United States, similarly, large furnaces have been designed and worked for refining steel by what is called there the "duplex" or "triplex" system, and here again the size of the electric furnace is determined by the size of the furnaces used for the Thomas and Bessemer processes, from which the liquid metal is obtained.

Turning to the question of current supply, two-phase and three-phase current is the most employed, since it is more

change no doubt proves that in its main constructive details the Heroult furnace cannot be improved.

With regard to the "Grönwall" type of furnace, the more recent changes in its design and method of operation have been directed towards simplifying the mechanical portions of the equipment and in rendering them as nearly as possible "fool-proof." For example, the tilting gear in the two smallest furnaces, namely, $\frac{1}{2}$ ton and 1 ton capacity, are worked by hand by means of bevel and worm gears operated by a large hand wheel. This actuates a pinion engaging with a gear segment underneath the furnace.

Tilting and Rocking Arrangements.

Commencing with the $1\frac{1}{2}$ ton furnaces, all the larger sizes have motor-driven tilting gears, situated behind and below the furnaces. The principle of their operation is shown in Fig. 2. An enclosed chain-drive transmits the power to the tilting gear, which is mounted on trunnions. The central sleeve is actuated through worm-gearing, this sleeve being out as an internal worm. By its rotation the

long duplex helical rack is moved outwards or inwards, according to the direction of rotation. This rack is connected to the furnace body by a special swivelling crosshead.

The larger furnaces are mounted on built-up steel rockers, which have notches to register with the foundation rails on which they rest. The point of contact between the rockers and the rails is almost directly under the centre of gravity of the whole furnace, so that a very small power indeed is required for tilting. This feature also insures a low pressure between the moving surfaces of the tilting gear, which, being totally enclosed and running in oil, is thoroughly protected.

Electrode Operating Gear.

The electrode operating gear has been similarly simplified, but the furnaces up to and including 2 tons capacity have hand-operated electrode gear. The weight of the electrode, with its contact clamp, copper leads and support-

no motion of the hand wheel. This hand wheel, however, can be used to accelerate or retard the movement imparted from the electrode to the motor, or to operate the electrode when the motor is stationary. The whole arrangement is free from any clutches, and the operating chains for the larger furnaces are enclosed in steel pipes.

The Electrode Economiser.

Another new feature of the Electrometals furnace is the electrode economiser, the construction of which is shown in Fig. 4. This is almost self-explanatory, but it may be stated that the cast-iron segments which form the economiser are so shaped that they tend to fall inwards, and thus to make a seal around the electrode, even when this is considerably tapered. A large number of these economisers have been fitted to various furnaces, and substantial improvements in electrode consumption are said to have resulted from their adoption.

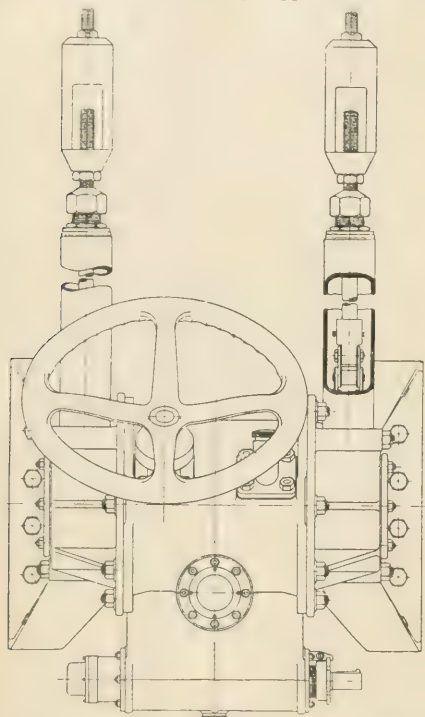
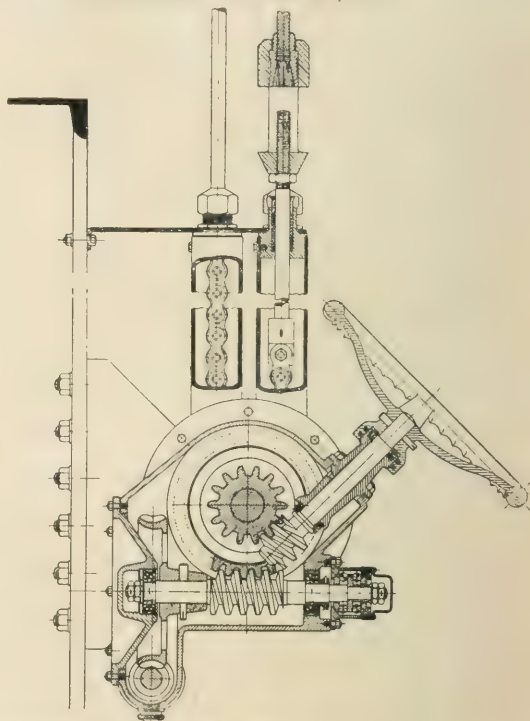


FIG. 3. ELECTRODE OPERATING GEAR FOR "ELECTROMETALS" FURNACES.



Overcoming Hearth Losses.

ing carriage, is counterbalanced by means of a weight, which travels in the opposite direction to the electrode and runs in guides between the masts at the back of the furnace. Ball-bearings are used throughout, and rope-suspension has taken the place of the vertical screw used in the earlier furnaces. A roller chain is introduced into the rope, and is driven by sprockets operated through worm-gearing from the hand wheels shown. This gives a positive drive, and the ammeters for indicating the current flowing are in a convenient position above the hand wheels.

In the larger furnaces the total weight of the moving parts is too great for hand operation, and a motor drive is necessary. These motors are operated by automatic control gear of the "Watford" type; the electrode-operating gear is shown in Fig. 3.

The general arrangement of counterbalancing the weight of the moving parts is the same as in the smaller furnaces, but the gear-box, with its auxiliary hand-control, is so arranged that when the driving motor is operating there is

In order to overcome some of the objections to the losses arising from the use of the hearth of the Grönwall type of furnace as a conductor, the construction of this has been improved in some important details, and Fig. 5 is a sectional elevation of the latest design. Below the dolomite lining, but insulated from the furnace body, there is a large, mild steel casting, which goes up behind the back wall and passes out through the furnace body at a point above the level of the liquid metal in the furnace. This form of hearth-current collector has been most successful, and no troubles with the bottom whatsoever have been experienced in the furnaces of this type. It is claimed for this form of construction that it is impossible for liquid metal percolating the basic lining to follow the path of the current and to escape from the furnace. The actual hearth of these furnaces is nearly elliptical in shape, the periphery of the upper surface being so arranged that the heat radiation from the two arcs is equal at all points.

Finally, it may be stated that Electro Metals, Ltd.,

have recently taken over the European patents of Mr. J. L. Dixon, which cover a number of arrangements for large 4 and 6 electrode furnaces, in which the amount of current passing through the hearth can be controlled and varied within fairly wide limits. It is intended to develop the design of these large furnaces, and when conditions become more normal it is expected there will be quite a big field for such furnaces in the refining of crude steel produced by the duplex and triplex processes.

New Developments Abroad.

As regards new developments abroad, the Soderberg electrode and the Russ electric arc furnace are worthy of notice.

The Soderberg electrode is a Norwegian invention, having for its aim the continuous moulding and baking of the electrodes while the furnace is in operation. For iron and steel furnaces the electrode mixture is stamped into sheet-iron moulds of the proper section and shape from a floor above the furnace, and as the electrode is gradually consumed fresh lengths of sheet-iron are riveted on above and more electrode material is added. For tilting furnaces the Soderberg electrodes are made up and added in sections. The advantages claimed are: (1) Absolute continuity of operation; (2) reduced electrode consumption; (3) reduced power losses; (4) greater regularity; (5) reduced costs.

The chief distinguishing feature of the Russ electric arc furnace—a German design—is the form of the electrode, which, instead of being a smooth carbon rod or cylinder of equal diameter above and below the furnace crown, terminates in a head that is much larger than the shaft which passes through the furnace roof. This head or terminal of the electrode, in fact, nearly covers the whole area of the furnace-bed. The effect of this enlargement is to prevent that creeping upwards of the electric arc which occurs with the more usual form of electrode, and also to retain the heat generated by the arc in the metal by checking the radiation towards the furnace crown. The life of the furnace roof is consequently greatly increased, with a considerable saving as regards renewals and maintenance costs.

The distance between the electrode head and the surface

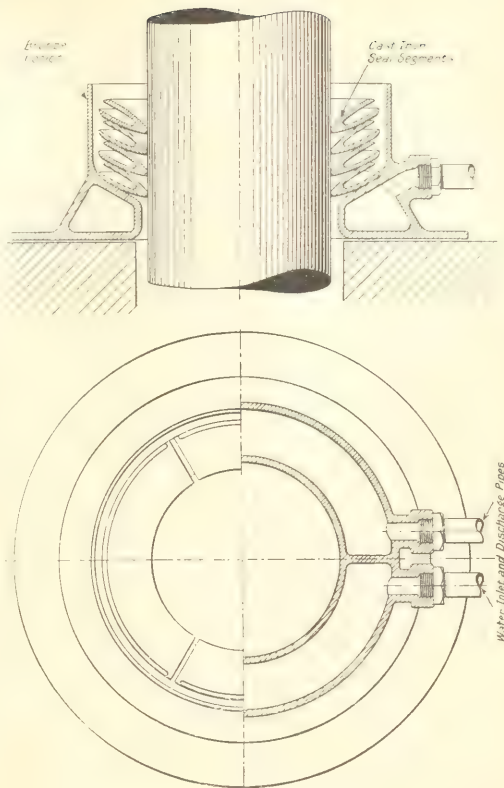


FIG. 4. ECONOMIZER FOR "ELECTROMETALS" FURNACES.

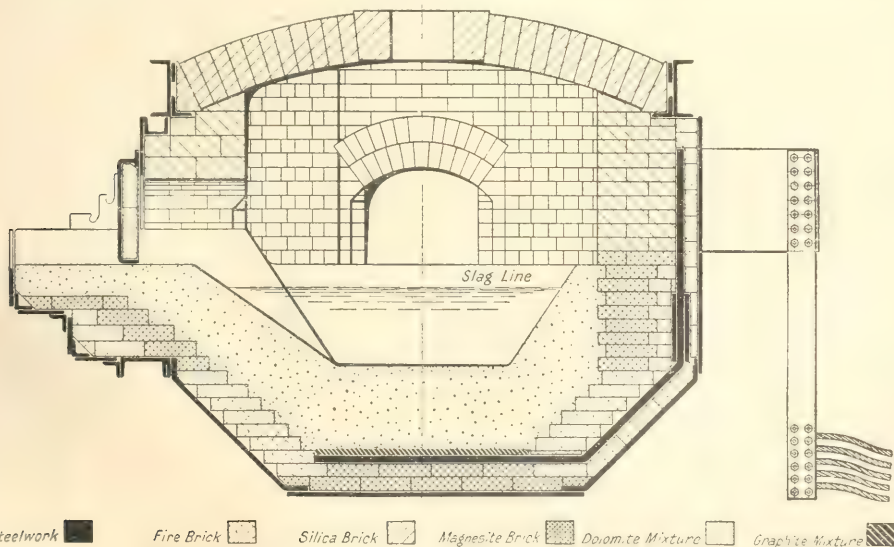


FIG. 5. SECTIONAL ELEVATION OF LATEST DESIGN OF GRANWALL FURNACE.

of the bath can also be made much smaller than in the usual type of arc furnace, and a more uniform and steady heat effect is therefore obtained. The opening in the furnace roof through which the electrode shaft passes can

be reduced in size, since the shaft is copper provided with a heat-resistant insulating covering, and the action of the hot furnace gases upon the material of the shaft at this point is consequently much diminished.

Progress in the Commercial Application of Electrolysis.

By W. E. HUGHES, B.A. (Cantab.).

It is desired in this article not only to note such developments as have during the last few years been made in the commercial applications of electrolytic processes in connection with the iron and steel industry, but also to comment, fairly and impartially, upon their practical and economic value. The latter purpose seems especially appropriate at the present time, for progress and development, in whatever field, are always accompanied by spurious growths, and it becomes necessary, sooner or later, to sort out the good from the bad and indifferent.

The Disadvantages of Substitutes.

Such a sifting is, indeed, very essential in connection with a development that has been made in the methods of treating articles preliminary to suspension in the plating tank for deposition of metal upon them. Such treatment is of first importance in order to secure a clean surface to deposit upon; the adhesion of the deposited metal depends upon it. It may be said, in general, that one of two methods must be employed—the one purely chemical, the other electro-chemical. The best substances to employ in these methods are, in the former case, brown potash dissolved in water (6 to 8 oz. per gallon), and in the latter case a mixture of caustic potash with potassium cyanide (3 oz. of potash and 1 of the cyanide to each gallon of water). During the war potash and potassium cyanide became scarce, and this necessitated the use of substitutes (or, rather, makeshifts) for the substances mentioned. The introduction of these was not new. They had been used before, but their number has increased, and the truth about them should be known—they will not, because they cannot, do the work potash and cyanide will do.

Development of Electro-Chemical Methods.

Another matter worth mention in connection with cleaning processes is that the electro-chemical method is becoming more extensively employed. This method is a good one where it is proper to use it. It is simple, cheap and effective. But it is not sufficiently recognised that its use is not always proper. The hydrogen gas liberated at the surface of the iron or steel articles (which form the cathodes) during the cleaning will, in certain cases, affect the physical properties of the metal to a very harmful extent.* The change in properties may proceed so far as to make the articles useless, as, for instance, in the cases of springs †, wire and the like. This is known to be due to the penetration of the iron or steel by the hydrogen gas, but the mechanism of the change is unknown.

Unsound and Harmful.

A third matter in connection with the cleaning process that must be noticed is the introduction of the so-called "coppering and cleaning" bath. It is intended hereby to clean the surfaces of the articles to be plated, and, at the same time, to deposit a layer of copper upon them. This combined process is to be roundly condemned. Scientifically, it is unsound; practically, it is harmful, and the fact that it forms the subject matter of several patents will not make it otherwise. It would be no more irrational to add fat and dirt to a plating bath and then try to deposit firmly adherent metal from it than is the use of a "coppering and cleaning" bath.

New Methods of Cleaning.

The foregoing remarks are not intended to condemn all new methods of cleaning. There is room for improvement here as in all the other processes connected with electro-plating. It is possible that a substitute for potash may be found, though this has not been done yet. A good

general rule to observe before adopting any proposed substitute is to obtain a chemical analysis of it, and in the light of this decide whether the substitute will effect, as well as potash will do, the chemical changes (largely, saponification) involved in the removal of the harmful substances from the surfaces to be deposited upon. Such an analysis will far outbalance its cost, whether the substitute be a good one and adopted, or a bad one and rejected.

Of all the metals commonly electro-deposited, only a few are of importance in connection with the iron and steel industry, namely, copper, iron, nickel (and cobalt) and zinc.

Electro-deposition of Copper.

The electro-deposition of copper for commercial purposes has increased considerably of recent years, but this extension has occurred in consequence of an increase in the number of applications of the process. Among these may be mentioned the manufacture of radiator tubes, lining aeroplane engines, the formation of water-jackets on cylinders, "building up" work (of which more will be said hereafter) and "reinforced work." This last application is one of interest and has possibilities. It is not new, but it has been considerably developed and extended lately. The uses to which such reinforced copper can be put have been classified by Mr. C. W. Denny in his handbook on copper deposition which was recently noticed in THE ELECTRICIAN. Mr. Denny's definition of "reinforced copper" is "copper reinforced with steel in the form of sheets and tubes"; it may be likened to reinforced concrete. This statement is of itself sufficient to indicate a host of actual and possible applications.

While applications of the deposition of copper have increased in number, there has been no development or progress in connection with the electrolyte used for the work. Nor is there any great likelihood of any. The acid copper bath (blue vitriol and sulphuric acid) is the most adaptable (universal) of all plating baths. The solution that may be looked upon as a standard one, namely, one consisting of 2 lbs. copper sulphate, 6 fluid ozs. of acid, and 1 gallon of water, can be varied in quantities of components to suit any desired end.

Uses of Electro-deposited Iron.

The electro-deposition of iron has of late been applied to quite a number of new commercial purposes. The most important of these are (a) the manufacture of iron of high purity and (b) "building up" work. There is no doubt that iron produced by the electrolysis of solutions of its salts holds its own, in matter of purity, with metal produced by any other means. This is so well recognised that most investigators of the properties of pure iron choose electrolytic iron as the material to work with. Iron produced electrolytically is now being more and more employed in metallurgical works practice also. J. Escard* has quite recently described the process of electrolytic production as carried out at Grenoble, France, and it is well known that large scale production is taking place in Germany at a number of works. Escard and also L. Guillet† enumerate a number of commercial uses of the process and product. Among them may be mentioned the manufacture of weldless tubes and the production of pure iron for use in the manufacture of parts of electrical machines. But perhaps the greatest extension of the commercial application of the electro-deposition of iron has occurred in connection with what is called the "building up" process. This, which consists in the repair of worn parts of machinery of all kinds by means of the deposition of iron upon them, has lately received considerable attention, and the general method has been often described in

* Cf. J. H. Andrew, Trans. Far. Soc., 1914, vol. 9, p. 316.

† Cf. P. Wüst and C. T. Fleckenstein, Trans. Am. Electrochem. Soc., 1918, vol. 33, p. 169.

* Le Génie Civil, 1919, vol. 75, pp. 165, 199 and 225.

† Jour. Iron and Steel Inst., 1914 (No. 2), p. 66.

technical publications. Attempts have been made (with some success) to form a complete union between the deposited iron and the metal deposited thereon, whereby both form together a complete whole. Such a unit can then be case-hardened or otherwise heat-treated, as necessary, and in this way a mechanically sound product can be produced.

Relative Advantages of Solutions Used.

The solutions in which the deposition of iron is accomplished have been the subjects of considerable research. It is still debatable whether sulphate or chloride solutions are preferable, but the view here taken is that for very many purposes the ferrous calcium chloride bath is the most suitable. This solution, which consists of ferrous chloride and calcium chloride (in the proportions of 6 lbs. of the former and 6½ lbs. of the latter, dissolved in a gallon of water) has most of the characteristics of the best type of plating bath. It is cheap and simple to make; it is easy to work and control, because, especially, the electrode reactions are fairly well known. The anode and cathode efficiencies are 100 per cent., approximately, and the deposit obtained is sound if proper working conditions are maintained and the bath is treated with ordinary care. The best deposition conditions are: *Current density*, 120 A per sq. ft., which gives a deposit of 5 to 6 thousandths of an inch thick per hour, though as much as 200 A per sq. ft. can be used, even without agitation of the electrolyte or cathodes; *temperature*, 110°C., though it may be anything between 90°C. and 110°C.; and for *anodes* good Swedish iron is the most suitable material to use. It is notable that the working limits of the solution are wide; this is always a good point in a plating solution, for the wider the working limits are the more nearly the bath is fool-proof. The physical properties and internal structures of deposits obtained from both chloride and sulphate baths have been thoroughly investigated scientifically during the last ten years. C. Duisberg*, J. Escard†, O. Bauer and W. Schneider‡, A. Müller§ and the writer|| (to mention only a few) have given accounts of their researches on the properties and structure of electrolytic iron in general, but especially of iron deposited from chloride baths. Very recently E. Gumlich¶ has published his extended researches on the influence of heating and melting in a vacuum on the magnetic properties of iron deposited from the double chloride bath, and he discusses, in the light of his results, the applicability of the iron to various electro-technical uses.

Improvements in Nickel Deposition.

The electro-deposition of nickel has received a deal of attention lately. One happy result is the gradual abandonment of the double sulphate bath, which O. P. Watts calls "that enemy of progress, which for so long has masqueraded as the plater's friend." It is now generally recognised that the only type of solution that is of any real use is one that is founded on the "single salt"—nickel sulphate (*cf.* THE ELECTRICIAN, May 13, 1921). A bath made of this (say, 2½ to 3 lbs. per gallon), together with common salt (½ to 1 oz.) and boracic acid (1 to 4 ozs.), will serve any purpose. The current densities employable are at least twice those that can be used with the "double salts" bath; 7 to 10 A per sq. ft. have been used in this country, and as much as 12 to 15 A per sq. ft. is being employed in everyday works practice in America. The result is either that a greatly increased output can be obtained without increasing the plant, or the floor space can be cut down if the output from the plant is already sufficient. And, in addition, there is the fact of the better—

smoother and softer—deposits obtained to be considered, which is of importance, especially for the reason that the labour costs of "finishing" can be reduced. A recent application of nickel deposition that should be mentioned is its employment in "building up" work. It seems to the writer, however, to be a very open question whether deposition of nickel for this purpose is really, broadly considered, an economical and efficient process. There is a good deal to be said on both sides. Nickel may be somewhat easier to deposit than iron, and it may wear as well, but nickel destroys the edges of cutting tools much more rapidly than iron, and the effects of heat-treatment (should any be necessary) on a nickel-plated iron or steel article is a matter of conjecture. Deposited iron will become one piece with the base metal, and the junction between the two disappear on heat-treatment; but it is very doubtful whether this would occur with nickel and iron, and, if it would not, then the engineer would always be faced with a product that might be mechanically unsound, for he would never be able to rely on the adhesion of the nickel deposit to its iron base.

Electro-Deposition of Zinc.

The notable advances that have been made recently in connection with the electro-deposition of zinc are those relating to methods of testing the deposited metal. Zinc is deposited on iron and steel for one purpose only, namely, to protect them from corrosion, and it is thus a matter of the greatest importance to be able to feel assurance that protection is secured. To judge from the fact that the ancient copper sulphate test is the one that is usually met with in practice, and which was during the war used in some Government workshops, it might be thought that this is the one and only method of testing zinc deposits that is of any use. The American Society for Testing Materials has shown* that, in fact, the Preece or Admiralty method is of very little use at all. Galvanised iron goods are meant to withstand that natural agent of corrosion—moist air; buyers of galvanised goods have no intention of employing them submerged in copper sulphate solution. The test is, then, illusory. It does not show whether the goods will rust or not; it only shows whether the zinc deposit under test is of approximately even thickness over the surface area of the article.

Burgess's Method.

But this can be shown much more certainly and accurately by C. F. Burgess's method. This consists in immersing the test article in a 3.2 per cent. solution of sulphuric acid in water. A cloud of hydrogen bubbles becomes evolved very soon after immersion, and the evolution from any part of the surface ceases as soon as the zinc is dissolved from that part. The gas evolution is so definite and pronounced that very small differences of thickness can be detected by its means—differences amounting to no more than a very small fraction of a thousandth of an inch, and which would be altogether masked in the copper sulphate test. Differences of thickness are certainly of some importance, but the matter of greatest concern is the porosity or non-porosity of the zinc layer. It is useless to deposit a thick layer of zinc on an iron article if that coat contains pores and cracks; a thick coat containing these is of far less value than a thin one that is free from them. A test for porosity is therefore of great value, and one has been devised (and should always be employed when testing a zinc deposit), namely, that introduced by W. H. Walker.† "If a piece of zinc be placed in a strong solution of caustic soda, heated to about 100°C., no action is noticeable. If now the zinc be touched with a piece of iron, hydrogen is evolved in great volume from the iron—that is, iron in contact with zinc in strong, hot, caustic soda is a seat of the formation of hydrogen. Hence, if a piece of galvanised iron, free from pin-holes and cracks, be so treated, no action is visible; if the iron be exposed, however, to even a minute degree, a

* Internat. Cong. App. Chem., 1912, vol. 28, p. 60 (v. also Zeit. f. Elektroch., 1909, vol. 15, p. 595).

† Stahl u. Eisen, 1921, vol. 41, p. 647.

§ Metallurgie, 1909, vol. 6, p. 149.

|| Jour. Iron and Steel Inst., 1920 (No. 1), p. 321; ib. 1921. (No. 1), p. 355; and Trans. Far. Soc., 1921.

¶ Stahl u. Eisen, 1921, vol. 41, p. 1 249.

* Proc. Am. Soc. Test. Mat., 1911, vol. II, p. 100, and ib., 1917, part I, p. 144.

† Proc. Am. Soc. Test. Mat., 1909, p. 430.

fine stream of hydrogen bubbles will be seen arising from the surface." That is the caustic soda test for porosity, and it is a good one, but it is true of it, as of the other two tests given above, that it does not test a deposit under natural conditions.

The Best Test of All.

This can only be done by exposure to the action of the natural agents of corrosion, and this is the best test of all. But time is necessary in such an one. Therefore, tests have been devised in which natural conditions are (approximately) simulated, and which, at the same time, produce results more quickly. Of these, the salt spray test is one of the best, and deserves to be better known than it appears to be. In outline it consists in this: The galvanised goods are subjected to the action of a very fine spray (or mist) of 20 per cent. common salt solution. For this purpose they are placed in a closed box, precautions being taken to prevent the spray jet playing directly upon them. The goods are removed from the box every twenty-four hours, carefully dried, and signs of rusting searched for. This test is claimed, with some justice, to be the best yet devised for testing zinc coatings in general, but especially such as will be exposed to marine conditions.*

The Causes of Porosity.

Porosity, which, as has been said, is a defect of prime importance, depends upon the deposition conditions that have obtained during the formation of the deposit. These condition the structure of the deposited zinc, which in turn is largely responsible for its porosity. It has lately been shown, by microscopic investigation† that the composition of the electrolyte used is of great moment, though observations of the surface features of zinc deposits have long ago directed attention to this fact. Recent work on the invention of solutions for electro-galvanising may, in a sense, be said to have been directed to securing non-porous deposits, though the reasons for the absence of porosity in deposits formed in the most successful baths appear to have been left to take care of themselves. As being among the most useful baths, the Meuser‡ and Trunkhahn§ solutions may be mentioned. The former consist of zinc sulphate, zinc, naphthalene, di-sulphonate and aluminium sulphate, in proportions which may vary through a wide range dependent on the current used and the purpose for which the deposit is desired. The Trunkhahn bath contains 25 kilo. zinc sulphate, 15 kilo. aluminium sulphate, 1 kilo. calcium carbonate, 4 kilo. maltose (or dextrin), $\frac{1}{2}$ kilo. brewer's yeast and 100 litres water. Both of these baths yield satisfactory deposits of very small grain-size when worked under suitable current conditions, namely, about 10 A per square foot.

A Final Suggestion.

It has always been a mystery why nickel-plated goods are not electro-galvanised before the imposition of the nickel coating. A nickel-plated article is not rendered "rust-proof" by the nickel. An examination of a bicycle that has been left out in the rain and allowed to dry will disclose this fact; the frequently occurring complaints of purchasers overseas that nickel-plated goods have arrived in a rusty condition also prove it. These things would not be if the following process were adopted: (1) *Deposition of zinc* for 10 to 15 minutes, succeeded by rinsing in water; (2) *deposition of copper* in the cyanide of copper for 2 to 5 minutes, succeeded by rinsing; and (3) *deposition of nickel* in a good bath founded on the "single salts"—nickel sulphate. This may seem a long and diffi-

cult process; as a fact, it is neither the one nor the other. It need occupy no more time than does nickel-plating as usually carried out in a first-class plating shop, since the time occupied in the nickel vat can be cut down by at least one-half, and the process is not nearly so difficult (or long) as silver-plating, with its "quicking," "striking," deposition in the "heavy" vat and, maybe, "brightening," with numerous scratch brushings in between. The fact is that we have here, in modern plating-shop practice, an instance of that old Russian adage—the bug-bear of Peter the Great: "Our fathers did it so; thou shalt not be wiser than they."

Electric Locomotives in Steel Works.

The installation of electricity in steelworks has effected great savings in cost and a large increase in output. From a study of locomotive costs it is equally certain that during the next few years there will be a large turnover from steam to electric drive for handling the traffic in and about the yards of large steel plants. A fair-sized steelworks will have from forty to sixty locomotives consuming coal and burning out the boiler tubes twenty-four hours a day while the actual operating time during which they are doing useful work is 60 per cent. or, say, fifteen hours. Repairs to a steam locomotive are a long and costly job, sometimes amounting



VIEW OF A MODERN ELECTRIC STEEL WORKS LOCOMOTIVE.

to two to three weeks, especially when retubing has to be done and a new firebox fitted.

On the other hand, the electric locomotive consists only of a motor driving through one spur reduction to the driving wheels. The armature, the only part that may go wrong, can be removed in less time than it takes even to cool down a steam locomotive to a temperature at which it can be handled. The control gear needs little attention and is convenient to repair or replace. The simplicity of the electric locomotive is in fact one of its greatest advantages, and, moreover, it costs nothing when standing idle.

There are three possible ways of supplying a steelworks electric locomotive with current. (1) Overhead conductors, (2) third rail, (3) batteries. The first will in most steelworks be ruled out on account of the cranes, which are ubiquitous. The third rail is regarded by a good many people with suspicion as being dangerous, but properly protected it is a safe and efficient way of collecting the current and one that can be installed over the complicated points and crossings met with in a steelworks.

The storage battery locomotive, now that we have such efficient batteries as the Edison and Exide, makes a good proposition, and in many cases will be found as cheap to instal as the third rail system where the hauls are short and the number of points large. The batteries are large enough for running through one shift and are arranged in steel boxes so that they can be lifted off and replaced with fully charged ones.

The locomotive is therefore not idle while charging up, and only a few extra batteries are required to keep the whole number of locos in operation. Each individual works must be studied and the system best suited adopted. In some cases a combination of battery and overhead or third rail will be most suited to the needs of the plant.

With the present high costs of coal and labour it is necessary to take advantage of every economy that can be effected, and the electric locomotive undoubtedly offers a big field for saving.

We are indebted to the Sanderson-Bibby Company for the illustration in this article.

* Bur. of Standards Circular, No. 80.

† By the writer in, as yet, unpublished work.

‡ Am. Pat., No. 905 837 (1908).

§ D. R. P., No. 210 552 (1905).

Notes on the Schneider Gas Engine.

By H. A. A. DOMBRAIN.

Continental practice in the manufacture of large gas engines is admittedly far ahead of British practice. Many years have been spent in pioneer work, and while British makers have undoubtedly improved greatly of recent years, and British gas engines are now made which can compare favourably with those of Continental makers, the experience accumulated abroad, where large gas engines have been in successful operation over long periods, constitutes a marked advantage over practice in this country. Belgium, French, and German manufacturers have from the outset been favourably disposed to the employment of large gas engines, and in an atmosphere devoid of prejudices, and even actively benevolent towards internal-combustion engines of large size, it can readily be understood that progress has been favourable and the development of the industry has been on a larger scale and more successful than elsewhere.

France was the original home of the gas engine, and practically all large iron works in France employ such engines for power development. One of the most popular made in France is the Schneider engine, of which it is thought that the following description can hardly fail to be of interest. Schneider & Co. design engines for a great variety of purposes and make a speciality of large engines for power purposes in iron and steel works. These engines will work on either blast furnace, coke-oven, producer or town gas. In the earlier stages the firm built single cylinder engines of comparatively low power, but the ever increasing needs of industry, calling for higher and higher powered engines, led them to concentrate their efforts on producing twin-cylinder engines.

Material Question.

Profiting by the previous experience gained in the building of these engines and in the use of the various gases which could be employed to drive them, Schneider & Co. bent their energies on gradually perfecting details, until they were able to produce first-class industrial machines strong and free from defects which would impair their steady working. These points were achieved by judicious design and by the employment of metals most appropriate to the work that was put on them. The cylinders, which were at first made of hard cast-iron and non-jacketed, are now cast from a metal specially suitable to the varying expansion and are fitted with a liner of hard metal to resist the wear. Likewise the pistons, originally made of cast-iron, are now of cast steel. Special attention is paid to the selection of suitable steel and to its scientific treatment.

According to the use to which it is to be put and to the power to be developed the Schneider engine is made in four types, viz., single cylinder, twin single cylinder, tandem, and twin tandem, the last enabling powers as high as 6 000 H.P. to be attained normally. They are all horizontal and four stroke.

Fixed Compression.

For plants not subject to great variation of load the engines are worked on a fixed compression basis. Such engines are generally installed for blast furnace work. On the other hand, where there is considerable and sharp variation of load the engines are run on a basis of variable admission and compression. The gases used must be well scrubbed so as not to contain tar, sulphur, or more than 0.02 to 0.03 grammes of dust per cubic meter. A dirty gas of course means frequent cleaning of cylinders and valve chambers, besides causing the danger of premature ignition; and failures in the past have been due to imperfect cleaning at least as often as to faulty design. The gas should be cool and dry and not exceed a temperature of 75°F. at the inlet, otherwise the efficiency is reduced. The heat consumption varies with the quality of the gas and ranges between 8 700 and 9 500 B.T.U. per H.P. per hour.

In Fig. 1 we give an illustration of the 3 000 H.P. blowing engine made for the Société Normande de Metallurgie. Fig. 2 is the same in course of assembling, and Fig. 3 is a view of its blowing cylinder in course of manufacture. The bed-plate, of ample base, is anchored for its whole length on the foundation to which it is secured by strong bolts. In front it is formed into a well to enable the waste oil from the crank pin and crank shaft to be recovered. It carries two bearings for the crank axle, these being fitted with cast iron liners run in with anti-friction metal. They are made in four pieces with arrangements to take up the wear. Cold water is circulated below the liners. The rear part of the bedplate carries the motion bars for the crosshead slipper. The cylinders, either cast in one piece with the jacket on, or, as in large bores, in symmetrical halves are of cast iron specially intended to withstand the relative expansion. They are fitted with wear-resisting cast-iron liners. They carry four branches, two on the top to receive the inlet valves and two below to receive the exhaust valves. This design is such as to reduce to a minimum the chances of a

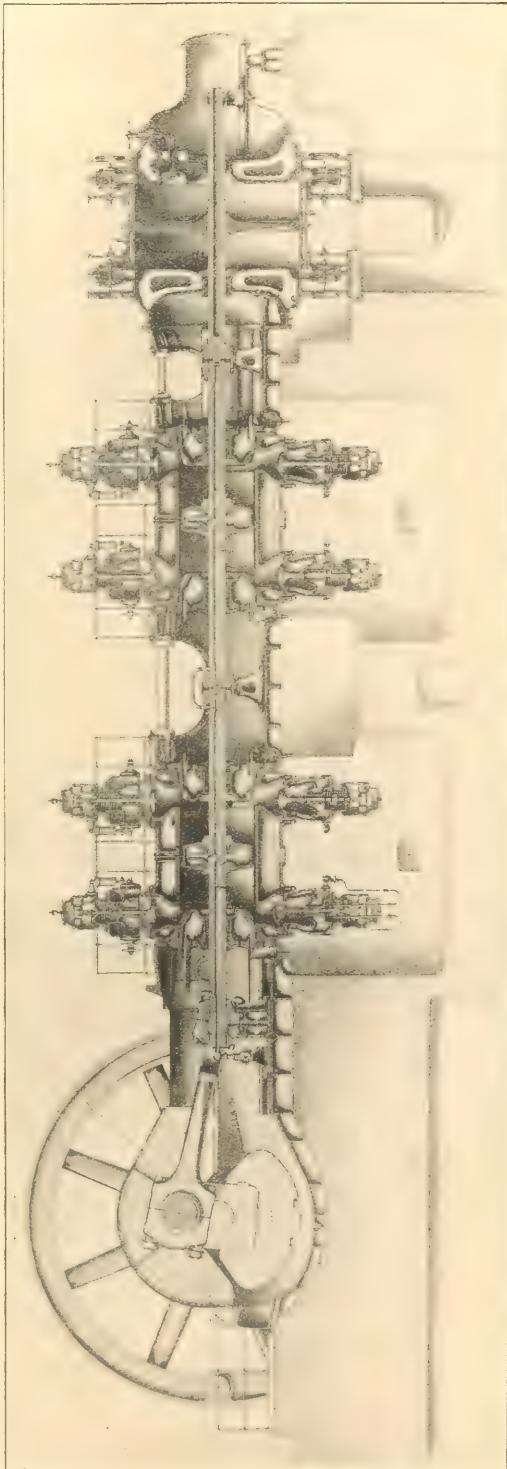


FIG. 1.—SECTIONAL VIEW OF 3 000 H.P. SCHNEIDER GAS ENGINE.

crack while working. For this reason also the jacket wall is placed as far as possible from the cylinder liner so that the free expansion of the latter is not impeded. The result is a spacious water chamber which can easily be cleaned by properly placed manholes; while the necessary points between the two walls are rendered sufficiently flexible. The cylinders are bolted to the bedplate, to the central

motion bar for the intermediate slipper. It is arranged so as to allow of easy dissembling and the removal of the cylinder covers, and rests on two longitudinal box girders grouted in to the brick-work. At the rear is placed the guide for the slipper supporting the outer end of the piston rod, which also serves as a support for the back cylinder and likewise rests on two box girders grouted

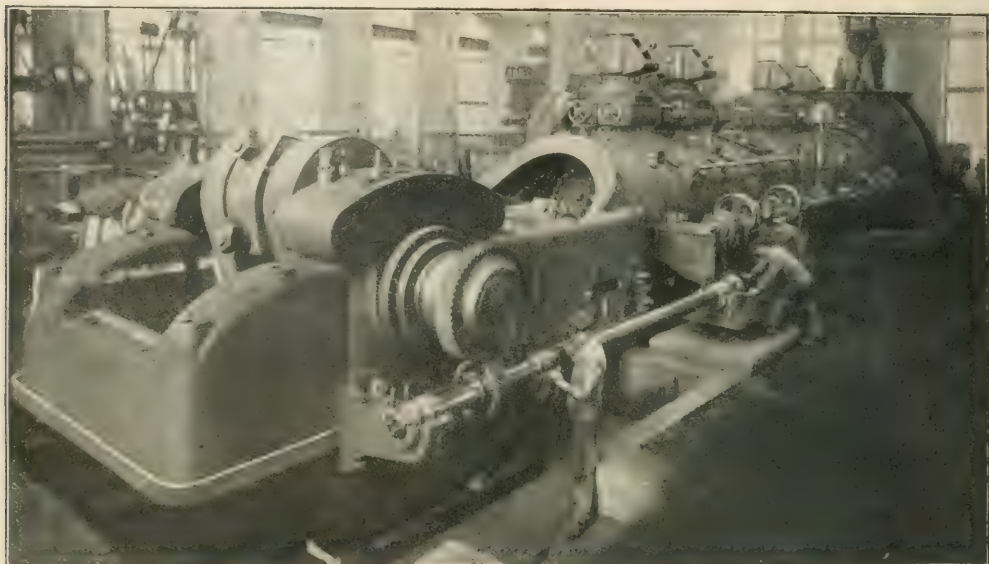


FIG. 2. SCHNEIDER 300 H.P. BLOWING ENGINE DRIVEN BY BLAST FURNACE GAS.

and to the rear distance pieces, and being concentrically housed into each are amply supported. They are interchangeable and the water-jacketed cylinder covers are similarly interchangeable.

Maintenance and Equilibrium.

The distance piece between the cylinders serves to support the

into the brick-work. It is of large dimensions, so as to allow of the removal of the cylinder cover and for dissembling the piston and piston rod. The cross-head slipper bars both in the distance piece and at the rear can slide freely on two box girders in such manner as not to interfere with the expansion of the whole. The cylinders and distance pieces constitute therefore an independent unit in

relation to the internal forces of transmission. The elastic deformations of the fixed parts of the engine have thus no effect on the moving parts, and as the equilibrium of the parts is vertically correct the vibrations produced by the engine are imperceptible. The pistons are of cast steel and are furnished with a certain number of rings of cast iron especially wear-resisting, which ensures even cooling. They are secured to hollow piston rods and carried on their slippers in such a manner that only the rings are in contact with the liners. The rods are secured to the forward cross-head and provided with a shoe of very large bearing surface run in with white metal. They are attached to each other by a special sleeve joint which allows of easy dissembling and accurate adjustment. Both shoes are run in with anti-friction metal. Water under pressure circulates both in the pistons and rods.

Connecting Rod and Crank-shaft Design.

The connecting rod, of forged steel, and having also steel bearings, run in with anti-friction metal, actuates a single-throw crank, likewise of forged steel, and generally built up with cheeks of forged steel forming balance weights, but is in some cases made of a solid forging with balance weights separately secured. The fly-wheel, of ample weight to secure even running, is generally in halves, held together by bolts and shrunk-on rings. In some cases it is made with forged steel arms. For engines

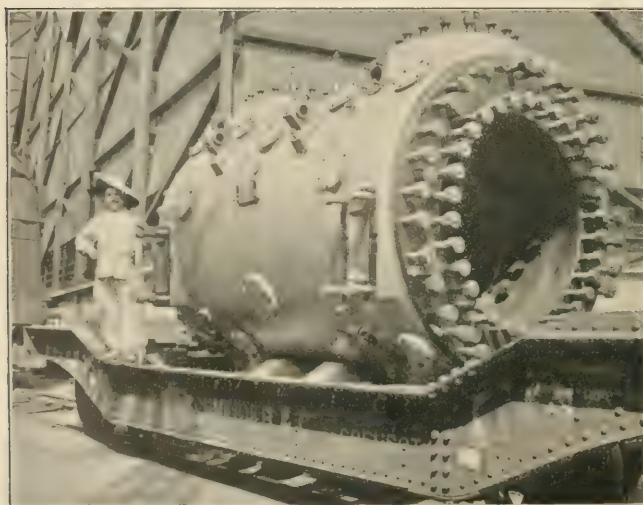


FIG. 3. CYLINDER FOR 3000 H.P. BLOWING ENGINE USING FURNACE GASES. MADE FOR LA SOC. NORMANDE DE METALLURGIE.

designed for electric-generator work the crank-shaft is keyed direct to the rotor of the alternator or to the armature of the dynamo. A hand or electric barring-engine, quickly engaged and disengaged, and working a rack on either the fly-wheel or the rotor allows the engine to be brought round to the best position for starting-up. Except in twin engines the crank-shaft is carried in an outer bearing bolted on to a cast-iron plate. This plummer-block has a cast-iron liner in halves run in with anti-friction metal. Cold water is circulated under this liner.

Valve Gear.

The inlet valves, two in number to each cylinder, are placed at the ends on the top. The exhaust valves, likewise two in number, are placed below directly opposite the inlet valves. According to circumstances the distribution is by either variable admission or by fixed compression. In the case of variable admission the latter and the compression are variable, the mixture remaining constant. The admission takes place through a valve opening inwards and by two cocks, one for air and one for gas, both being contained in the inlet chamber. These cocks are controlled by a dash-pot operated by the governor. At the commencement of aspiration they open the ports for the admission of air and gas at the same time as the inlet valve opens, and are held open until the volume of mixture required by the particular demands of the engine

aspiration stroke. At the end of the compression stroke the fresh mixture last admitted is found localised round the sparking-plugs and easily takes fire; even with poor gas the air more or less mixed remains close to the piston. In both cases the exhaust is effected by forged steel valves water-cooled and worked by positive motion.

The valves are placed in cast-iron valve chambers which are also water-cooled. The inlet valves are worked either in the usual way from a 2 to 1 cam-shaft, or by an intervening auxiliary shaft provided with back-gear. In the first method of distribution the air and gas are actuated by dash-pots worked by an independent eccentric. In the second method the gas cock is actuated by a rod coupled to a cam lever keyed on to the spindle of the lever actuating the mixture valve. These arrangements which characterise the Schneider system are very simple and exact. Means have been taken to avoid wear in the working parts, *e.g.*, the trips of the dash-pots are of a metal specially treated. Moreover, all the designs have been carried out with a view to quick dissembling and assembling. It needs only a few minutes to dissemble, clean, and re-assemble the gas cocks.

Governing, Ignition, and Lubrication.

The governor is of the Isochrone spring type with heavy weights and of great power, and is provided with a spring balance so as to

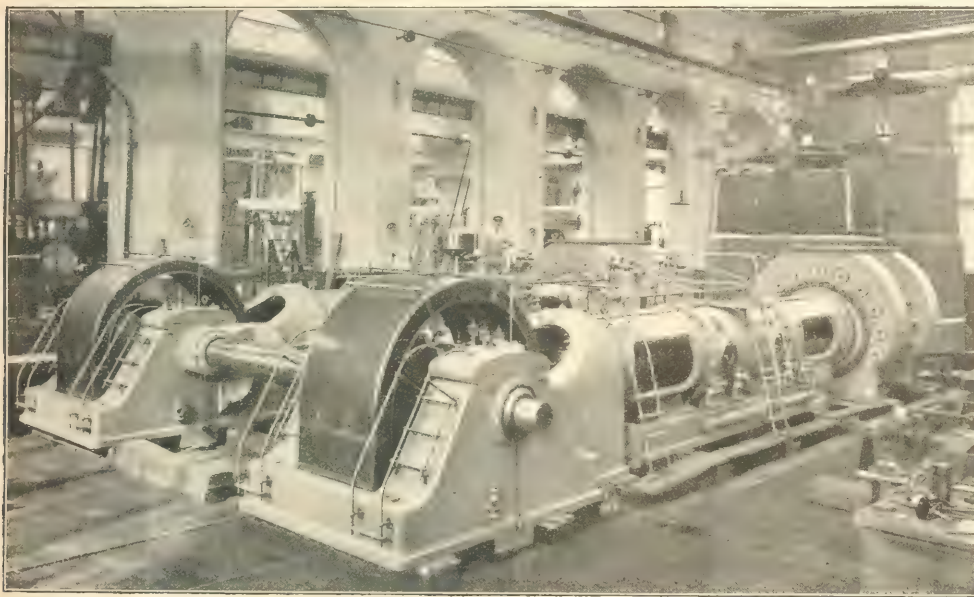


FIG. 1. 1200 H.P. GAS ENGINE IN THE LONGWY STEEL WORKS.

is drawn in, when the dash-pot acts. The cocks are instantly closed by a powerful spring furnished with buffers, and the ports being closed the inlet remains open up to the completion of the aspiration stroke. The cocks are also arranged for fixed compression so as to assure a mixture as nearly exact as possible. To effect this they are provided with a small hand mechanism which enables them to be moved longitudinally while working and by this means to vary the length of the ports uncovered. In the case of fixed compression the admission of gas only is variable.

The Mixing Valve.

The introduction of air and gas to the cylinder is effected by a valve, carrying a mixing cage keyed on to its spindle, and by a gas-distributing cock placed at the side of the cage. By giving a turn with the hand to this cage the apertures can be regulated and therefore the volume of both gas and air can be varied according to the heat units contained in the gas employed. The cock is controlled by a dash-pot actuated by the governor. At the commencement of aspiration only air is admitted, but at a point determined by the demands of the engine the cock sharply opens the gas port. The gas enters the cylinder and intimately mixes with the air already there which continues to be drawn in up to the end of the

allow of varying the speed when working. In the case of engines for electric generation by alternators the balance for variable distribution is worked by a small motor capable of being set in motion from the distributing board so as to allow of easy coupling-up of the units. The ignition is carried out by the use of Lodge plugs using a primary current of 8 to 10 V or by means of the usual make-and-break, using a current of 70 to 80 V. There are several plugs at each end of the cylinders. They are regulated by a special distributor mounted on the cam-shaft and controlled from the governor. The oiling of the plummer-blocks, connecting rods, bearings and cross-head slippers is effected by means of a geared pump worked from the cam-shaft. The waste oil runs into the well under the crank-shaft and thence to a filter box to be used again. The oiling of the piston, stuffing boxes and the exhaust valve spindle is carried out by a special pump of the firm's own design; a sight-feed lubricator is also actuated by the cam-shaft. The other parts are oiled either by rings screwed down or by sight-feed lubrication. The quantity of oil used is about 1.5 to 2 drams per H.P. per hour, the water in the cylinder jacket, covers, valve boxes, and exhaust valves requires a pressure of about 8 lb., which is supplied from a pump worked from the engine. Each overflow pipe has a cock at the end and empties into a sump in full view, consequently it is easy to regulate the temperature of the circulating

Table II.—BLOWING ENGINES.—GENERAL DETAILS.

ENGINE.					BLOWER.						
Class of Engine.	H.P. on blower piston.	Effective H.P.	Bore and Stroke, inches.	Revs. per min.	Gas.	Bore and Stroke, inches.	Class of clap valves.	Volume of air delv. per min.	Volume of fresh air.	Pressure of air discharged.	Gross Weight lbs.
Single-acting single cylinder.	240	255	37.4 × 40.15	90	Blast furnace gas, lowest heat units 36 B.T.U.	42.15 × 40.15	Hoerbiger.	15 748 cub. ft.	15 183 cub. ft.	26.5 lb. per sq. in.	24 770
Double-acting single cylinder.	530	560	39.3 × 40.15	85		73.65 × 40.15	Do.	18 779 cub. ft.	17 790 cub. ft.	51.5 lb. per sq. in.	44 460
Single-acting single cylinder.	330	360	40.5 × 40.95	80		74.8 × 40.98	Corliss.	22 245 cub. ft.	21 357 cub. ft.	44.1 lb. per sq. in.	41 617
Double-acting twin single cylinder.	860	915	36.4 × 40.15	72		64.5 × 40.15	Hoerbiger.	25 529 cub. ft.	21 503 cub. ft.	66.15 lb. per sq. in.	53 950
Double-acting tandem.	890	950	35.4 × 39.7	90		86.6 × 39.7	Southwark.	26 432 cub. ft.	25 750 cub. ft.	16.15 lb. per sq. in.	35 890
Do.	860	915	35.4 × 39.7	84		92.9 × 39.7	Hoerbiger.	27 945 cub. ft.	25 594 cub. ft.	58.8 lb. per sq. in.	23 780
Do.	1 120	1 190	36.6 × 40.15	92		92.9 × 40.15	Do.	33 438 cub. ft.	31 597 cub. ft.	66 lb. per sq. in.	23 780
Do.	1 260	1 340	39.3 × 40.15	90		98.4 × 40.15	Do.	36 772 cub. ft.	34 250 cub. ft.	66 lb. per sq. in.	44 460
Do.	1 150	1 220	39.7 × 40.55	84		100.7 × 40.5	Do.	38 841 cub. ft.	36 722 cub. ft.	55.8 lb. per sq. in.	44 460
Do.	2 220	2 360	40.5 × 40.95	83		114.7 × 40.9	Do.	53 029 cub. ft.	50 140 cub. ft.	88.2 lb. per sq. in.	99 100

water so that the overflow does not exceed 45 to 50 deg. (104° to 122°F.). The amount required naturally varies with the temperature of the supply, but is an average of 15 to 18 gals. per 1 h.p. per hour. The starting is effected by compressed air at a pressure of 170 to 220 lb. per square inch. This is usually taken from a small reservoir charged by an electrically-driven compressor.

Starting Arrangements.

Special distributors connected with this reservoir allow the air to be admitted at the proper moment. The first explosions are very rapid and the engine starts up quickly without need for interfering with the fixed compression. The consumption of air is small and several starts can be made by one charge of the reservoir, provided the pressure of the latter does not fall below 120 lb. per square inch. The compressed air is admitted to both sides of the piston, thereby obviating the necessity of barring the engine round. One man can start the largest engine.

In those cases where the gas engine as above described is used for blast furnace work the blower is mounted in tandem with the cylinders as shown in Fig. 1. It consists of a close-grained cast-iron cylinder at each end of which a large head is securely bolted on, and in which latter are contained the suction and delivery clacks. For high pressures the cylinder is water-jacketed. The clack valves usually employed are of the Hoerbiger type, but the firm also fit the Southwark. The covers of the heads are of sufficient size to allow of drawing the blowing pistons without dismantling anything else. The rear cover is divided into compartments, each of which is provided with a valve, communicating when necessary with the interior of the cylinder. The object of this arrangement is to vary the clearances and by that means to raise or lower the pressure and consequently the volume of air delivered.

Table I shows the general details of a Schneider engine for electric plant and Table 2 those for furnace work. A synopsis of one of the large plants carried out by the firm is also given.

From the above description and information it will be seen that the continental makers have been alive to the value of large internal combustion engines. The Schneider engine has been selected on account of their world-wide reputation and because it is not well known in this country.

The following is an extract from the report of trials made on two electric generator sets using blast-furnace gas. They were rated at 2 200 h.p. and were erected at the works of the Société des Acieries de Longwy.

Each set consisted of twin double-acting tandem engines working on the one crank-shaft and having the armature of a dynamo keyed direct to the latter.

Table I.—GENERAL DETAILS OF SCHNEIDER ENGINE.

Diameter of gas cylinders	9.9 m.
Piston stroke	1.100 m.
Revs. per min.	100
Normal H.P.	2 200
Guaranteed reserve power	10 per cent.
Average H.P. developed during the trial	2 225
Caloric value of the gas	3 820 B.T.U.
Consumption in calories per effective H.P. per hour (average of five tests)	9 036 B.T.U.
Maximum power developed	2 500 H.P.
Water consumed per eff. H.P. per hour	15.5 galls.
Oil consumed per eff. H.P. per hour	0.8 dram.

A sharp reduction of current from 3 300 to 1 800 amperes caused an increase of speed from 102.4 to 104 revs. per min. without any explosions, shocks, or premature ignitions. The increase of speed was therefore only 1.5 per cent.

Engineering Steels.*

Dr. Aitchison has written an interesting and useful book. It is addressed especially to engineers and users; but there is much in it that should be helpful to a wider circle of readers. The author's style of expression is almost conversational; he has wisely refused to adopt the dry-as-dust mode to which we are accustomed in scientific text-books. And this is a distinct gain; for the reader will find his attention held where otherwise he might be tempted to somnolence.

After an excellent Foreword by Prof. W. C. Unwin, the author begins with a not-too-long introduction to steel-melting processes and a chapter on the casting and working of steel. The reader then meets (in Chap. III.) a very interesting and lucid survey of the heat treatment of steel, including annealing and tempering. But perhaps Chapter IV., which deals with mechanical testing, is the one that will prove the most interesting and most useful to engineers in general. In treating this subject, Dr. Aitchison has rightly been careful to define what he means by such terms as "hardness" and "elastic limit." This course is very proper, and, indeed, very necessary. Too often we meet in text-books with descriptions of methods of measuring "hardness," only to find that the author does not himself appear quite clear as to what that property of matter is which he calls "hardness." Dr. Aitchison frankly says (p. 93) that: "For most purposes, the hardness may be regarded as the resistance which a material exerts against deformation," and therein gives a definition that an engineer will understand. So with "elastic limit." For his purpose the author adopts the definition of the British Engineering Standards Association, wherein "elastic limit" means the same thing as "Limit of Proportionality" of strain to stress. The remaining five chapters of the book are concerned with descriptions of various kinds of steel—plain carbon steel, case-hardened steels, cold-worked steels, alloy steels, and tool steels—with the use of which engineers have to become familiar. A number of appendices, dealing with, for the most part, methods of testing steels, complete the text, which is illustrated throughout by numerous photomicrographs and clearly-drawn figures.

* **ENGINEERING STEELS.** By Dr. L. Aitchison. (London: Macdonald & Evans.) Pp. xxxi. + 396. 25s. net.

Motor Equipment for Main Drive of Rolling Mills.

We give below particulars of electrically-driven rolling mills (in operation and in course of erection) in so far as such data has been supplied to us:—

Installed for	Description of mill.	Motor.		Supply.	Drive.	Installed by
		H.P.	Speed r.p.m.			
Steel, Peech & Tozer	Continuous billet	5000/9500	92	3 ph., 6300 v., 50 cye.	Gear	B.T.H.
Whitcomb Co.	Wire rod	2000/4700	490	3 ph., 2000 v., 50 cye.	Rope & gr	B.T.H.
Steel, Peech & Tozer	Slab	1200/3000	240	3 ph., 6300 v., 50 cye.	Gear	B.T.H.
Stewarts & Lloyds	Pilger	1000/3000	368	3 ph., 440 v., 25 cye.	Gear	B.T.H.
S. African Steel Union Corporation	3 high	750/1800	365	3 ph., 525 v., 50 cye.	Rope	B.T.H.
Govt. Rolling Mills, Southampton	24 in. & 20 in. sheet	750/1600	266	3 ph., 3300 v., 50 cye.	Rope & gr	B.T.H.
Elliott Metal Co.	Sheet	700/1450	120	3 ph., 440 v., 25 cye.	Rope & gr	B.T.H.
F. Smith & Co.	Roughing & finishing rod	650/1400*	365	3 ph., 3300 v., 50 cye.	Rope dret	B.T.H.
Andrews & Co.	9 in. rod (finishing)	650/1300	650	3 ph., 3300 v., 50 cye.	Direct	B.T.H.
Meltingriffith Co.	24 in. sheet (three mills)	550/1500	360	3 ph., 2200 v., 25 cye.	Gear	B.T.H.
Babcock & Wilcox	Tube piercing	550/1400	290	3 ph., 400 v., 25 cye.	Gear	B.T.H.
Birmingham Corrugated Iron Co.	28 in. sheet (two mills)	350/1400	730	3 ph., 440 v., 50 cye.	Gear	B.T.H.
Upper Forest & Worcester S. & T. Co.	24 in. sheet (four mills)	550/1300	210	3 ph., 3300 v., 50 cye.	Gear	B.T.H.
Upper Forest & Worcester S. & T. Co.	24 in. sheet (four mills)	550/1100	210	3 ph., 3300 v., 50 cye.	Gear	B.T.H.
Upper Forest & Worcester S. & T. Co.	24 in. sheet (four mills)	550/1100	210	3 ph., 3300 v., 50 cye.	Gear	B.T.H.
Govt. Rolling Mills, Southampton	20 in. & 18 in. sheet	500/1100	292	3 ph., 3300 v., 50 cye.	Rope & gr	B.T.H.
Weldless Steel Tube Co.	Tube piercing	500/1200	730	2 ph., 2700 v., 50 cye.	Gear	B.T.H.
Govt. Rolling Mills, Southampton	20 in. & 18 in. sheet	500/1000	292	3 ph., 3300 v., 50 cye.	Rope & gr	B.T.H.
F. Smith & Co.	Draw benches	400/1000	730	3 ph., 2200 v., 50 cye.	Gear	B.T.H.
Andrews & Co.	14 in. roughing	400/900	730	3 ph., 3300 v., 50 cye.	Gear	B.T.H.
Govt. Rolling Mills, Southampton	18 in. sheet	400/800	332	3 ph., 3300 v., 50 cye.	Rope & gr	B.T.H.
Govt. Rolling Mills, Southampton	16 in. & 15 in. sheet	400/800	332	3 ph., 3300 v., 50 cye.	Rope & gr	B.T.H.
Babcock & Wilcox	Tube rolling	375/800	104	3 ph., 400 v., 25 cye.	Gear	B.T.H.
Stewarts & Lloyds	20 in. sheet (3 stands)	350/900	360	3 ph., 400 v., 25 cye.	Rope & gr	B.T.H.
Munition Factory, Birmingham	30 in. & 24 in. sheet	300/1000	360	3 ph., 440 v., 25 cye.	Gear	B.T.H.
T. Bolton & Sons	Slabbing and sheet	300/750	360	3 ph., 400 v., 50 cye.	Gear	B.T.H.
Elliott Metal Co.	Sheet	300/690	380	3 ph., 440 v., 25 cye.	Gear	B.T.H.
Govt. Rolling Mills, Southampton	15 in. & 12 in. sheet	300/600	322	3 ph., 3300 v., 50 cye.	Rope & gr	B.T.H.
Govt. Rolling Mills, Southampton	Sheet	300/600	322	3 ph., 3300 v., 50 cye.	Rope & gr	B.T.H.
Andrews & Co.	14 in. intermediate	300/600	210	3 ph., 3300 v., 50 cye.	Direct	B.T.H.
Tubes, Limited	Tube rolling	300/600	290	3 ph., 5000 v., 25 cye.	Rope	B.T.H.
Tubes, Limited	Hydraulic piercing	260/800	485	3 ph., 440 v., 25 cye.	Gear	B.T.H.
Tubes, Limited	Tube piercing	250/720	730	3 ph., 440 v., 25 cye.	Gear	B.T.H.
Tubes, Limited	Tube piercing	250/720	730	3 ph., 440 v., 25 cye.	Gear	B.T.H.
Tubes, Limited	Tube piercing	250/720	730	3 ph., 440 v., 25 cye.	Gear	B.T.H.
Munition Factory, Birmingham	24 in. & 18 in. sheet	250/650	360	3 ph., 440 v., 25 cye.	Gear	B.T.H.
Babcock & Wilcox	Tube piercing	250/600	730	3 ph., 400 v., 25 cye.	Gear	B.T.H.
Munition Factory, Birmingham	Sheet	250/550	290	3 ph., 440 v., 25 cye.	Gear	B.T.H.
Muntz Metal Co.	Tube piercing	250/500	480	2 ph., 440 v., 50 cye.	Gear	B.T.H.
Muntz Metal Co.	Tube rolling	250/500	480	2 ph., 440 v., 50 cye.	Gear	B.T.H.
Aluminium Corporation	Sheet	250/500	415	3 ph., 440 v., 50 cye.	Rope	B.T.H.
Jones & Colver	Rod	200/500	485	2 ph., 200 v., 50 cye.	Belt	B.T.H.
Perfecta Tube Co.	Pilger	360	360	3 ph., 440 v., 25 cye.	Rope	B.T.H.
Babcock & Wilcox	Pilger	180/360	360	3 ph., 400 v., 25 cye.	Rope	B.T.H.
Dorman, Long & Co.	Continuous rod	150/325	360	3 ph., 440 v., 40 cye.	Gear	B.T.H.
Dorman, Long & Co.	Continuous rod	150/325	470	3 ph., 440 v., 40 cye.	Gear	B.T.H.
Dorman, Long & Co.	Continuous rod	150/325	780	3 ph., 440 v., 40 cye.	Gear	B.T.H.
Oldbury Rolling Mills	9 in. rhng. & 7 in. finshg.	150/300	360	3 ph., 400 v., 25 cye.	Rope & dir.	B.T.H.
Munition Factory, Birmingham	Sheet	125/250	490	3 ph., 440 v., 25 cye.	Gear	B.T.H.
Elliott Metal Co.	Sheet	100/200	490	3 ph., 440 v., 25 cye.	Gear	B.T.H.
Cammell, Laird & Co.	Sheet	100/200	360	3 ph., 440 v., 25 cye.	Gear	B.T.H.
Tupper & Co.	Rod	80/160	475	2 ph., 200 v., 50 cye.	Belt	B.T.H.
Govt. Rolling Mills, Southampton	12 in. finishing	50/100	480	3 ph., 440 v., 50 cye.	Gear	B.T.H.
Govt. Rolling Mills, Southampton	12 in. finishing	50/100	480	3 ph., 440 v., 50 cye.	Gear	B.T.H.
Govt. Rolling Mills, Southampton	8 in. finishing	40/80	715	3 ph., 440 v., 50 cye.	Gear	B.T.H.
Heeley Silver Mills	Cold rolls	30/60	725	2 ph., 200 v., 50 cye.	Gear	B.T.H.
Dorman, Long & Co.	28 in. cogging	1200/3600	90	3 ph., 400 v.	Direct	B.T.H.
Dorman, Long & Co.	Wire rod	1250/2500	120/180	460 v. d.c.	Gear & blt.	B.T.H.
Partington Steel & Iron Co.	20 in. 3 high roughing	1200/3000	55/90	500 v. d.c.	Direct	B.T.H.
Partington Steel & Iron Co.	18 in. 3 high intermediate	1200/3000	90/180	500 v. d.c.	Direct	B.T.H.
Partington Steel & Iron Co.	18 in. 3 high finishing	1200/3000	90/180	500 v. d.c.	Direct	B.T.H.
Blagenavon Co.	Sheet finishing	1000/2000	175/350	460 v. d.c.	Gear	B.T.H.
Locke, Lancaster & Co.	Sheet	440/880	660	460 v. d.c.	Gear	B.T.H.
Glenamock Iron & Steel Co.	12 in. guide	350/700	130/170	440 v. d.c.	Direct	B.T.H.
Metal Mfg. Co. London	Tube piercing	200/400	500	250 v. d.c.	Gear	B.T.H.
Metal Mfg. Co. London	Special	150/300	480	440 v. d.c.	Gear	B.T.H.
Gravesend Steel & Tinplate Co.	Cold rolls	75/200	200/300	220 v. d.c.	Gear	B.T.H.
Gravesend Steel & Tinplate Co.	Special	75/150	500	440 v. d.c.	Gear	B.T.H.
Neville Druce	Sheet	62/124	525/600	500 v. d.c.	Gear	B.T.H.
Neville Druce	Special	50/100	600	440 v. d.c.	Gear	B.T.H.
Dorman, Long & Co.	42 in. reversing plate	6000/20500	40/70	3 ph., 2750 v., 40 cye.*	Direct	B.T.H.
Steel, Peech & Tozer	36 in. reversing cogging	6000/15500	48/100	3 ph., 6300 v., 40 cye.*	Direct	B.T.H.
Dorman, Long & Co.	29 in. reversing plate	4000/12000	50/100	3 ph., 2750 v., 40 cye.*	Direct	B.T.H.
Dorman, Long & Co.	28 in. reversing cogging	1200/3600	70/90	3 ph., 2750 v., 40 cye.*	Direct	B.T.H.
John Brown & Co.	24 in. reversing cogging	600/1800	117/170	3 ph., 6600 v., 50 cye.*	Gear	B.T.H.
Patent Shaft & Axletree Co.	Special	250/500	90/180	3 ph., 5000 v., 50 cye.*	Direct	B.T.H.
Locke, Lancaster & Co.	21 in. sheet	125/300	200	460 v. d.c.	Gear	B.T.H.
F. Smith & Co.	Copper rod	950/1900	375	3 ph., 6500 v., 50 cye.	Rope	B.T.H.
Hadfield's, Sheffield	14 in. finishing	500/1000	75/150	230 v. d.c.	Direct	B.T.H.
Hadfield's, Sheffield	11 in. finishing	400/800	150/250	230 v. d.c.	Direct	B.T.H.
Hadfield's, Sheffield	28 in. reversing cogging	3200/11600	60/120	3 ph., 3000 v., 50 cye.*	Direct	B.T.H.
O. B. Jacobsen	Sheet	400/950	480	3 ph., 500 v., 50 cye.*	Gear	B.T.H.
O. B. Jacobsen	Sheet	350	415	3 ph., 500 v., 50 cye.	—	B.T.H.
United Steel Co.	Hoop (roughing)	1500/805	325/175	3 ph., 6300 v., 50 cye.†	—	B.T.H.

* With flywheel motor-generator sets.

† Induction motor drives for speed regulating sets.

Motor Equipment for Main Drive of Rolling Mills—continued.

Installed for	Description of mill.	Motor.		Supply.	Drive.	Installed by
		H.P.	Speed r.p.m.			
United Steel Co.	Hoop (intermediate)	100/50	500/300	230 v. d.c.	Gear	B.T.H.
United Steel Co.	Hoop (finishing)	2500/1670	240 160	3 ph., 6300 v., 50 cyc.†	Gear	B.T.H.
United Steel Co.	Merchant	3000	470/280	3 ph., 6300 v., 50 cyc.†	Gear	B.T.H.
Phillips, Gilbert & Co.	Piercing	200/400	500	250 v. d.c.	Gear	B.T.H.
Phillips, Gilbert & Co.	Piercing	200 400	500	250 v. d.c.	Gear	B.T.H.
Phillips, Gilbert & Co.	Piercing	400 800	489	3 ph., 400 400 v., 50 cyc.	Gear	B.T.H.
Phillips, Gilbert & Co.	Piercing	400 800	489	3 ph., 400/440 v., 50 cyc.	Gear	B.T.H.
Bolckow Vaughan	3 high merchant	3000	514	3 ph., 2400 v., 60 cyc.	Gear	G.E.C.
Sheffield Steel Prod.	Merchant reversing	1200 4200	60/120	400 v. d.c.	Direct	G.E.C.
Sheffield Steel Prod.	Merchant	800	100/200	100 v. d.c.	Direct	G.E.C.
Sheffield Steel Prod.	Merchant	550	100/200	400 v. d.c.	Direct	G.E.C.
Sheffield Steel Prod.	Merchant	350	250/500	400 v. d.c.	Direct	G.E.C.
Frodingham Iron & Steel Co.	3 high merchant	750/1500	72/180	440 v. d.c.	Direct	G.E.C.
Stewart & Lloyd	Merchant	900	73	3 ph., 440 v., 25 cyc.	Direct	G.E.C.
Condes Des Works	Merchant	500	600	3 ph., 380 v., 50 cyc.	Gear & rp.	G.E.C.
Condes Des Works	Merchant	250	600	3 ph., 380 v., 50 cyc.	Gear & rp.	G.E.C.
Abertillery Tinsplate Co.	Tinsplate	400/800	214	3 ph., 3000 v., 50 cyc.	Gear	G.E.C.
H. H. Vivian & Co.	Copper, brass, nickel, &c.	400/800	293	3 ph., 25 cyc. 440 v.	Gear	G.E.C.
Yorkshire Copper Works	Piercing	400	320	550 v. d.c.	Rope dr.	G.E.C.
Yorkshire Copper Works	Piercing	400	320	550 v. d.c.	Rope dr.	G.E.C.
Hallamshire Steel & File Co.	2 high merchant	220	588	3 ph., 3300 v., 50 cyc.	Lam. gear	G.E.C.
T. Farley & Sons	2 high merchant	300	375	3 ph., 5000 v., 25 cyc.	Rope	G.E.C.
Shipman's Wire Mills	Wire	275	390	3 ph., 2000 v., 50 cyc.	Rope	G.E.C.
Talbot Stead Tube Co.	Pilger	200/400	100/200	440 v. d.c.	Direct	G.E.C.
Talbot Stead Tube Co.	Pilger	200/400	100/200	440 v. d.c.	Direct	G.E.C.
Talbot Stead Tube Co.	Piercer	300	500	3 ph., 440 v., 50 cyc.	Rope	G.E.C.
Talbot Stead Tube Co.	Tube	300	500	3 ph., 440 v., 50 cyc.	Rope	G.E.C.
Johnsons Iron & Steel Co.	Merchant	300	52/100	500 v. d.c.	Direct	G.E.C.
Johns H. I. Co.	Merchant	300	200	500 v. d.c.	Rope	G.E.C.
Elbow Vale Iron & Steel Co.	Pilger	200/400	400/550	250 v. d.c.	Gear	G.E.C.
Elbow Vale Iron & Steel Co.	Pilger	200/400	400/550	250 v. d.c.	Gear	G.E.C.
McKenzie Bros.	Brass	150	492	3 ph., 3000 v., 25 cyc.	Gear	G.E.C.
Grice, Grice & Co.	Copper	100	492	3 ph., 5000 v., 25 cyc.	Gear	G.E.C.
James & Rossmore	Lead	60	960	2 ph., 210 v., 50 cyc.	Belt†	G.E.C.
J. Booth & Co.	Rod	75	710	3 ph., 440 v., 25 cyc.	Gear	G.E.C.
Calcutta Mint	Silver & nickel	150	350	460 v. d.c.	Gear	G.E.C.
Calcutta Mint	Silver & nickel	150	350	460 v. d.c.	Gear	G.E.C.
Calcutta Mint	Silver & nickel	150	350	460 v. d.c.	Gear	G.E.C.
Calcutta Mint	Silver & nickel	150	350	460 v. d.c.	Gear	G.E.C.
Calcutta Mint	Silver & nickel	50	550	460 v. d.c.	Gear	G.E.C.
Calcutta Mint	Silver & nickel	50	550	460 v. d.c.	Gear	G.E.C.
Calcutta Mint	Silver & nickel	50	550	460 v. d.c.	Gear	G.E.C.
Calcutta Mint	Silver & nickel	50	550	460 v. d.c.	Gear	G.E.C.
Calcutta Mint	Silver & nickel	50	550	460 v. d.c.	Gear	G.E.C.
Calcutta Mint	Silver & nickel	50	550	460 v. d.c.	Gear	G.E.C.
Rayless, Jones & Bayliss	3 high	500	240/312	440 v. d.c.	Rope	Elec. Con. Co.
Rayless, Jones & Bayliss	3 high	600	280/380	440 v. d.c.	Rope	Elec. Con. Co.
Metal Manufacturers	Cold copper	400	300	250 v. d.c.	Rope	Elec. Con. Co.
Thomas Bolton & Sons	Cold copper	300	400/550	200 v. d.c.	Rope	Elec. Con. Co.
Thomas Bolton & Sons	Cold copper	300	400/550	200 v. d.c.	Rope	Elec. Con. Co.
Thomas Bolton & Sons	Cold copper	300	400/550	200 v. d.c.	Rope	Elec. Con. Co.
Thomas Bolton & Sons	Cold copper	475	300/400	205 v. d.c.	Rope	Elec. Con. Co.
Thomas Bolton & Sons	Cold copper	600	380/400	205 v. d.c.	Rope	Elec. Con. Co.
Usines Metallurgiques de Saint Eloi	3 high continuous	600	250	550 v. d.c.	Dir.-coup.	Elec. Con. Co.
Leoni Punt & Co.	3 high continuous	600	250	550 v. d.c.	Dir.-coup.	Elec. Con. Co.
Tremblay & Lamoignon du Havre	3 high continuous	800/1600	60/90	440 v. d.c.	Dir.-coup.	Elec. Con. Co.
Welsh Tinsplate & Metal Stamping Co.	Plate	500	135/150	500 v. d.c.	Dir.-coup.	Elec. Con. Co.
Samuel Osborn & Co.	2 high merchant	350	550/440	2 ph., 2000 v.	Rope	Elec. Con. Co.
Richard Johnson & Nephew	3 high merchant	500	428/360	3 ph., 6500 v.	Rope	Elec. Con. Co.
Alfred Hickman	Cogging and live rolls	4800/9600	+ 120	460/500 v. c.c.	Geared	Elec. Con. Co.
Alfred Hickman	Bar.	6000/12000	+ 120	460/500 v. c.c.	Dir.-coup.	Elec. Con. Co.
Short Bros.	Hot rolls	250	400	440 v. d.c.	Rope	Elec. Con. Co.
Short Bros.	Hot rolls	250	400	440 v. d.c.	Rope	Elec. Con. Co.
Wolverhampton Corrugated Iron Co.	Cold bars	100	500	220 v. d.c.	Belt	Elec. Con. Co.
Wolverhampton Corrugated Iron Co.	Cold bars	120	250	220 v. d.c.	Geared	Elec. Con. Co.
Wolverhampton Corrugated Iron Co.	Cold bars	250	300	220 v. d.c.	Gear	Elec. Con. Co.
Oriental Tube Co.	Tubes	90	410	500 v. d.c.	Rope	Elec. Con. Co.
Oriental Tube Co.	Tubes	200	410/430	500 v. d.c.	Rope	Elec. Con. Co.
Brotherton Tubes & Conduits	Tubes	100	363	400 v. a.c.	Steel Belt	Elec. Con. Co.
Brotherton Tubes & Conduits	Tubes	150	375/366	400 v. a.c.	Steel Belt	Elec. Con. Co.
Tubes, Ltd.	Tubes, nickel	120	500	460 v. d.c.	Gear	Elec. Con. Co.
Tubes, Ltd.	Tubes	500	130/200	460 v. d.c.	Dir.-coup.	Elec. Con. Co.
Tubes, Ltd.	Tubes	110	160	460 v. d.c.	Dir.-coup.	Elec. Con. Co.
Tubes, Ltd.	Tubes	200	160	460 v. d.c.	Dir.-coup.	Elec. Con. Co.
Tubes, Ltd.	Tubes	350	250	460 v. d.c.	Gear	Elec. Con. Co.
Tubes, Ltd.	Tubes	400	280	460 v. d.c.	Gear	Elec. Con. Co.
John Perks & Sons	Merchant	50	+ 125	440/460 v. d.c.	Dir.-coup.	Elec. Con. Co.
John Perks & Sons	Merchant	100	+ 125	440/460 v. d.c.	Dir.-coup.	Elec. Con. Co.
Kynochs, Ltd.	Sheet	65	750	3 ph., 520 v., 50 cyc.	Sheet	English Elec. Co.
Kynochs, Ltd.	Sheet	65	750	3 ph., 520 v., 50 cyc.	Sheet	English Elec. Co.
Kynochs, Ltd.	Sheet	42	750	3 ph., 500 v., 50 cyc.	—	English Elec. Co.
Kynochs, Ltd.	Sheet	42	750	3 ph., 500 v., 50 cyc.	—	English Elec. Co.
Kynochs, Ltd.	Sheet	42	750	3 ph., 500 v., 50 cyc.	—	English Elec. Co.
Kynochs, Ltd.	Sheet	42	750	3 ph., 500 v., 50 cyc.	—	English Elec. Co.
Kynochs, Ltd.	Sheet	42	750	3 ph., 520 v., 50 cyc.	Sheet	English Elec. Co.
Kynochs, Ltd.	Sheet	42	750	3 ph., 520 v., 50 cyc.	Sheet	English Elec. Co.
Tregoning & Co.	Cold rolls	200	200	3 ph., 500 v., 50 cyc.	Rope	English Elec. Co.

† Induction motor drives for speed regulating sets. ‡ Belt to counter shaft and by double helical gearing from main shaft. Mill speed 10 r.p.m.

Motor Equipment for Main Drive of Rolling Mills—continued.

Installed for	Description of mill.	Motor.		Supply.	Drive.	Installed by
		H.P.	Speed r.p.m.			
Davy Bros.	Plate	200	600	3 ph., 220 v.	Rope	English Elec. Co.
Davy Bros.	Merchant	120	500	2 ph., 2000 v.	Rope	English Elec. Co.
Davy Bros.	—	120	500	2 ph., 4 wire, 50 cye.	—	English Elec. Co.
Henry Wiggin & Co.	Sheet nickel	200	300	3 ph., 440 v., 25 cye.	Gear	English Elec. Co.
Henry Wiggin & Co.	Sheet nickel	150	375	3 ph., 440 v., 25 cye.	Rope & gr.	English Elec. Co.
Daniel & Arter	Strip	158	300	3 ph., 440 v., 25 cye.	Gearing	English Elec. Co.
John Baker & Co.	Disc	290	150	3 ph., 6300 v., 50 cye.	Gearing	English Elec. Co.
John Baker & Co.	Disc	290	150	3 ph., 6300 v., 50 cye.	Gearing	English Elec. Co.
Clyde Alloy Steel Co.	Merchant	250	500	3 ph., 400 v., 25 cye.	Rope	English Elec. Co.
James & Rooke	Breaking down	350	300	3 ph., 5000 v., 25 cye.	Gearing	English Elec. Co.
James & Rooke	Breaking down	200	300	3 ph., 5000 v., 25 cye.	Gearing	English Elec. Co.
Chas. Hirst & Co.	Draw benches	110	375	235 v. d.c.	Gear	English Elec. Co.
Chas. Hirst & Co.	Draw benches	110	375	235 v. d.c.	Gear	English Elec. Co.
Chas. Hirst & Co.	Draw benches	110	375	235 v. d.c.	Gear	English Elec. Co.
Chas. Hirst & Co.	Draw benches	110	375	235 v. d.c.	Gear	English Elec. Co.
Chas. Hirst & Co.	Draw benches	110	375	235 v. d.c.	Gear	English Elec. Co.
Aston Chain and Hook Co.	—	200	375	3 ph., 5000 v., 25 cye.	Belt	English Elec. Co.
Steel Nut & Joseph Hampton	Draw benches	200	510	3 ph., 400 v., 25 cye.	Rope	English Elec. Co.
Wm. Bayless	—	200	375	3 ph., 440 v., 25 cye.	Rope	English Elec. Co.
Wm. Bayless	—	172	500	3 ph., 5000 v., 25 cye.	—	English Elec. Co.
Wm. Bayless	Tube	120	500	3 ph., 5000 v., 25 cye.	Gear	English Elec. Co.
Crosthwaites Engineering & Furnace Co.	Reeling	150-400	500	3 ph., 400 v., 25 cye.	Gear	English Elec. Co.
Crosthwaites Engineering & Furnace Co.	Reeling	150-300	600	440 v. d.c.	Gear	English Elec. Co.
Crosthwaites Engineering & Furnace Co.	Reeling	150-300	600	440 v. d.c.	Gear	English Elec. Co.
Crosthwaites Engineering & Furnace Co.	Reeling	150-400	500	3 ph., 400 v., 25 cye.	Gear	English Elec. Co.
Crosthwaites Engineering & Furnace Co.	Reeling	150-400	500	3 ph., 400 v., 25 cye.	Gear	English Elec. Co.
George Jones	Sheet	350	375	3 ph., 5000 v., 25 cye.	Rope	English Elec. Co.
George Jones	Tube	120	550	3 ph., 5000 v., 25 cye.	Gear	English Elec. Co.
George Jones	—	100	500	500 v. d.c.	—	English Elec. Co.
Richard Hill & Co.	Wire	175	385	3 ph., 2750 v., 40 cye.	Gear	English Elec. Co.
Richard Hill & Co.	Wire	175	385	3 ph., 2750 v., 40 cye.	Gear	English Elec. Co.
Richard Hill & Co.	Wire	132	392	3 ph., 440 v., 40 cye.	Gear	English Elec. Co.
Winfields Rolling Mills	Brass sheet	175	375	3 ph., 5000 v., 25 cye.	Rope	English Elec. Co.
Winfields Rolling Mills	Brass sheet	108	375	3 ph., 5000 v., 25 cye.	Rope	English Elec. Co.
Wilkes, Son & Mapplebeck	Copper plate	150	485	3 ph., 5000 v., 25 cye.	Gear	English Elec. Co.
Wilkes, Son & Mapplebeck	Copper plate	120	485	3 ph., 5000 v., 25 cye.	Gear	English Elec. Co.
Wilkes, Son & Mapplebeck	Copper plate	75	485	3 ph., 5000 v., 25 cye.	Gear	English Elec. Co.
A. F. Parkes	Sheet steel	150	375	3 ph., 5000 v., 25 cye.	—	English Elec. Co.
A. F. Parkes	Sheet steel	142	375	3 ph., 5000 v., 25 cye.	—	English Elec. Co.
Heaton Dugard	Sheet	140	375	3 ph., 5000 v., 25 cye.	—	English Elec. Co.
Heaton Dugard	Sheet	100	500	3 ph., 440 v., 25 cye.	Gear	English Elec. Co.
Heaton Dugard	Sheet	100	500	3 ph., 440 v., 25 cye.	Gear	English Elec. Co.
Heaton Dugard	Sheet	80	500	3 ph., 440 v., 25 cye.	Gear	English Elec. Co.
John Hands & Sons	Sheet	150	375	3 ph., 5000 v., 25 cye.	Belt	English Elec. Co.
Wm. West	German silver	150	500	3 ph., 5000 v., 25 cye.	Gear	English Elec. Co.
Ellicott Metal Co.	—	150	375	3 ph., 400 v., 25 cye.	—	English Elec. Co.
John Summers & Sons	—	140	500	3 ph., 440 v., 50 cye.	—	English Elec. Co.
British Aluminium Co.	Breaking down	300	375	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	135	400/600	460 v. d.c.	—	English Elec. Co.
British Aluminium Co.	—	135	400/600	460 v. d.c.	—	English Elec. Co.
The Redbrook Tinplate Co.	Cold rolls	125	240	3 ph., 2200 v.	Rope	English Elec. Co.
The Redbrook Tinplate Co.	Hot tinplate	100	240	3 ph., 2200 v.	Rope	English Elec. Co.
John Wood & Sons	Merchant	125	490	2 ph., 2000 v., 50 cye.	Rope	English Elec. Co.
Thomas Smith & Sons	—	105	150	3 ph., 440 v., 25 cye.	—	English Elec. Co.
H. Roberts	—	100	750	2 ph., 200 v., 50 cye.	—	English Elec. Co.
Perry & Co.	—	100	300	3 ph., 25 v., 440 cye.	Gear	English Elec. Co.
Carr, Wild & Co.	—	100	750	2 ph., 200 v., 50 cye.	Direct	English Elec. Co.
Isaac Nash & Sons	—	95	375	2 ph., 2700 v., 50 cye.	Belt	English Elec. Co.
Kemp & Sons	Sheet	80	500	3 ph., 440 v., 25 cye.	Gear	English Elec. Co.
Kemp & Sons	Sheet	80	500	3 ph., 440 v., 25 cye.	Gear	English Elec. Co.
Kemp & Sons	Sheet	45	500	3 ph., 440 v., 25 cye.	Gear	English Elec. Co.
Rotherham Forge & Rolling Mills	Reeling	54	725	460 v. d.c.	Belt	English Elec. Co.
E. Lloyd & Co.	Sheet	50	500	—	—	English Elec. Co.
E. Lloyd & Co.	Sheet	50	500	—	—	English Elec. Co.
J. J. Habershon & Co.	Cold rolls	66	285	3 ph., 50 cye., 200 v.	—	English Elec. Co.
Howell & Co.	Flux tube	350	300/128	3 ph., 3000 v., 50 cye.	Dir. epd.	English Elec. Co.
Howell & Co.	Tube	250	585	3 ph., 3000 v., 50 cye.	Dir. epd.	English Elec. Co.
Howell & Co.	Tube	110	600	3 ph., 3000 v., 50 cye.	Dir. epd.	English Elec. Co.
Howell & Co.	Tube	75	600	3 ph., 3000 v., 50 cye.	Dir. epd.	English Elec. Co.
John Brown & Co.	Tyre	1350	500	3 ph., 6600 v., 50 cye.	Gear	English Elec. Co.
John Brown & Co.	Tyre	600/1200	500	3 ph., 6600 v., 50 cye.	Gear	English Elec. Co.
John Brown & Co.	Bar	200	450/200	230 v. d.c.	Rope	English Elec. Co.
John Brown & Co.	Bar	200	450/200	230 v. d.c.	Rope	English Elec. Co.
Corrugated Iron Co., Widnes	—	600	585	3 ph., 440 v., 50 cye.	—	English Elec. Co.

Motor Equipment for Main Drive of Rolling Mills—continued.

Installed for	Description of mill.	Motor.		Supply.	Drive.	Installed by
		H.P.	Speed r.p.m.			
Monkbridge Iron Co., Ltd.	Tyre	600	500	2 ph., 2000 v., 50 cyc.	Direct	English Elec. Co.
Monkbridge Iron Co., Ltd.	Tyre	300	500	2 ph., 2000 v., 50 cyc.	Direct	English Elec. Co.
English McKenna Process Co.	Rail	500	280	3 ph., 400 v., 25 cyc.	Gear	English Elec. Co.
English McKenna Process Co.	Rail	500	280	3 ph., 400 v., 25 cyc.	Gear	English Elec. Co.
English McKenna Process Co.	Rail	500	280	3 ph., 400 v., 25 cyc.	Gear	English Elec. Co.
English McKenna Process Co.	Rail	500	280	3 ph., 400 v., 25 cyc.	Gear	English Elec. Co.
English McKenna Process Co.	Rail	500	280	3 ph., 400 v., 25 cyc.	Gear	English Elec. Co.
English McKenna Process Co.	Rail	500	280	3 ph., 400 v., 25 cyc.	Gear	English Elec. Co.
English McKenna Process Co.	Merchant	350	250/125	3 ph., 400 v.†	Direct	English Elec. Co.
John Williams	Merchant	500	300	3 ph., 400 v., 25 cyc.	Gear	English Elec. Co.
Sheffield Forge & Rolling Mills Co.	Merchant	500	88	3 ph., 3300 v., 50 cyc.	Direct	English Elec. Co.
Sheffield Forge & Rolling Mills Co.	Merchant	350	125	3 ph., 3300 v., 50 cyc.	Direct	English Elec. Co.
Sheffield Forge & Rolling Mills Co.	Sheet	250	375	2 ph., 2000 v., 50 cyc.	Gear	English Elec. Co.
Sheffield Forge & Rolling Mills Co.	Merchant	300	500	2 ph., 3300 v., 50 cyc.	Gear	English Elec. Co.
Sheffield Forge & Rolling Mills Co.	Merchant	150	500	2 ph., 3300 v., 50 cyc.	Gear	English Elec. Co.
Waterloo Tinplate Co.	Hot	500	214	500 v. d.c.	Gear	English Elec. Co.
Waterloo Tinplate Co.	Cold	225	300	500 v. d.c.	Gear	English Elec. Co.
Bowesfield Steel Co.	Sheet	750	194	3 ph., 2750 v., 40 cyc.	Rope	English Elec. Co.
Weldless Steel Tube Co.	Tube	340	750	2 ph., 2750 v., 50 cyc.	Gear	English Elec. Co.
Weldless Steel Tube Co.	Tube	340	750	2 ph., 2750 v., 50 cyc.	Gear	English Elec. Co.
Weldless Steel Tube Co.	Tube	150	750	2 ph., 2750 v., 50 cyc.	Gear	English Elec. Co.
Weldless Steel Tube Co.	Tube	150	750	2 ph., 2750 v., 50 cyc.	Gear	English Elec. Co.
Barrow Hematite Steel Co.	Merchant	360	85/200	440 v. d.c.	Direct	English Elec. Co.
Barrow Hematite Steel Co.	Hoop	375	230/350	440 v. d.c.	Direct	English Elec. Co.
Barrow Hematite Steel Co.	Planishing	340	230/350	440 v. d.c.	Direct	English Elec. Co.
Barrow Hematite Steel Co.	Roughing	400	270/600	440 v. d.c.	Gear	English Elec. Co.
Barrow Hematite Steel Co.	Finishing	400	270/600	440 v. d.c.	Gear	English Elec. Co.
Dorman Long	Sheet	1800	200	3 ph., 2750 v., 40 cyc.	Rope	English Elec. Co.
J. B. & S. Lees	Strip	380	200/350	500 v. d.c.	Rope & dir.	English Elec. Co.
J. B. & S. Lees	Strip	338	200/350	500 v. d.c.	Direct	English Elec. Co.
Brown Bayley's Steel Works	Merchant	400	85/200	460 v. d.c.	Direct	English Elec. Co.
Brown Bayley's Steel Works	Merchant	2000	80/150	460 v. d.c.	Direct	English Elec. Co.
Improved Steel Co.	Roughing	600	500	2 ph., 2700 v., 50 cyc.	Gear	English Elec. Co.
Improved Steel Co.	Finishing	600	600/340	2 ph., 2700 v., 50 cyc.†	Gear	English Elec. Co.
Wm. Bain & Co., Ltd.	Merchant	350	300/100	3 ph., 440 v., 25 cyc.†	Direct	English Elec. Co.
Guest, Keen & Nettelfolds	—	275	375	3 ph., 440 v., 25 cyc.	—	English Elec. Co.
Guest, Keen & Nettelfolds	—	200	750	3 ph., 440 v., 25 cyc.	—	English Elec. Co.
Guest, Keen & Nettelfolds	—	175	375	3 ph., 440 v., 25 cyc.	—	English Elec. Co.
Guest, Keen & Nettelfolds	—	100	375	3 ph., 440 v., 25 cyc.	—	English Elec. Co.
Birmingham Battery & Metal Co.	Piercer	300	600	440 v. d.c.	Direct	English Elec. Co.
Birmingham Battery & Metal Co.	—	120	550	440 v. d.c.	Dir. cpld.	English Elec. Co.
Nederlandsche Kabelfabrick Delft. Holl.	Copper	300	375	3 ph., 220 v., 50 cyc.	Direct	English Elec. Co.
Charles Clifford & Sons	Sheet	275	300	3 ph., 5000 v., 25 cyc.	Gear	English Elec. Co.
Charles Clifford & Sons	Sheet	275	300	3 ph., 5000 v., 25 cyc.	Gear	English Elec. Co.
Charles Clifford & Sons	Sheet	105	250	3 ph., 440 v., 25 cyc.	Direct	English Elec. Co.
Dugard Bros.	Sheet brass	275	375	3 ph., 5000 v., 25 cyc.	Gearing	English Elec. Co.
Dugard Bros.	Sheet brass	100	500	3 ph., 5000 v., 25 cyc.	Gearing	English Elec. Co.
Willans & Robinson	Tube	275	360	410 v. d.c.	Rope	English Elec. Co.
Allen Everitt & Sons	—	250	500	3 ph., 400 v., 25 cyc.	—	English Elec. Co.
Allen Everitt & Sons	—	250	375	3 ph., 400 v., 25 cyc.	—	English Elec. Co.
Allen Everitt & Sons	—	150	375	3 ph., 400 v., 25 cyc.	—	English Elec. Co.
Allen Everitt & Sons	—	150	375	3 ph., 400 v., 25 cyc.	—	English Elec. Co.
Allen Everitt & Sons	—	100	500	3 ph., 400 v., 25 cyc.	—	English Elec. Co.
Allen Everitt & Sons	—	100	500	3 ph., 400 v., 25 cyc.	—	English Elec. Co.
Allen Everitt & Sons	—	80	500	3 ph., 400 v., 25 cyc.	—	English Elec. Co.
District Iron & Steel Co.	Hoop	250	365	3 ph., 5000 v., 25 cyc.	Rope	English Elec. Co.
Union Steel Corporation	Merchant	255	90/180	3 ph., 525 v., 50 cyc.	Direct	English Elec. Co.
Barker & Allen, Ltd.	Sheet nickel	250	300	3 ph., 440 v., 25 cyc.	Rope	English Elec. Co.
Barker & Allen, Ltd.	Sheet nickel	120	300	3 ph., 440 v., 25 cyc.	Rope	English Elec. Co.
Barker & Allen, Ltd.	Sheet nickel	50	375	3 ph., 440 v., 25 cyc.	Rope	English Elec. Co.
Barker & Allen, Ltd.	Sheet	50	750	3 ph., 440 v., 25 cyc.	Belt	English Elec. Co.
Barker & Allen, Ltd.	Breaking down	130	500	3 ph., 440 v., 25 cyc.	Rope	English Elec. Co.
Cammell, Laird & Co.	Merchant	210	750	3 ph., 3000 v., 50 cyc.	Belt	English Elec. Co.
John Hall & Sons	Hoop	250	250	2 ph., 2700 v., 50 cyc.	Direct	English Elec. Co.
F. R. Simpson & Co.	Merchant Rgh. 9 in. Fin. Tin.	250	250	3 ph., 400 v., 25 cyc.	Rope	English Elec. Co.
Kynochs, Ltd.	Sheet	200	600	3 ph., 500 v., 50 cyc.	Gear	English Elec. Co.
Kynochs, Ltd.	Sheet	200	600	3 ph., 520 v., 50 cyc.	—	English Elec. Co.
Kynochs, Ltd.	Sheet	165	600	3 ph., 500 v., 50 cyc.	Pinion	English Elec. Co.
Kynochs, Ltd.	Sheet	165	600	3 ph., 520 v., 50 cyc.	—	English Elec. Co.
Kynochs, Ltd.	Sheet	115	600	3 ph., 500 v., 50 cyc.	Gear	English Elec. Co.
Kynochs, Ltd.	Sheet	115	600	3 ph., 500 v., 50 cyc.	Belt	English Elec. Co.
Kynochs, Ltd.	Sheet	115	600	3 ph., 500 v., 50 cyc.	Belt	English Elec. Co.
Kynochs, Ltd.	Sheet	100	750	3 ph., 500 v., 50 cyc.	Pinion	English Elec. Co.
Kynochs, Ltd.	Sheet	80	750	3 ph., 500 v., 50 cyc.	Belt	English Elec. Co.
Kynochs, Ltd.	Sheet	75	750	3 ph., 500 v., 50 cyc.	Pinion	English Elec. Co.
Kynochs, Ltd.	Sheet	75	750	3 ph., 500 v., 50 cyc.	Pinion	English Elec. Co.
Kynochs, Ltd.	Sheet	65	750	3 ph., 500 v., 50 cyc.	—	English Elec. Co.
Kynochs, Ltd.	Sheet	65	750	3 ph., 520 v., 50 cyc.	—	English Elec. Co.
Skinner & Co. Iron Co.	Reversing, roughing & fng.	19000	140	465 v. d.c.*	Direct	English Elec. Co.
Skinner & Co. Iron Co.	Reversing, cogging	12000	120	550 v. d.c.*	Direct	English Elec. Co.
Cammell Laird & Co.	Reversing, roughing & fng.	19000	150	465 v. d.c.*	Direct	English Elec. Co.
Wellman Seaver Rolling Mill Co.	Reversing, cogging	12008	120	650 v. d.c.*	Direct	English Elec. Co.
Scottish Iron & Steel Co.	Reversing, cogging	6380	175	630 v. d.c.*	Direct	English Elec. Co.
Monmouthshire Steel & Tinplate Co.	Reversing (finishing)	5300	140	600 v. d.c.*	Direct	English Elec. Co.
Elliott's Metal Co.	Reversing copper plate	890	105	400 v. d.c.*	Gear	English Elec. Co.
Birmingham Mint	Reversing copper plate	780	500	400 v. d.c.*	Gear	English Elec. Co.

* With flywheel motor-generator sets.

† Induction motor drives with speed regulating sets.

Motor Equipment for Main Drive of Rolling Mills—continued.

Installed for	Description of mill.	H.P.	Motor. Speed r.p.m.	Supply.	Drive.	Installed by
Birmingham Battery & Metal Co.	Reversing copper plate	450	210	435 v. d.c.*	Gear	English Elec. Co.
Manganese, Bronze & Brass Co.	Extruding press	240	400	500 v. d.c.*	Gear	English Elec. Co.
Mond Nickel Co.	Reversing 2 stand	1200	100	450 v. d.c.*	Direct	English Elec. Co.
David Colville & Sons	3 high plate	12000	0 120	680 v. d.c.*	Direct	English Elec. Co.
David Colville & Sons	Merchant	400	200/100	220 v. d.c.	Direct	English Elec. Co.
David Colville & Sons	Merchant (finishing)	400	150/300	220 v. d.c.	Direct	English Elec. Co.
David Colville & Sons	Merchant (rfg.)	250	90 150	220 v. d.c.	Direct	English Elec. Co.
Richard Johnson & Nephew	Wire	2750	500	3 ph., 6600 v., 50 cyc.	Gear	English Elec. Co.
Richard Johnson & Nephew	Wire	750	750	3 ph., 6600 v., 50 cyc.	Gear	English Elec. Co.
Richard Johnson & Nephew	Wire	750	750	3 ph., 6600 v., 50 cyc.	Gear	English Elec. Co.
Kayser, Ellison & Co.	Wire	1200	245/365	3 ph., 500 v., 50 cyc.†	Belt	English Elec. Co.
Kayser, Ellison & Co.	Cogging	375	375	3 ph., 500 v., 50 cyc.	Rope	English Elec. Co.
Eston Sheet & Galvanising Co.	Sheet	1000	200	3 ph., 2750 v., 40 cyc.	Rope	English Elec. Co.
Bolchow Vaughan & Co.	Sheet	1000	200	3 ph., 2750 v., 40 cyc.†	Rope	English Elec. Co.
Cargo Fleet Iron Co.	Merchant	1000	150 75	3 ph., 2750 v., 40 cyc.†	Direct	English Elec. Co.
Elliot's Metal Co.	Copper	1000	250	3 ph., 440 v., 25 cyc.	Rope	English Elec. Co.
Birmingham Metal & Munitions Co.	Sheet	750	187	3 ph., 440 v., 25 cyc.	Rope	English Elec. Co.
Monmouthshire Steel & Tinplate Co.	Cogging	750	75	3 ph., 2750 v., 25 cyc.	Direct	English Elec. Co.
Baldwins, Ltd.	Hot tinplate	600	150	3 ph., 2100 v., 50 cyc.	Rope	English Elec. Co.
Baldwins, Ltd.	Hot tinplate	600	150	3 ph., 2100 v., 50 cyc.	Rope	English Elec. Co.
Baldwins, Ltd.	Hot tinplate	600	150	3 ph., 2100 v., 50 cyc.	Rope	English Elec. Co.
Baldwins, Ltd.	Cold rolls	440	150	3 ph., 2100 v., 50 cyc.	Rope	English Elec. Co.
Baldwins, Ltd.	Cold rolls	300	250	3 ph., 2100 v., 50 cyc.	Rope & gr.	English Elec. Co.
Darlington Rolling Mills Co.	Rail	600	270 450	460 v. d.c.	Rope	English Elec. Co.
Darlington Rolling Mills Co.	Merchant	450	110/247	460 v. d.c.	D.C. & R.	English Elec. Co.
Darlington Rolling Mills Co.	Forge train	250	300 450	460 v. d.c.	Rope	English Elec. Co.
Darlington Rolling Mills Co.	Forge train	250	300 450	460 v. d.c.	Rope	English Elec. Co.
Monks, Hall & Co.	Wire (finishing)	550	400 530	500 v. d.c.	Direct	English Elec. Co.
Monks, Hall & Co.	Wire (roughing)	400	200 300	500 v. d.c.	Direct	English Elec. Co.
Monks, Hall & Co.	Merchant	400	92 125	500 v. d.c.	Direct	English Elec. Co.
Raine & Co.	Rail	600	60 120	500 v. d.c.	Direct	English Elec. Co.
Raine & Co.	Merchant (roughing)	400	80/160	500 v. d.c.	Direct	English Elec. Co.
Raine & Co.	Merchant (finishing)	400	60 250	500 v. d.c.	Direct	English Elec. Co.
Tubes, Ltd.	Tube	375	375	3 ph., 5000 v., 25 cyc.	Rope	English Elec. Co.
Tubes, Ltd.	Tube	200	375	3 ph., 5000 v., 25 cyc.	Rope	English Elec. Co.
Tubes, Ltd.	Tube	200	375	3 ph., 5000 v., 25 cyc.	Rope	English Elec. Co.
Tubes, Ltd.	Tube	170	375	3 ph., 5000 v., 25 cyc.	Rope	English Elec. Co.
Tubes, Ltd.	Tube	170	375	3 ph., 5000 v., 25 cyc.	Rope	English Elec. Co.
Tubes, Ltd.	Tube	170	375	3 ph., 5000 v., 25 cyc.	Rope	English Elec. Co.
Tubes, Ltd.	Tube	150	480 300	460 v., 25 cyc. d.c.	Belt	English Elec. Co.
Tubes, Ltd.	Tube	80	600/700	460 v., 25 cyc. d.c.	Belt	English Elec. Co.
Armstrong, Whitworth & Co.	Light sheet steel	650/2500	200	6600 v., 50 cyc., and 500 v. d.c.*	Gear	Lanes. D.&M. Co.
Hanson, Dales & Co.	Lead	150	600	345 v., "Lanes." drv.	Dir. cpld.	Lanes. D.&M. Co.
Walker, Parker & Co.	Lead	150	600	420 v., "Lanes." drv.	Dir. cpld.	Lanes. D.&M. Co.
Walker, Parker & Co.	Lead	100	460	460 v., "Lanes." drv.	Gear	Lanes. D.&M. Co.
Armstrong, Whitworth & Co.	Tool steel (non-reversing)	120	400 475	500 v. d.c.	Gear	Lanes. D.&M. Co.
Blaenavon Co.	Steel tyres (non-reversing)	300	300	460 v. d.c.	Gear	Lanes. D.&M. Co.
Blaenavon Co.	Steel tyres (non-reversing)	300	300	460 v. d.c.	Gear	Lanes. D.&M. Co.
Darlington Rolling Mills Co.	Steel bars (non-reversing)	1000/1300	200	440 v. d.c.	Rope	Lanes. D.&M. Co.
Smith & McLean	Steel sheets (non-revers.)	400	120 200	500 v. d.c.	Gear	Lanes. D.&M. Co.
Taylor Bros.	Steel wheels (non-revers.)	530 800	300 600	250 v. d.c.	Gear	Lanes. D.&M. Co.
Bibby & Co.	Copper (non-reversing)	100	300 480	460 v. d.c.	Rope	Lanes. D.&M. Co.
British Insulated & Helsby Cables Co.	Copper (non-reversing)	400	350 400	240 v. d.c.	Rope	Lanes. D.&M. Co.
Broughton Copper Co.	Copper (non-reversing)	300	350 400	500 v. d.c.	Rope	Lanes. D.&M. Co.
G. Adams & Sons	Non-reversing	200	415	2700 v., 50 cyc.	Rope	Lanes. D.&M. Co.
Chesterfield Tube Co.	Tube (non-reversing)	150	240	440 v., 50 cyc.	Gear	Lanes. D.&M. Co.
Earle, Bourne & Co.	Non-reversing	600	240	5000 v., 25 cyc.	Dir. cpld.	Lanes. D.&M. Co.
Earle, Bourne & Co.	Non-reversing	450	360	5000 v., 25 cyc.	Dir. cpld.	Lanes. D.&M. Co.
Earle, Bourne & Co.	Non-reversing	200	360	5000 v., 25 cyc.	Dir. cpld.	Lanes. D.&M. Co.
Earle, Bourne & Co.	Non-reversing	225	360	2750 v., 50 cyc.	Dir. cpld.	Lanes. D.&M. Co.
Earle, Bourne & Co.	Tube (non-reversing)	100	360	440 v., 25 cyc.	Rope	Lanes. D.&M. Co.
Low Moor Iron Co.	Bar (non-reversing)	250	243	1000 v., 50 cyc.	Rope	Lanes. D.&M. Co.
Low Moor Iron Co.	Bar (non-reversing)	400	480 375	1000 v., 50 cyc.	Rope	Lanes. D.&M. Co.
Low Moor Iron Co.	Bar (non-reversing)	175	243	1000 v., 50 cyc.	Rope	Lanes. D.&M. Co.
J. Reynolds & Sons	Non-reversing	80	480	400 v., 25 cyc.	Gear	Lanes. D.&M. Co.
Appleby Iron Co.	40 in. reversing slabbing	6000/15200	48 100	1350 v. d.c.	Direct‡	Met. Vickers Elec.
Appleby Iron Co.	10 ft. reversing plate	6000/15200	48 100	1350 v. d.c.	Direct‡	Met. Vickers Elec.
Appleby Iron Co.	7 ft. reversing plate	5000/13300	60 120	1350 v. d.c.	Direct‡	Met. Vickers Elec.
J. Cockerill & Co.	36 in. reversing cogging	5000/16500	60 120	1350 v. d.c.	Direct‡	Met. Vickers Elec.
J. Cockerill & Co.	33½ in. reversing section	5000/16500	60 120	1350 v. d.c.	Direct‡	Met. Vickers Elec.
Bolckow, Vaughan & Co.	40 in. reversing cogging	4800/16700	50 100	1200 v. d.c.	Direct‡	Met. Vickers Elec.
Bolckow, Vaughan & Co.	18 in. finishing	1200/2500	290	3 ph., 60 per., 2400 v.	Geared	Met. Vickers Elec.
Bolckow, Vaughan & Co.	16 in. roughing & finishing	500 1000	300	3 ph., 60 per., 2400 v.	Geared	Met. Vickers Elec.
La Magona d'Italia	Reversing plate	3300/9520	50 100	800 v. d.c.	Direct‡	Met. Vickers Elec.
La Magona d'Italia		1200 2400	86	3 ph., 50 cyc., 5000 v.	—	Met. Vickers Elec.
La Magona d'Italia		1200 2400	86	3 ph., 50 cyc., 5000 v.	—	Met. Vickers Elec.
La Magona d'Italia		1200 2400	86	3 ph., 50 cyc., 5000 v.	—	Met. Vickers Elec.
La Magona d'Italia		1200 2400	75	3 ph., 50 cyc., 5000 v.	—	Met. Vickers Elec.
La Magona d'Italia		700 1400	250	3 ph., 50 cyc., 5000 v.	—	Met. Vickers Elec.
La Magona d'Italia		700 1400	250	3 ph., 50 cyc., 5000 v.	—	Met. Vickers Elec.
La Magona d'Italia		350 700	500	3 ph., 50 cyc., 5000 v.	—	Met. Vickers Elec.
La Magona d'Italia		250/500	300	3 ph., 50 cyc., 5000 v.	—	Met. Vickers Elec.
Vickers, Ltd.	28 in. reversing cogging	3000/8000	50/100	800 v. d.c.	Direct‡	Met. Vickers Elec.
Vickers, Ltd.	24 in. sheet	450 900	250	3 ph., 50 cyc., 650 v.	—	Met. Vickers Elec.
Vickers, Ltd.	12 in. bar	400/800	87/125	220 v. d.c.	Direct	Met. Vickers Elec.
Vickers, Ltd.	Tube piercer	250/500	600	220 v. d.c.	—	Met. Vickers Elec.
Vickers, Ltd.	Tube piercer	150/300	485	3 ph., 50 cyc., 650 v.	—	Met. Vickers Elec.

* With flywheel motor-generator sets.

† Induction motor drives with speed regulating sets.

‡ Cascade set.

§ With M.G. set.

Motor Equipment for Main Drive of Rolling Mills—continued.

Description of mill.	Motor.		Supply.	Drive.	Installed by
	H.P.	Speed r.p.m.			
Whitehead Iron & Steel Co.	2500/1560	240/160	500 v. d.c.	Geared†	Met. Vickers Elec.
Whitehead Iron & Steel Co.	1500/815	350/175	500 v. d.c.	Geared†	Met. Vickers Elec.
Whitehead Iron & Steel Co.	100/40	600/240	500 v. d.c.	Geared†	Met. Vickers Elec.
Whitehead Iron & Steel Co.	1000/3000	74	3 ph., 50 cyc., 3000 v.	Direct	Met. Vickers Elec.
Whitehead Iron & Steel Co.	1000/3000	107	3 ph., 50 cyc., 3000 v.	Direct	Met. Vickers Elec.
Whitehead Iron & Steel Co.	1500/3000	107	3 ph., 50 cyc., 3000 v.	Direct	Met. Vickers Elec.
Whitehead Iron & Steel Co.	800/1600	136/205	3 ph., 42 cyc., 2000 v.	Geared	Met. Vickers Elec.
Whitehead Iron & Steel Co.	500/1000	85	3 ph., 50 cyc., 3000 v.	Direct	Met. Vickers Elec.
Whitehead Iron & Steel Co.	500/1000	85	3 ph., 50 cyc., 3000 v.	Direct	Met. Vickers Elec.
Whitehead Iron & Steel Co.	1500/3750	294	3 ph., 50 cyc., 3000 v.	Rope	Met. Vickers Elec.
Whitehead Iron & Steel Co.	240 m.m.	800/1600	3 ph., 50 cyc., 5000 v.	Direct	Met. Vickers Elec.
Whitehead Iron & Steel Co.	350 m.m.	700/1400	3 ph., 50 cyc., 5000 v.	Direct	Met. Vickers Elec.
Whitehead Iron & Steel Co.	500/1250	365	3 ph., 50 cyc., 5000 v.	Direct	Met. Vickers Elec.
Whitehead Iron & Steel Co.	180/360	195	3 ph., 50 cyc., 3000 v.	Direct	Met. Vickers Elec.
Whitehead Iron & Steel Co.	1500/3000	295/270	220 v.	Geared	Met. Vickers Elec.
Whitehead Iron & Steel Co.	700/1400	490	3 ph., 25 cyc., 6500 v.	Geared	Met. Vickers Elec.
Whitehead Iron & Steel Co.	600/1200	405	345 v. d.c.	Geared*	Met. Vickers Elec.
Whitehead Iron & Steel Co.	400/800	585	230 v. d.c.	—	Met. Vickers Elec.
Whitehead Iron & Steel Co.	1500/3000	187	3 ph., 50 cyc., 2200 v.	Direct†	Met. Vickers Elec.
Whitehead Iron & Steel Co.	1300/2500	28/36	550 v. d.c.	Direct†	Met. Vickers Elec.
Whitehead Iron & Steel Co.	1300/2500	28/34	500 v. d.c.	Direct†	Met. Vickers Elec.
Whitehead Iron & Steel Co.	1250/3000	60/120	440 v. d.c.	Direct*	Met. Vickers Elec.
Whitehead Iron & Steel Co.	1200/2400	365	3 ph., 50 cyc., 6000 v.	Geared	Met. Vickers Elec.
Whitehead Iron & Steel Co.	1000/3000	245	3 ph., 50 cyc., 5000/5500v	Geared	Met. Vickers Elec.
Whitehead Iron & Steel Co.	1000/2300	180	3 ph., 25 cyc., 3000/5500v	Geared	Met. Vickers Elec.
Whitehead Iron & Steel Co.	1000/2000	240	3 ph., 25 cyc., 5000 v.	Direct	Met. Vickers Elec.
Whitehead Iron & Steel Co.	500/1000	365	3 ph., 25 cyc., 5000 v.	Geared	Met. Vickers Elec.
Whitehead Iron & Steel Co.	200/700	360	3 ph., 25 cyc., 5000 v.	Geared	Met. Vickers Elec.
Whitehead Iron & Steel Co.	265/660	360	3 ph., 25 cyc., 440 v.	Geared	Met. Vickers Elec.
Whitehead Iron & Steel Co.	1000/2500	184	3 ph., 50 cyc., 2200 v.	Geared	Met. Vickers Elec.
Whitehead Iron & Steel Co.	1000/2500	184	3 ph., 50 cyc., 2200 v.	Geared	Met. Vickers Elec.
Cargo Fleet & Iron Co.	1000/2000	130/300	550 v. d.c.	Direct†	Met. Vickers Elec.
Cargo Fleet & Iron Co.	800/2500	60/100	460 v. d.c.	Direct†	Met. Vickers Elec.
Cargo Fleet & Iron Co.	750/1875	50/100	460 v. d.c.	Direct†	Met. Vickers Elec.
Cargo Fleet & Iron Co.	500/1000	730	3 ph., 25 cyc., 440 v.	Geared	Met. Vickers Elec.
Cargo Fleet & Iron Co.	500/1000	290	3 ph., 25 cyc., 440 v.	Geared	Met. Vickers Elec.
Cargo Fleet & Iron Co.	290/130	365	3 ph., 25 cyc., 440 v.	Geared	Met. Vickers Elec.
Cargo Fleet & Iron Co.	200/130	365	3 ph., 25 cyc., 440 v.	Rope	Met. Vickers Elec.
Cargo Fleet & Iron Co.	150/300	485	3 ph., 25 cyc., 440 v.	—	Met. Vickers Elec.
Cargo Fleet & Iron Co.	150/300	485	3 ph., 25 cyc., 440 v.	—	Met. Vickers Elec.
Cargo Fleet & Iron Co.	150/300	485	3 ph., 25 cyc., 440 v.	—	Met. Vickers Elec.
Cargo Fleet & Iron Co.	800/2000	200/225	400 v. d.c.	Direct	Met. Vickers Elec.
Cargo Fleet & Iron Co.	325/700	585	3 ph., 40 cyc., 2750 v.	Geared	Met. Vickers Elec.
Cargo Fleet & Iron Co.	800/536	112/75.5	3 ph., 50 cyc., 3000 v.	Direct	Met. Vickers Elec.
Cammell Laird & Co.	800/1600	405	360 v. d.c.	Geared*	Met. Vickers Elec.
Cammell Laird & Co.	500/1000	400	240 v. d.c.	Geared*	Met. Vickers Elec.
Cammell Laird & Co.	800/1600	500	500 v. d.c.	Geared*	Met. Vickers Elec.
Cammell Laird & Co.	750/1500	480	3 ph., 50 cyc., 3000 v.	Geared	Met. Vickers Elec.
Cammell Laird & Co.	750/1600	125/200	500 v. d.c.	Direct†	Met. Vickers Elec.
Cammell Laird & Co.	750/1500	500	3 ph., 50 cyc., 5000 v.	—	Met. Vickers Elec.
Cammell Laird & Co.	600/1200	290	3 ph., 50 cyc., 3300 v.	Rope	Met. Vickers Elec.
Cammell Laird & Co.	570/1000	490	3 ph., 50 cyc., 6300 v.	Geared	Met. Vickers Elec.
Cammell Laird & Co.	570/1000	490	3 ph., 50 cyc., 6300 v.	Geared	Met. Vickers Elec.
Cammell Laird & Co.	550/1500	490	3 ph., 50 cyc., 490 v.	Geared	Met. Vickers Elec.
Cammell Laird & Co.	550/1500	375	3 ph., 50 cyc., 5000 v.	Geared	Met. Vickers Elec.
Cammell Laird & Co.	550/1400	375	3 ph., 50 cyc., 5000 v.	—	Met. Vickers Elec.
Cammell Laird & Co.	550/1400	375	3 ph., 50 cyc., 5000 v.	—	Met. Vickers Elec.
Cammell Laird & Co.	550/1350	300/365	3 ph., 50 cyc., 5000 v.	—	Met. Vickers Elec.
Cammell Laird & Co.	550/1350	300/365	3 ph., 50 cyc., 5000 v.	—	Met. Vickers Elec.
Cammell Laird & Co.	500/1500	365	3 ph., 25 cyc., 400 v.	Ropes	Met. Vickers Elec.
Cammell Laird & Co.	350/700	242	3 ph., 25 cyc., 400 v.	Rope	Met. Vickers Elec.
Cammell Laird & Co.	500/1500	365	3 ph., 25 cyc., 400 v.	Rope	Met. Vickers Elec.
Cammell Laird & Co.	250/600	480	3 ph., 25 cyc., 440 v.	Rope	Met. Vickers Elec.
Cammell Laird & Co.	500/1500	365	3 ph., 25 cyc., 440 v.	Rope	Met. Vickers Elec.
Cammell Laird & Co.	500/1300	27.5/34.5	500 v. d.c.	Direct	Met. Vickers Elec.
Cammell Laird & Co.	125/250	240	3 ph., 25 cyc., 400 v.	—	Met. Vickers Elec.
Cammell Laird & Co.	500/1200	163	3 ph., 50 cyc., 3000 v.	Direct	Met. Vickers Elec.
Cammell Laird & Co.	500/1000	585	3 ph., 50 cyc., 3000 v.	—	Met. Vickers Elec.
Cammell Laird & Co.	400/920	580	3 ph., 50 cyc., 3000 v.	—	Met. Vickers Elec.
Cammell Laird & Co.	300/600	240	3 ph., 50 cyc., 3000 v.	—	Met. Vickers Elec.
Cammell Laird & Co.	220/500	360	3 ph., 50 cyc., 3000 v.	—	Met. Vickers Elec.
Cammell Laird & Co.	500/1100	120/240	3 ph., 25 cyc., 2200 v.	Direct	Met. Vickers Elec.
Cammell Laird & Co.	500/1000	150/250	240 v. d.c.	Geared	Met. Vickers Elec.
Cammell Laird & Co.	250/550	244	3 ph., 50 cyc., 3000 v.	Rope	Met. Vickers Elec.
Cammell Laird & Co.	500/1000	415	3 ph., 50 cyc., 440 v.	Geared	Met. Vickers Elec.
Cammell Laird & Co.	500/1000	100/200	460 v. d.c.	Direct†	Met. Vickers Elec.
Cammell Laird & Co.	500/1000	290	3 ph., 50 cyc., 440 v.	Geared	Met. Vickers Elec.
Cammell Laird & Co.	350/700	250/125	3 ph., 50 cyc., 440 v.	Geared	Met. Vickers Elec.
Cammell Laird & Co.	500/1000	150/350	440 v. d.c.	Direct†	Met. Vickers Elec.
Cammell Laird & Co.	200/400	585	3 ph., 50 cyc., 440 v.	Geared	Met. Vickers Elec.
Cammell Laird & Co.	500/864	260/315	480 v. d.c.	Geared	Met. Vickers Elec.
Cammell Laird & Co.	450/1000	230	3 ph., 50 cyc., 2150 v.	Geared	Met. Vickers Elec.

* With M.G. Set.

† With rotary converter.

‡ Direct on to countershaft.

Motor Equipment for Main Drive of Rolling Mills *continued.*

Installed for	Description of mill.	Motor.		Supply.	Drive.	Installed by
		H.P.	Speed r.p.m.			
Soc. Anon. des Acieries d'Anvers	Finishing	325/700	300	3 ph., 50 cyc., 2150 v.	Gearred	Met. Vickers Elec.
Soc. Anon. des Acieries d'Anvers	Finishing	325/700	300	3 ph., 50 cyc., 2150 v.	Gearred	Met. Vickers Elec.
Soc. Anon. des Acieries d'Anvers	Roughing	150/450	300	3 ph., 50 cyc., 2150 v.	Belt	Met. Vickers Elec.
The Mint, Birmingham	Merchant	400/1500	365	3 ph., 25 cyc., 440 v.	Gearred	Met. Vickers Elec.
The Mint, Birmingham	Hot rod	275/900	365	3 ph., 25 cyc., 440 v.	Gearred	Met. Vickers Elec.
The Mint, Birmingham	Roughing and finishing	225/600	365	3 ph., 25 cyc., 440 v.	Gearred	Met. Vickers Elec.
The Mint, Birmingham	Roughing and finishing	225/600	365	3 ph., 50 cyc., 2150 v.	Gearred	Met. Vickers Elec.
The Mint, Birmingham	Red	50/100	710	3 ph., 25 cyc., 410 v.	Gearred	Met. Vickers Elec.
Sir Theo. Fry & Co.	Forge	400/800	330	3 ph., 40 cyc., 400 v.	Rope	Met. Vickers Elec.
Sir Theo. Fry & Co.	16 in. mill	250/500	385	3 ph., 40 cyc., 400 v.	Rope	Met. Vickers Elec.
Sir Theo. Fry & Co.	16 in. mill	250/500	385	3 ph., 40 cyc., 400 v.	Rope	Met. Vickers Elec.
Sir Theo. Fry & Co.	10 in. mill	250/500	385	3 ph., 40 cyc., 400 v.	Rope	Met. Vickers Elec.
Sir Theo. Fry & Co.	8 in. mill	250/500	385	3 ph., 40 cyc., 400 v.	Rope	Met. Vickers Elec.
Birmingham Metal & Munitions Co.	Copper and brass	400/800	365	3 ph., 25 cyc., 5000 v.	Rope	Met. Vickers Elec.
Birmingham Metal & Munitions Co.	Copper and brass sheet	275/550	365	3 ph., 25 cyc., 440 v.	Gearred	Met. Vickers Elec.
Birmingham Metal & Munitions Co.	Copper and brass sheet	160/500	365	3 ph., 25 cyc., 400 v.	Gearred	Met. Vickers Elec.
Birmingham Metal & Munitions Co.	Copper and brass sheet	160/500	365	3 ph., 25 cyc., 400 v.	Gearred	Met. Vickers Elec.
Birmingham Metal & Munitions Co.	Copper and brass sheet	275/550	365	3 ph., 25 cyc., 400 v.	Gearred	Met. Vickers Elec.
Italian Co., for Villa Cogozza		400/800	412	3 ph., 42 cyc., 500 v.	Rope	Met. Vickers Elec.
Harts Hill Iron Company	10 in. merchant	350/700	220/100	650 v. d.c.	Direct†	Met. Vickers Elec.
Redheugh Sheet Iron & Steel Co.	2 in. high sheet	350/1000	360	3 ph., 40 cyc., 400 v.	Ropes	Met. Vickers Elec.
Shelton Iron, Steel & Coal Co.	10 in. bar	350/700	450/720	500 v. d.c.	Ropes	Met. Vickers Elec.
Shelton Iron, Steel & Coal Co.	12 in. bar	350/700	450/660	500 v. d.c.	Ropes	Met. Vickers Elec.
Fielding & Platt	Pilger	350/700	365	3 ph., 50 cyc., 2000 v.	Direct	Met. Vickers Elec.
Union Steel Corporation		350/700	485	3 ph., 50 cyc., 525 v.	Rope	Met. Vickers Elec.
J. Summers & Co.	3 and 2 high strip	325/800	570	3 ph., 40 cyc., 400 v.	Rope	Met. Vickers Elco.
D. Bennie & Sons	3 high roughing	300/600	250/330	500 v. d.c.	Direct	Met. Vickers Elec.
D. Bennie & Sons	2 high finishing	150/300	200/265	500 v. d.c.	Direct	Met. Vickers Elec.
Prallfrig (Italy)	6 plate mills	300/900	410	3 ph., 42 cyc., 500 v.	Belt	Met. Vickers Elec.
Elliott's Metal Co.	Cold brass	300/600	365	3 ph., 25 cyc., 440 v.	Gearred	Met. Vickers Elec.
Pitney Street Rolling Mills	Cold brass	300/600	350	3 ph., 25 cyc., 5000 v.	Rope	Met. Vickers Elec.
Pitney Street Rolling Mills	Strip	300/600	360	3 ph., 25 cyc., 5000 v.	—	Met. Vickers Elec.
Trivdale Rolling Mills Co.	Cold brass	300/600	365	3 ph., 50 cyc., 200 v.	Gearred	Met. Vickers Elec.
Heeley Silver Mills, Ltd.	Cold cupro-nickel	300/600	365	3 ph., 50 cyc., 3300 v.	Gearred	Met. Vickers Elec.
Heeley Silver Mills, Ltd.	Cold cupro-nickel	300/600	370	3 ph., 50 cyc., 3300 v.	Gearred	Met. Vickers Elec.
Soc. Anon. Westinghouse, Paris		300/600	350/750	440 v. d.c.	—	Met. Vickers Elec.
Perfecta Tubes, Ltd.	Piercer	300/600	365	3 ph., 25 cyc., 440 v.	Gearred	Met. Vickers Elec.
Perfecta Tubes, Ltd.	Breaking down	200/400	365	3 ph., 25 cyc., 440 v.	Gearred	Met. Vickers Elec.
Perfecta Tubes, Ltd.	Breaking down	150/300	365	3 ph., 25 cyc., 440 v.	Gearred	Met. Vickers Elec.
Armstrong, Whitworth & Co.		280/560	390	3 ph., 40 cyc., 440 v.	Ropes	Met. Vickers Elec.
Armstrong, Whitworth & Co.	Brass sheet	150/300	380	3 ph., 40 cyc., 440 v.	Gearred	Met. Vickers Elec.
Tupper & Co.	Strip	275/690	365	2 ph., 50 cyc., 2700 v.	Rope	Met. Vickers Elec.
Royal Arsenal, Woolwich		250/500	370	500 v. d.c.	—	Met. Vickers Elec.
Royal Arsenal, Woolwich		250/500	370	500 v. d.c.	—	Met. Vickers Elec.
Royal Arsenal, Woolwich		250/500	370	500 v. d.c.	—	Met. Vickers Elec.
Royal Arsenal, Woolwich		250/500	370	500 v. d.c.	—	Met. Vickers Elec.
Royal Arsenal, Woolwich		250/500	370	500 v. d.c.	—	Met. Vickers Elec.
G. Johnston & Co.	Brass sheet	250/700	240	3 ph., 25 cyc., 440 v.	Gearred	Met. Vickers Elec.
British Insulated & Helsby Cable	2 high sheet	250/375	350/380	240 v. d.c.	Belt	Met. Vickers Elec.
Victoria Iron Rolling Co.		250/290	250/700	460 v. d.c.	Gearred	Met. Vickers Elec.
Evered & Co.	Strip	250/600	375	3 ph., 25 cyc., 400 v.	Gearred	Met. Vickers Elec.
Muntz Metal	Tube piercing	250/300	485	3 ph., 25 cyc., 400 v.	Gearred	Met. Vickers Elec.
Old Park Silver Mills Co.	2 pair cupro nickel	230/460	320	3 ph., 50 cyc., 350 v.	Gearred	Met. Vickers Elec.
Wm. Hunt & Sons	Strip	200/450	365	3 ph., 25 cyc., 400 v.	Rope	Met. Vickers Elec.
Wm. Hunt & Sons (The Braides)	Special	200/600	365	3 ph., 25 cyc., 400 v.	Rope	Met. Vickers Elec.
J. Booth & Co.	Brass	200/400	360	3 ph., 25 cyc., 5000 v.	—	Met. Vickers Elec.
J. Booth & Co.	Brass	100/200	480	3 ph., 25 cyc., 440 v.	—	Met. Vickers Elec.
J. Booth & Co.	Brass	100/200	480	3 ph., 25 cyc., 440 v.	—	Met. Vickers Elec.
J. Booth & Co.	Brass	100/200	480	3 ph., 25 cyc., 440 v.	—	Met. Vickers Elec.
J. Booth & Co.	Brass	100/200	480	3 ph., 25 cyc., 440 v.	—	Met. Vickers Elec.
J. Booth & Co.	Brass	75/150	720	3 ph., 25 cyc., 440 v.	—	Met. Vickers Elec.
Cocker Bros.	12 in.	200/400	600	230/240 v. d.c.	—	Met. Vickers Elec.
Cocker Bros.	10 in.	100/200	530/800	220 v. d.c.	—	Met. Vickers Elec.
J. Williams & Co.	2 high sheet	200/600	365	3 ph., 25 cyc., 400 v.	Rope	Met. Vickers Elec.
W. H. Moore & Sons	Brass sheet	200/600	240	3 ph., 25 cyc., 440 v.	Gearred	Met. Vickers Elec.
James & Colver	Bar	200/400	500	2 ph., 50 cyc., 200 v.	Belt	Met. Vickers Elec.
J. Brown & Co.	12 in. merchant	200/400	200/450	230 v. d.c.	Gearred	Met. Vickers Elec.
J. Brown & Co.	12 in. merchant	200/400	200/450	230 v. d.c.	Gearred	Met. Vickers Elec.
W. Jessop & Sons	Merchant	150/300	210	500 v. d.c.	Direct	Met. Vickers Elec.
Oldbury Rolling Mills	3 high merchant	150/400	480	3 ph., 25 cyc., 400 v.	Gearred	Met. Vickers Elec.
Harrison & Co.	Cold brass	150/300	480	3 ph., 25 cyc., 440 v.	Gearred	Met. Vickers Elec.
Harrison & Co.	Cold brass	100/225	480	3 ph., 25 cyc., 440 v.	Gearred	Met. Vickers Elec.
W. H. Robertson	Groove	150/300	640	110 v. d.c.	Gearred	Met. Vickers Elec.
Britannia Tube Co.	Brass	150/300	240	3 ph., 25 cyc., 440 v.	Rope	Met. Vickers Elec.
Barker Bros., Ltd.	Cold cupro nickel	130/400	480	3 ph., 25 cyc., 440 v.	Belt	Met. Vickers Elec.
Bassett, Bagnall & Co.	Strip	125/190	575	500 v. d.c.	Gearred	Met. Vickers Elec.
Hall Street Metal Rolling Co.	Cold brass	125/250	480	3 ph., 25 cyc., 440 v.	Rope	Met. Vickers Elec.
Hall Street Metal Rolling Co.	Silver strip and sheet	70/140	550	140 v. d.c.	—	Met. Vickers Elec.
C. A. Robinson & Co.	Strip	100/250	480	2 ph., 25 cyc., 200 v.	Gearred	Met. Vickers Elec.
C. A. Robinson & Co.	Strip	100/250	480	2 ph., 25 cyc., 200 v.	Gearred	Met. Vickers Elec.
Empire Aluminium Co.	Aluminium sheet	100/200	400	500 v. d.c.	Direct	Met. Vickers Elec.
Scottish Tube Co.	Tube	100/200	470	3 ph., 25 cyc., 440 v.	Gearred	Met. Vickers Elec.
Rotherham Forge & Rolling Mill Co.	S. m. rod	100/200	725	3 ph., 50 cyc., 3000 v.	Gearred	Met. Vickers Elec.
Holman, Mitchell & Co.	Reversing lead	90/180	120	550 v. d.c.	Gearred*	Met. Vickers Elec.
Foster, Blackett & Wilson	Reversing lead	90/180	435	460 v. d.c.	Gearred*	Met. Vickers Elec.
Foster, Blackett & Wilson	Lead sheet	90/180	570	3 ph., 40 cyc., 400 v.	Gearred	Met. Vickers Elec.
R. B. Byass & Co.	Copper	90/180	500	500 v. d.c.	Gearred	Met. Vickers Elec.
R. B. Byass & Co.	Copper	90/180	500	500 v. d.c.	Gearred	Met. Vickers Elec.
Mardy Tinsplate Co.	3 sheet	80/200	300	400 v. d.c.	Gearred	Met. Vickers Elec.

* With M.G. Set.

† With rotary converter.

Electricity and Tube Tyre and Wheel Mills.

By W. E. SWALE

The electrical and mechanical problems involved in ordinary rolling processes are well known. However, little has been published regarding the rolling of tubes, tyres and wheels, and as these processes present rather distinctive problems from the electrical designer's point of view, a brief consideration of the outstanding features of each drive may be profitable.

Weldless Tubes.

High grade weldless steel tubes are now made, for the greater part, in three separate processes, viz.: "piercing," "cam-rolling," and "drawing." The successive stages are shown in Fig. 1. The action of the piercing mill (due to Mannesmann) depends on the use of rolls placed on a slant. As will be seen from a simple vector diagram (Fig. 2) the effect of displacing the rolls from the usual parallel position is to cause a combined motion, which rotates the

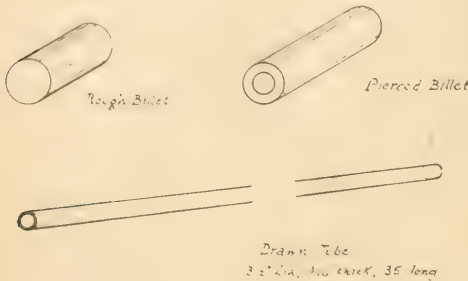


FIG. 1.—STAGES IN THE MANUFACTURE OF TUBES.

billet and at the same time drives it forward over a mandrel, so producing a short hollow tube. Smaller tubes, up to about 4 in. diam., are usually pierced on a "Stiefel" mill having bevel rolls, while above 4 in. diam. and up to the largest sizes, the mills have double-conical rolls arranged as shown in the sketch.

A consideration of the amount of material displaced will explain the high powers required on these mills. On a particular steam driven mill a billet of 8½ in. diam. by 2 ft. 8 in. long (i.e., a section equalling 56·7 sq. in.) is reduced to a tube of 8 in. diam. by 3½ in. bore (i.e. section equalling 38·2 sq. in.). Compared with this, when breaking down a 4 in. by 4 in. billet on a 12 in. merchant mill driven by 450 H.P. motor, 8 passes are taken in all, the initial section being only 16 sq. in. On the other hand, of course, as the piercing process is completed in one pass, the intervals of light load are

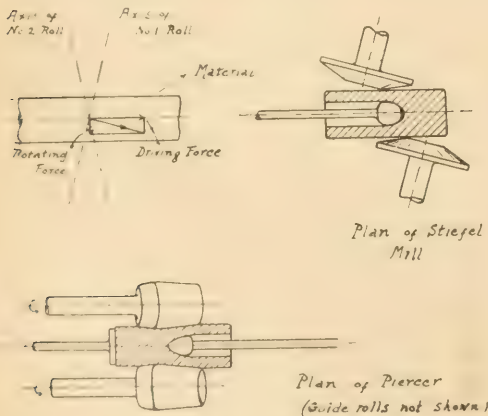


FIG. 2.—DIAGRAMS OF PIERCING PROCESSES.

considerably greater than on ordinary mills. Fig. 3 shows a typical H.P.-time curve for a piercer working with a 7 in. billet. This cycle corresponds to an R.M.S. rating of about 500 H.P. Some of the largest mills now working take over 2 000 H.P. while piercing. As

the extra power called for when dealing with a billet below normal temperature may be considerable it is customary to specify a high overload capacity. The specification of a large German mill, taking billets up to 325 mm. diam., called for the following motor:

R.M.S. rating	900 H.P.
Normal peak load	2 000 H.P. for one minute
Maximum peak load	3 000 H.P. for one minute

As in many other drives it was customary until quite recently to fit flywheels to these mills. The practice appears, however, to have

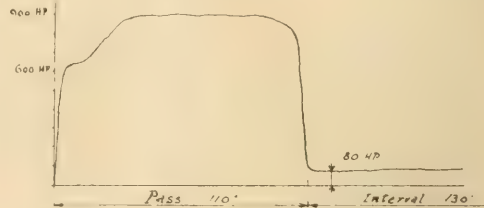


FIG. 3.—H.P.-TIME CURVE OF MANNESMANN PIERCER, WORKING ON 7 INCH BILLETS.

no valid reason, being merely a relic of the steam engine days. It is clear from the nature of the process that once the billet is firmly gripped the torque remains steady and the length of the pass is such that a flywheel on the mill can fulfil no useful purpose.

The "Pilger" Process.

The second stage in the manufacture of the tube is the elongation performed on the "Pilger" mill or "cam" rolls. It is not generally known that this ingenious process takes its name from the pilgrims of old, for whom one form of penance consisted in completing a journey taking three steps forward and two steps backward successively. The principle is illustrated in Fig. 4. As soon as

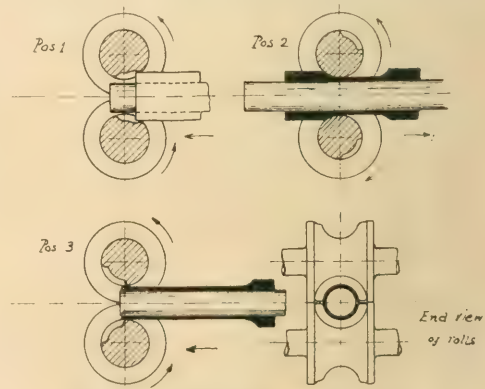


FIG. 4.—OPERATION OF "PILGER" MILL.

the material is freed by the arrival of the small diameter of the rolls, it is shot forward again by a pneumatic ram to meet the large diameters, the ram at the same time imparting a turn of about one quarter of a revolution to the tube. The process thus consists of series of passes, each commencing with a severe hammer-like blow as the material meets the rolls. The tube is usually pierced and finished in one heat, so the process has to be carried out rapidly and the rolls usually revolve at about 60 to 90 revs. per min. A typical H.P.-time curve is shown in Fig. 5, which illustrates the severe nature of the duty. In this case the specifications of the motor was as follows:

R.M.S. rating	600 H.P.
Normal peak	1 000 H.P. for 1½ minutes
Maximum peak	1 500 H.P. for 2 minutes

The Inutility of the Flywheel.

In the case of the "Pilger" mill, likewise, it is difficult to see what useful purpose can be served by the addition of a flywheel,

each individual pass being so short that there is no time for a fly-wheel to come into action. The essential feature of the drive is the repeated shock on the rolls, part of which will be transmitted to the motor, particularly in the case of a direct coupled drive. Special attention must therefore be paid to the design of the motor. This should have heavy brushgear with strong springs to prevent commutation troubles caused by a chattering of the brushes, a robust shaft and bearings and a heavy bed secured with a number of long foundation bolts and very carefully grouted in. A considerable number of the larger size steel tubes, *e.g.*, those used for high pressure water tube boilers, can be practically finished on the "Pilger" mill, and have only to pass through the straightening rolls. Certain

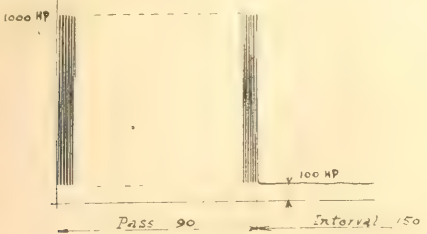


FIG. 5. H.P.-TIME CURVE OF PILGER MILL.

of the smaller sizes have to be further reduced on the draw bench, but this is a process which is beyond the scope of the present article.

Tyre Rolling.

There is an ever increasing demand for railway tyres of all sizes, ranging from the standard goods truck tyre of about 2 ft. 9 in. internal diameter to the largest locomotive tyre of over 6 ft. 6 in. internal diameter. All these tyres are made on various types of mills. The steel is cast into hexagonal ingots which are partially parted by an ingot slicer, the individual "cheeses" then being broken off. In older mills the "cheeses" are perforated and roughed out under a beaking hammer. A modern equipment consists of branding press, a roughing mill and a finishing mill. The evolution of the tyre mill has not been simple, and a variety of types have been employed. For the purposes of this article, however, it will suffice to consider two types only, which illustrate the difference between the single motor and the two motor drives. In the older "Jackson" mill the outer roll is driven and the inner roll simply runs idle. As rolling progresses the driving roll is pushed closer and closer to the fixed roll. Small guide rolls prevent the tyre from whipping about on the face plate. A mill roughing out tyres of 6 ft. internal diameter would have a h.p. time curve somewhat as shown in Fig. 6, the roll speed increasing from

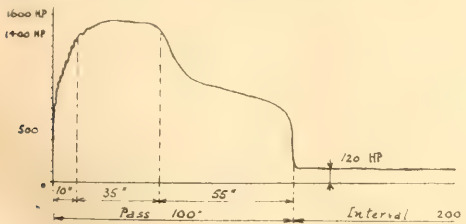


FIG. 6.—H.P.-TIME CURVE OF "JACKSON" MILL.

0.60-80 revs. per min. The characteristic features of the mill are the horizontal position of the tyre and the fact that only the larger outer roll is driven.

Drives from the Metallurgist's View Point.

From the metallurgist's point of view, the older form of drive has the disadvantage that work is being done on the section from one side only, that is to say, not sufficient draft can be put on to the inner roll to ensure satisfactory forming of the material. This objection is overcome by the modern roughing mill which embodies a two motor drive. Fig. 7 illustrates the arrangement of a mill of this type in which the tyre is rolled vertically. A glance at the initial and final dimensions of a tyre, shown in Fig. 8, will explain the interesting problem in speed regulation which arises. It should be noted that the dimensions of the tyre and rolls have been chosen

quite arbitrarily, and that to facilitate calculation of the initial and final diameters the section has been regarded as a rectangular one. The following relative speeds result from this data; the figures

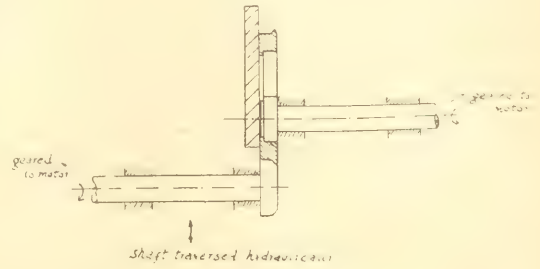


FIG. 7.—NEW TYPE OF ROUGHING MILL.

given in the third line represents the limiting position and will only result when rolling a tyre of no magnitude.

	Speed Ratio.		Actual Speeds while rolling.	
	Inside roll r.p.m.	Outside roll r.p.m.	Inside roll r.p.m.	Outside roll r.p.m.
Beginning	0.85	1	35	41
End	1.84	1	80	43.5
Limiting position (<i>i.e.</i> , rolls touching)	2.14	1	80	37.4

Speed Adjustment.

It is thus necessary to provide a means of adjusting the speeds of the rolls in an increasing ratio as rolling proceeds. The speed regulation of each roll could be effected by hand and independently, but a much more convenient form of drive is obtained by the simple expedient of connecting the armatures of the two motors in series the voltage being controlled on the Ward-Leonard system. To study the resulting effects it is necessary to remember that the rolls are mechanically inter-connected by the ring of hot material and must thus exercise torques corresponding to the roll diameters. Before the rolls touch the material they will have speeds proportional to their inertia and neck friction. Once the tyre is gripped the operator endeavours to maintain a constant current so that the load on the motors at any instant corresponds to the roll diameters and the roll speeds. It is conceivable that in the limiting case one roll will drop its speed to zero whereupon the field of the other motor will be so weakened as to cause a dangerous overspeed. Both

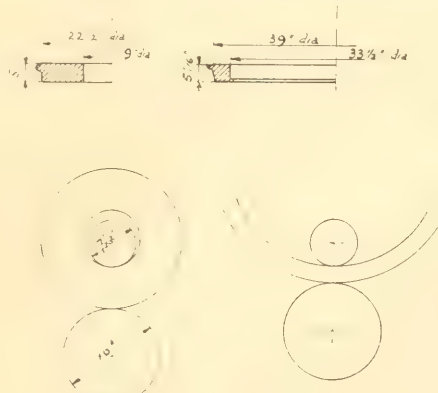


FIG. 8. RELATIVE DIMENSIONS OF TYRE

motors should therefore be safeguarded by means of centrifugal overspeed devices.

Mills of this type allow heavier drafts and can therefore turn out greater tonnages than the single motor mills. The motors are connected to the rolls through gears of suitable ratios; the sizes being of the order of 500 to 600 h.p. for the bottom roll and 300 to 400 h.p. for the top roll.

Auxiliary Electrical Plant at Dorman Long & Company's Redcar Works.

An interesting example of the application of electrical equipment of a variety of kinds to the carrying out of the processes of iron and steel making is supplied by DORMAN LONG & COMPANY'S Redcar works. We give below some details of the plant

and considerably to capital and maintenance costs, and is rendered unnecessary because the three-phase steelworks motor such as has been specially designed by the G.E.C., has proved itself fully capable of the heavy duty demanded. The main requirements for such a motor are that it should (1) be totally enclosed and of exceptionally robust construction; (2) be capable of rapid reversal and acceleration and (3) admit of being easily dismantled.

Motor Design.

In the case of the particular "Witton" motor employed at Redcar, the cast-steel frame is in two halves, being bolted along the axis. It is of symmetrical design, so that in case of emergency the motor may be turned round, the drive being, possible from either end. Strong feet are provided at each corner of the frame, so that the motor may be securely bolted to its foundation. The stator is built up of laminations in suitable clamp rings. It is quite independent of the carcass, and is self-contained with the windings. The armature is of small diameter so as to reduce the rotational inertia, but otherwise it is generally in accordance with standard practice. Both rotor and stator windings consist of bar-type conductors with moulded insulation.

Special attention has been given to the question of rapid dismantling, for in the event of slight trouble the output of steel may be seriously reduced unless the motor can be returned to service with minimum delay. It is only necessary to remove the bolts securing the two halves of the frame, when the top half of the



FIG. 1. TWO 75 H.P. WITTON STEELWORKS MOTORS DRIVING SPECIAL TRAVELLING CRANES WITH REVOLVING UNDERHUNG CARRIAGES (HENSIS & JACK PATENT) AND LIFTING MAGNETS.

installed there by the GENERAL ELECTRIC COMPANY and of the methods employed to render the operations as automatic as possible.

The Use of Three-phase Motors.

An interesting technical point is the use of three-phase motors for a class of work, which has generally been believed to be the preserve of d.c. plant. There has been much discussion as to the best electrical system to adopt in a steelworks, and, in view of the well-known properties of the direct current motor in dealing with variable loads and speeds, that system has been widely used in the past. But various factors have in the past decade or so tended to encourage the use of three-phase current. They may be briefly summarised as follows:—1. The tendency to require much larger quantities of power in a steelworks. 2. The larger area occupied



FIG. 3. 50 H.P. MOTOR OPERATING SCREWING DOWN GEAR ON 42-IN. PLATE MILL.

carcase can be raised, and the rotor and stator lifted from the bottom half. The stator can then be easily slid from the rotor. In view of the many almost inaccessible situations in which these motors have to work, it will be realised how much time is saved by the method described, more particularly as there are no foundation bolts to move. It has in fact been found possible to change a rotor or stator and have the machine in commission again within half an hour.

These motors have a starting torque of two and-a-half times the normal, and, almost needless to add, will withstand heavy overloads. The design of bearings and all mechanical details is on very liberal lines. The majority of these machines, of which upwards of 100 were supplied, are rated at 75 H.P., 440 V, 40 cycles, 480 revs. per min. For some other duties, motors with unsplit frame were supplied. These were rated at 50 H.P., 440 V, 40 cycles, 480 revs. per min., and are seen in Fig. 5.

The Measurement of Power.

It is a very difficult matter to determine the power required for driving live roller gear, and several careful tests were necessary before a suitable rating could be decided upon.

In addition to live roller gear these motors are used for driving the feed rolls of three mills, the rolls which take the plates from these mills to the shears, straightening machines, hot banks, cranes, and screwing down gears. (See Figs. 1 to 3.)

How Magnets Save Labour.

The method employed at these works for transporting plates on the hot banks is also electrical, and calls for special attention.



FIG. 2. 75 H.P. STEELWORKS MOTOR DRIVING ROLLS BETWEEN 42-IN. PLATE MILL AND PLATE STRAIGHTENING MACHINE.

by the steelworks, involving transmission problems, 3. The development of the turboalternator, and 4. The advantages of linking up with an outside supply system which is almost sure to be three-phase. For these reasons the three-phase system is installed in many steelworks to-day.

It would of course be possible in these circumstances to use d.c. motors if recourse were had to converting plant. But this would

In the first place the plates only have spot contact with the bank: efficient cooling is thus provided on both the upper and lower surfaces. Further, lowering skids and their attendant mechanical complications have been dispensed with, their places being taken by a series of flat magnets of Witton-Kramer design, which travel in guides the full length of the hot banks (Fig. 4). The magnets are brought up to the roll train (with which the hot banks are placed at right angles), push out bridge pieces beneath the train,



FIG. 4. WITTON-KRAMER RECTANGULAR MAGNETS ON THE SKID BANK.

and so are brought into contact with the under side of the plate which can then be skidded to any position on the bank, parallel, of course, with the point of removal. As the magnets work below the plates on the hot bank, it is a simple operation to transfer the outside plate (or first plate delivered on the bank) to the roller gear which conveys plates to the plate shears. The power for driving the magnets across the banks is supplied from the 50 h.p. motors described above, the drive being through gearing on to a shafting to which are keyed pulleys fitted with an endless wire rope.

Details of Magnet Design.

The type of magnet employed embodies numerous special features. The magnet skeleton consists of two rectangular side pieces forming the two poles of the magnet, and two oblong cores on which the magnet coils are wound. There is a non-magnetic top cover and manganese side pieces, bevelled to facilitate smooth sliding of the magnets under the plates. The bottom cover is of manganese provided with substantial lugs at each end for the attachment of the wire ropes which pull the magnet backwards and forwards. From the bottom of the magnet a bracket is extended to carry the electric current collector gear.

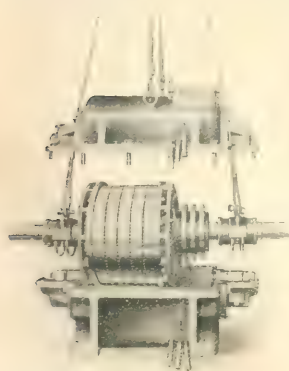


FIG. 5. 75 H.P. WITTON STEELWORKS MOTOR SHOWING EASE WITH WHICH DISMANTLING CAN BE CARRIED OUT.

motor. This arrangement allows of the three trains being used as a continuous conveyor, when desired. The plates are skidded from the mill train to the hydraulic turnover gear at the end of the bank, where they are turned over for examination, marked to size, and afterwards skidded to the cross-cut shears, which are capable of shearing plates up to 1½ in. thick, and the full width of the mill rolls. The scrap from these shears is delivered by an

electric magnet into bogies on the mill floor, the bogies being wheeled to the sketch or scrap shears. The roller gear then conveys the plates to the right and left hand shears, the former of which is served by a special plate handling machine (Fig. 6).

The Plate Handling Machine.

This plate handling machine (Ennis's patent) consists of two trains of independently operated rollers, magnets being placed at intervals between the rollers. These are so arranged that they can be travelled across the full length of the table, the travel gear of each magnet being independently operated. Further, the magnet can rotate on a 6 in. centre pin which forms part of the travelling carriage on which it is mounted.

The excitation of the magnets, the operation of the travelling motion, and the rotation of the rollers are all controlled from a platform placed at the far end of the plate handling machine. The whole table travels on rails on the floor level. The method of operation, therefore, is that the plates are delivered to the live roll from the hot bank, and travel down it until delivered to the plate handling machine. There it is gripped by the magnets, and the table is travelled to a position beside the shearing machine. Then by means of the magnet travelling motion, the plate is lined up against the stops on the shearing machine and sheared. In the case of long plates the shearing process takes place two or three times, the plate handling machine being travelled the requisite distance after each operation. When one side is sheared the plate is revolved on the table by running the two sets of rollers in reverse directions and the shearing operation repeated. The whole process is controlled by one man, and it may be noted that whereas with an ordinary castor set nine men are required,

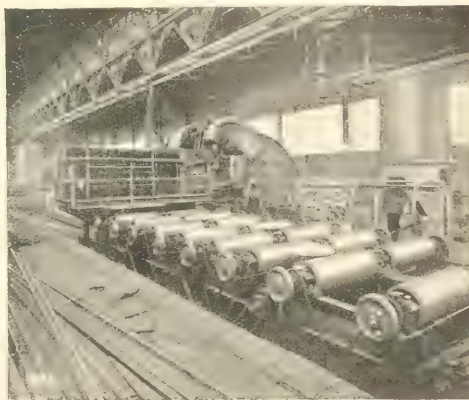


FIG. 6. MECHANICAL TABLE FOR TRANSFERRING AND HANDLING PLATES AT SHEARS (ENNIS PATENT).

with the Ennis patent handling machine three only are needed.

The general design of the rotary magnet coil used and its pole system is the same as that of the skid magnet, except that a single coil only is utilized, a manganese housing again being employed, and the bottom cover carrying the slirprings. The brush gear is mounted on the travelling carriage and is so arranged that it can lift with the slirprings should the magnet be pulled up on its centre post when holding a curved plate.

The generating plant includes a G.E.C. turbo-alternator with a normal output of 2 500 kVA on a 2 750 V, 40 cycle circuit at 2 400 revs. per min. In its construction are embodied the several special features associated with the G.E.C. design. Amongst these may be mentioned: 1. The solid rotor. 2. The system of ventilation in which the air cooling the rotor at no stage comes into contact with that cooling the stator. 3. The clamping system which holds the end turns of the stator winding securely in position, thus guarding against any movement on short circuit.

A large part of the switchgear is in stonework cubicles in the basement, and is mechanically remote controlled. The 3 000 V high-tension gear installed controls the turbo-alternator just mentioned, the 1 000 kW feeders (both incoming and outgoing), the 1 000 kW transformers, &c., as well as 440 V gear for 2 000 A incoming feeders, and 350 kW outgoing feeders. The operating boards for both high and low tension gear are in two sections, each consisting of a six-panel flat-back board for the high-tension gear, and a five-panel desk type board for the low tension. It might also be mentioned that there are two 200 h.p. motor generator sets in the station for supplying current to the Witton Kramer magnets.

An Electrically-Driven Strip Mill Plant.

An interesting electrically driven strip mill plant has recently been put in operation at the works of the Improved Steel Company, Lupton, through whose courtesy we are enabled to publish an account and illustrations of the equipment which has been installed by the English Electric Company.

The mill has been erected in a new building approximately 80 ft. wide by 350 ft. long, whose lay out has been so arranged that there is a straight flow of material through the shop. Fig. 1 shows the general lay-out of the mills and furnaces looking from the finishing mill towards the incoming end of the shop.

Facilitating Production

Both the mills are of the double two-high type, 14 in. diameter and are driven through machine-cut pinions supplied with pressure

width of 12 in. and of thicknesses varying from 16 gauge to 4 gauge. In addition they can deal with small sections and special shapes, and it is anticipated that outputs of from 20 tons to 100 tons per eight hours shift will be obtained, depending on the class and weight of finished product.

The Cogging Mill.

The drive for the cogging mill consists of a 3-phase induction motor running at a synchronous speed of 300 revs. per min. and capable of giving 650 H.P. continuously when supplied from a 2 700 volt, 50 cycle 2-phase supply.

A flexible coupling connects the motor to the pinion of a 5:1 gear reduction, the wheels of which are of the double helical type. The shaft carrying the spur wheel is extended to take a flywheel 2½ tons in



FIG. 1. GENERAL LAY-OUT OF MILLS, LOOKING TOWARDS INCOMING END OF SHOP.

oil lubrication. They are so arranged that the product from the roughing mill leaves a groove approximately in line with the first groove of the finishing mill, thus minimising the time taken in transferring the metal between the two mills. The distance between the two mills is also reduced to a minimum for the same reason.

The heating furnaces, of which there are two, are of the continuous pusher gas fired type and are capable of heating 100 tons of billets or slabs per eight hour shift. The pushers are hydraulically operated and are situated at the back of the furnaces, whilst the outlet doors for the heated metal face towards one another. The overhead electrically operated crane, which runs the full length of the shop, has a maximum lifting capacity of 25 tons. This ensures rapid manipulation of rolls, housings or material.

The mills are designed to deal with strip metal up to a maximum

weight, 17 ft. in diameter, the whole being supported by two heavy bearings. The shaft is extended through the bearing and is connected to the mill pinion shaft by a lever-controlled claw clutch. Apart from the introduction of a resistance in the rotor of the 3-phase motor to give a 10 per cent. speed drop between no-load and full-load to make use of the flywheel-stored energy, this mill runs at constant speed.

The Finishing Mill.

In view of the wide variety of sections to be dealt with in the finishing mill, variable speed for this mill was considered essential, and a high efficiency set operating on the "Kramer" system was adopted, as shown in Fig. 2. The set, as can be seen from the illustration, consists of a 3-phase and d.c. motor mounted on the same shaft, the sliprings of the rotor and the commutator of the

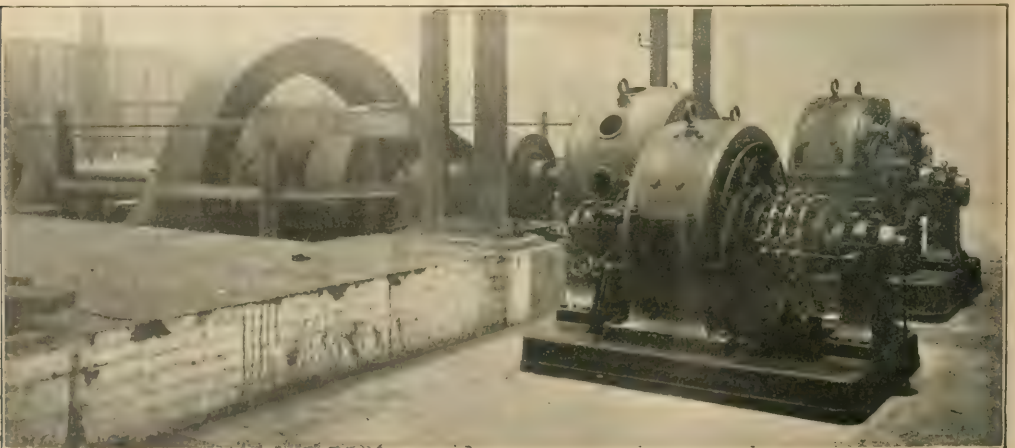


FIG. 2.—VIEW OF THE VARIABLE SPEED DRIVE ON FINISHING MILL, OPERATING ON KRAMER SYSTEM.

rotary being connected respectively to the sliprings of the induction motor rotor and the commutator of the d.c. motor. The speed of the set is controlled by varying the field of the d.c. motor, and a compound winding on this machine gives a speed fall of 1 per cent. between no-load and full-load. The operation of such a set is identical with that of a compound wound d.c. motor. In addition to the speed range, the set is designed to give unity power factor at all loads and speeds by a suitable design of the rotary converter.

The output of this set is also 600 H.P., and the full-load speed range

is from 340 to 510 revs. per min., corresponding to a full-load speed of 113 to 170 revs. per min. on the mill. The induction motor receives power from the mains at 2 700 V, 2-phase, 50 cycles, the supply for the d.c. motor at any speed below top synchronous speed passing from the rotor of the induction motor through the rotary. A similar arrangement of double helical reduction gearing and couplings between the motor shaft and mill pinion is adopted as in the case of the cogging mill, the flywheel in this instance having a weight of 20 tons and a diameter of 10½ ft.

A Modern Reversing Mill Drive.

An interesting example of up-to-date rolling mill practice is afforded by a 28 in. reversing cogging mill drive which is being installed by HADFIELD'S, LTD., in their East Hecla Works, Sheffield. We are indebted to this firm for permission to publish the following description.

The mill, which was constructed by the BRIGHTSIDE FOUNDRY AND ENGINEERING COMPANY, consists of two stands of 2½ in. rolls, one roughing and one finishing, and is designed to deal with ingots of 2½ and 30 cwt. in weight. The mill will be capable of rolling down at one heat to 2 in. square steel billets, the normal output of these being approximately 15 tons per hour, and the maximum output 20 tons per hour for a period of two hours; but the main product will be high carbon, alloy and "Era" manganese steels, the latter comprising rails and other special sections.

Electrical Equipment.

The mill is electrically driven and the main features of the electrical plant, all of which is being supplied by the BRITISH THOMSON-HOUSTON COMPANY, are briefly described below.

The mill motor, which has an R. M. S. rating of 3 200 H.P. and a maximum rating of 11 600 H.P., is capable of exerting a constant torque of 125 tons ft. from standstill to 60 revs. per min. in either direction, and gives a constant horse power of 3 200 H.P. between the speeds of 60 and 120 revs. per min. The overload capacity corresponds to a torque of 453 tons ft. between standstill and 60 revs. per min., and 11 600 H.P. between the speeds of 60 and 120 revs. per min.

The motor is of the double unit type, having two armatures and two magnet frames; the two armatures being mounted on a common shaft in two large pedestal bearings on a heavy section combination baseplate. The space between the magnet frames, each of which is split for convenience in handling, is enclosed by planished steel covers. Oil ring lubrication is employed in the two mill type bearings, and a phosphor bronze thrust face is provided on the driving end bearing to take any end thrust which might be transmitted through the driving coupling. As an extra safeguard, in addition to the holding down bolts, the bearing pedestals are provided with chocks to prevent transverse movement and with folding taper keys which prevent any lateral movement. The armature spiders, of specially robust construction, are each keyed to the shaft by two tangential folding keys, thus transmitting the drive effectively in either direction. A view of the motor, from the driving end, is given in Fig. 1 and affords some indication of the liberal mechanical design adopted. The complete double armature weighs 59 tons, the total weight of the complete machine being 182 tons.

The Mill Motor.

The mill motor is shunt wound, with compensating windings in the pole faces, and is provided with commutating poles; the two armatures being connected in series for a maximum voltage of 1 300 V. Ventilating air for the motor is cooled and cleaned by first passing through a wet air filter of the "Invincible" type and capable of dealing with 2 000 cub. ft. of air per min. A fan, driven by a variable speed d.c. motor, is employed to draw the air through the filter and to deliver it to the mill motor where it is introduced below the foundations and, entering the space between the two magnet frames, circulates outwards towards the commutators.

Power is supplied to the mill motor from a flywheel motor-generator set, comprising an induction motor of 1 800 H.P. running at 600 revs. per min. (synchronous speed) on a pressure of 3 300 V coupled direct to two shunt wound compensated generators, each rated at 1 300/4 750 kW when running at 500/600 revs. per min. at

650 V. The three machines are carried in four pedestal bearings on a combined baseplate, the shaft extension of the outer generator being fitted with a buffer spring type flexible coupling connecting a cast steel flywheel of 11 ft. 6 in. diam. and 30 tons in weight. The flywheel is mounted in two pedestal bearings, set on foundation caps, and is covered by a sheet steel guard. A similar guard is provided for the flexible coupling, but, in the illustration, Fig. 2, both guards have been removed to show the construction of the coupling and flywheel. Both the motor and generators are of the open type, with bearings of the spherical seated, self-aligning type arranged for oil ring lubrication. Water cooling is employed for the flywheel bearings which are arranged both for oil ring and flood lubrication.

Flywheel and Brake Gear.

The cast steel flywheel, which was made by Hadfields, is of the built-up type, two heavy rings, forming the ring, being spigotted and securely held by through bolts to the central boss and disc

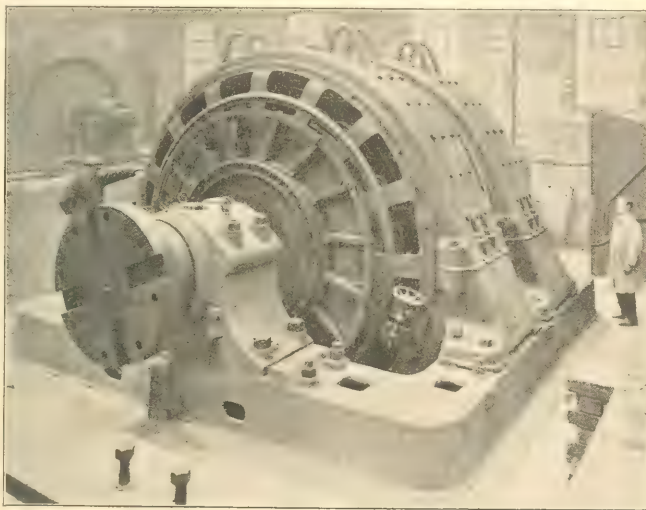


FIG. 1.—B. T. H. DOUBLE UNIT MILL MOTOR. VIEW FROM DRIVING END.

wheel portion, the bolt heads and nuts being counter sunk, riveted and turned, so that no projections are left. This construction reduces the risk of unsound metal and practically eliminates the initial stresses which would be produced by shrinkage during cooling were the wheel cast with a heavy rim. Water-cooled brake gear is provided to bring the flywheel quickly to rest in case of emergency, and consists of cast iron water-cooled brake shoes operating on the flywheel rim, and controlled from a hand-wheel through steel girder compound levers. The speed of the flywheel set is indicated on two instruments, one located on the main instrument board and the other on the control platform, these instruments being supplied from a magneto generator driven directly from the induction motor shaft extension.

The Exciter Set.

The mill motor and generator fields are supplied from a three-unit exciter set, which comprises a d.c. motor, mill motor exciter and generator exciter. The field windings of these exciters are designed to give rapid control of the mill motor and, since all speed variation is obtained by control of the exciter fields, only small currents have to be handled, a Ward-Leonard controller, mounted on the control

platform, being used for this purpose. The cylinder of the controller is operated through gearing by a single vertical lever, working in a slot, on the gate principle, the controller contacts being so arranged that the motor exciter field cannot be weakened until all the resistance has been cut out of the generator exciter field. Dash pots prevent the lever being operated too quickly in either direction, and needle valves are provided so that the action of the dash pots can

be easily adjusted. The controller, illustrated in Fig. 3, is provided with a catch to hold the lever in the off position, and a push button is mounted on the frame for tripping the circuit breakers in case of emergency.

mined value depending on the setting of the relays. When the motor reaches full speed only a small portion of the resistance is left in the rotor circuit.

When the load on the induction motor increases to some predetermined limit, say 25 per cent. overload, a high-speed relay opens the first of the slip regulating contactors, thus introducing more resistance into the rotor circuit and causing the motor speed

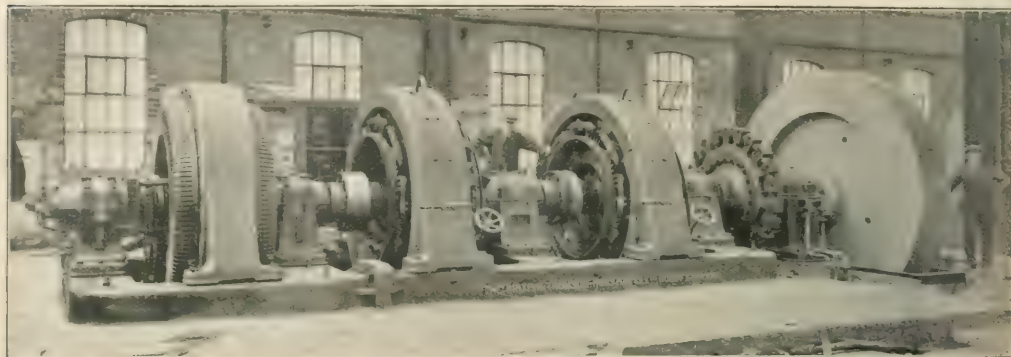


FIG. 2. B. T. H. FLYWHEEL MOTOR GENERATOR SET

be easily adjusted. The controller, illustrated in Fig. 3, is provided with a catch to hold the lever in the off position, and a push button is mounted on the frame for tripping the circuit breakers in case of emergency.

Power Supply and Control.

The power for driving the mill is taken from the Sheffield Corporation mains at 11 200 V, and transformed down by static transformers to 3 300 V. The supply to the induction motor is controlled by switchgear of the ironclad draw-out truck type, starting and speed

to drop, energy thus being obtained from the flywheel. If the overload persists, the second slip regulating contactor will open and so on. To avoid decrease in voltage due to this drop in speed, the contactors are provided with compensating contacts so that the generator fields are automatically strengthened as the speed falls.

Advantages of the Control System.

The advantages of this type of control may be briefly summarised as follows: The starting operation is automatic; a limited current is drawn from the line during starting; and extremely rapid and positive action is obtained during slip regulating, the action of the slip relay being practically instantaneous when the load increases to the value for which the relay is set. A further feature lies in the fact that only a small amount of resistance is normally in the rotor circuit, and the amount introduced with increase in load is the minimum possible to relieve the induction motor. This resistance is left in for the minimum period and the losses are therefore small.

The operating gear for the motor, screw-downs, manipulators, and live rolls, is situated on a platform over the main rolls. On this platform, also, is mounted the Ward-Leonard controller, shown in Fig. 3, and a main instrument desk which is equipped with a main ammeter, reading the current input to the mill motor, and two-speed indicators for the mill motor and flywheel set respectively. A switch, giving remote control of the main circuit breakers, is also provided on the control desk, together with indicating lamps showing the operation of the circuit breakers.



FIG. 3. WARD-LEONARD CONTROLLER TYPE C, SIZE B, FOR 11 000 HP. ROLLING MILL MOTOR, WITH OVER-LOAD RELAY

being controlled by a special contactor starting and slip regulating panel. With this type of control the starting operation is entirely automatic, for, when the main oil switch is closed, the whole of the starting resistance is connected in the rotor circuit, and, as the motor speed increases, the starting contactors close in sequence under the action of the notching relays, cutting out portions of the resistance in suitable steps. Successive contactors will not close until the current drawn from the line has fallen to some predeter-

International Conference on H.T. Systems.

THE UNION DES SYNDICATS DE L'ELECTRICITE, of which Mr. Triboi Lasperiere is the General Secretary, have invited the following countries to send delegates to a Conference to be held in Paris (at the offices of the Union) to discuss the various technical problems relating to high tension transmission systems:

Great Britain, Belgium, Spain, United States of America, France, Holland, Italy and Switzerland.

The following delegates have been nominated by the Institution of Electrical Engineers to represent British interests:—Mr. P. V. Hunter, Mr. E. B. Woodmore and Mr. W. B. Woodhouse.

The conference will be divided into three sections, dealing with (1) power station operation, including sub-stations; (2) construction of lines; and (3) distribution. It is hoped that the delegates from each country will submit papers on the subjects brought forward for discussion. The meetings will commence on Monday, the 21st inst., and will continue until the 26th inst. No afternoon meeting will take place on Nov. 24, when the celebrations in honour of Ampere will take place. On the same day (Nov. 24) a dinner will be given to the delegates at the Palais d'Orsay. A number of visits and excursions are also being arranged.

The various national electrotechnical committees of the International Electrotechnical Commission have been asked to assist in making the Conference as representative and as successful as possible, and the Union des Syndicats de l'Electricite notify that, in addition to the delegates specially nominated, the meetings will be open to all engineers who wish to attend.

Electricity and Drop-Forging Manufacture.

That electricity as a motive power has long found its place in the manufacture of drop-forgings may be generally acknowledged, providing the motors are of robust design, mechanically and electrically, so that no fears need be entertained on the score of overloads. The usual practice is to group hammers ranging from 10 to 30 cwt. falling weight, in batteries of five or six hammers, say, one each of 30 cwt., 20 cwt., 15 cwt., and 10 cwt., with two small preparing hammers of 5 or 6 cwt. falling weight. This enables the drop-forging to standardise a motor throughout his works. Where heavier hammers are employed the number of units in one battery is cut down to two, or in the case of very heavy hammers, to one only, and the same size motor used. On the other hand, the clipping presses lend themselves very well to unit motor drive, as do also the fans for blowing the forge fires. The methods of driving are various, but for the hammers the belt drive has undoubtedly advantages over a direct gear drive, while on the clipping presses a direct gear drive is the general rule, though there are one or two belt driven presses on the market.

These ideas are shown in practice at the works of The HUGHES-JOHNSON STAMPINGS, LTD., of Langley Green, to which a visit was paid recently. The drop-hammers are arranged in groups, and the standardisation of motors has been carried out even where single hammers of 4 ton and over falling weight are used.



DROP-FORGED SHAFTS WITH INTEGRAL FLANGES.

An illustration of the products of these hammers are some very large shafts, such as are shown herewith, while a class of drop-forgings of interest to the electrical trade are smaller shafts which are finished with coupling flanges complete, and solid with the shaft, inter-pole pieces, commutator rings of 12 in. and larger diameters, copper controller contact fingers, eyebolts, and bow nuts for lifting requirements. In addition to the copper forgings for contact fingers, we understand varieties of forgings in non-ferrous metals including brass, German silver, aluminium, and aluminium alloys are also turned out. An interesting point is that the furnace heats are carefully indicated by electric pyrometers, and the whole operation of heating, particularly in the case of the nickels, nickel chromes, tungstens, chromiums, and cobalt chrome steels is carefully watched, so that fatigue of material during production can be avoided.

The Gyroscopic Compass.

Dr. Paper on the "Gyroscopic Compass," read before the BRISTOL MINGHAM and DISTRICT ELECTRIC CLUB last Saturday, Mr. H. F. Stoughton gave some account of the theory and principles of the compass, and then described the early history of the application of these principles to the marine compass, pointing out that the construction of iron ships, together with the heavy steel armaments of modern warships, had made the magnetic compass exceedingly unreliable and had rendered the necessary corrections a very complicated process. The introduction of the gyroscopic compass had provided a mechanical substitute with considerable accuracy. It was possible, therefore, by electrical impulse to control any number of subsidiary compasses in different parts of the ship. It also made possible the keeping of an automatic record of a ship's course, and went very far to eliminate the fallible human element.

Reliability in Iron and Steel Works.

Mr. R. H. Archer Coulson, of the Skinningrove Iron Company, delivered his presidential address to the CHATHAM INSTITUTE OF ENGINEERS at Middlesbrough on Monday, Nov. 7. In urging the need of reliability in works management, Mr. Coulson said the use of grabs and magnets went a long way towards reducing iron and steel works costs, and there was no doubt that the future would see the extended use of electric locomotives, the more so as accumulators were becoming more efficient. The possibility of running locomotives a complete shift on one charge was within reasonable distance, and they would then see the huge delay that now exists in obtaining coal and water, and the loss of heat units due to locomotives standing under steam, done away with.

The question of generation and distribution was an important matter. Briefly, he would suggest that all generators should be as large as could be used economically. Generally speaking, the larger the units, the lower would be the cost of generating, overhauling, and replacements. By having switchboards of the simplest possible type, troubles were eliminated, particularly as they were called upon to operate automatically with the minimum of attention. By operating at a medium high voltage, the cost of switchgear and transmission lines, with their heavy maintenance costs, was cut down.

Underground cables were a doubtful advantage, and should be avoided as far as possible. There was always the danger of heavy traffic over lines, or subsidence, due to water and other causes, which caused the cables to sag, and might pull out the joints, but the most serious point was the length of time taken to locate and repair a fault. Overhead cables certainly lent themselves to easy location of faults and repairs. Using the power house as the centre of distribution had its disadvantages, mainly due to the danger of its becoming unwieldy as the plant grew, as that in the event of a fault it had to be looked for throughout the whole works, whereas with sub-stations a fault was limited to quite a small section, and much valuable time was saved. Motors in an iron and steel works had to operate under the most severe conditions, particularly in the mill, and nothing but the best should be used, as the demand upon a motor was more severe in this class of work than in any other. A large saving could be effected by keeping down the number of types of motors. Having once decided on a type, it should be adhered to, so that all motors of that particular size were interchangeable and the number of spares reduced to a minimum.

Post Office Activities: Underground Cables.

Speaking at Bedford last week, Mr. KELLAWAY, the Postmaster-General, said the Post Office was engaged on an extensive programme for the laying of telegraph and telephone cables underground. The necessity for this was shown by the damage done by the gale during the previous week-end. At ten o'clock on the following Monday morning 163 London trunks were stopped. The main open route to Bristol, via Reading and Marlborough, was broken down east of Chippenham. The London and Exeter route was broken east of Yeovil. Whilst there was no complete stoppage of communication between London and any of the large towns, or with Ireland or Scotland, communication with Germany and Holland was severed. The Post Office had placed contracts for the laying of over 800 miles of main cables. These included the trunk lines between London and Manchester, Southampton, Bristol and Brighton, Liverpool and Manchester, Birmingham and Worcester, Derby and Leeds, Glasgow and Edinburgh, and Birmingham and Manchester.

Speaking of the telephone service, Mr. Kellaway said that in addition to the programme of work for underground cables, the Post Office was also putting in hand a large number of new telephone exchanges and extensions to existing exchanges. During the next six months twenty-three new exchanges would be completed and forty-seven existing exchanges would be extended. During the year ending Oct. 31 twenty-six new exchanges had been completed and extensions had been made for fifteen exchanges. The total number of stations in use at the end of September was 964,479, or an increase of 3,447 over the total at the end of August. New orders were coming in at a satisfactory rate, and the number of people giving up the telephone was slightly below normal. They were fast overtaking arrears of work. At the beginning of the year they had 32,000 applications for telephones which they were not able to satisfy. That number had now been reduced to 15,000.

Insurance of Diesel Engines Against Breakdown.

The amended arrangements made by the Insurance Committee of the DIESEL ENGINE USERS ASSOCIATION for the insurance of Diesel engines against breakdown, including periodical inspection and reports by engineers having special Diesel engine experience, were reported at the last meeting of the association. A preferential rebate is allowed off the premiums to all Diesel engine installations whose engineers or managers are members of the Diesel Engine Users Association. An important provision under the standard policy is that which provides for arbitration in the event of a dispute without having recourse to the expensive method of proceeding under the Arbitration Act. In the event of disagreement in the interpretation of the policy, the matter may be submitted for arbitration to a Special Committee of the Diesel Engine Users Association. The services of this Committee as arbitrators are, however, only available if the engine user is a member or subscriber of the association. Particulars of the scheme of insurance under this standard Diesel engine policy can be obtained on application to the Honorary Secretary of the Association, 19, Cadogan-gardens, London, S.W. 3.

Legal Intelligence.

HACKNEY BOROUGH COUNCIL v. DORE.

The appeal by the Hackney Borough Council from a decision of the North London Police Court magistrate in this case was dismissed by a Divisional Court on Monday. We propose to give a report of the case in our next issue.

THE GAS-FILLED LAMP PATENT.

On Monday the House of Lords (Viscounts Haldane, Finlay and Cave, and Lords Dunedin and Shaw) commenced the hearing of arguments in the appeal by the British Thomson-Houston Company from a decision of the Court of Appeal upholding a judgment of Mr. Justice Sargent, who dismissed plaintiffs' action for an alleged infringement of their patent by the Corona Lamp Works. It will be remembered that Mr. Justice Sargent held that respondents had infringed, and that the specification disclosed an invention of a high order of merit, but that claim one of the patent did not sufficiently define and limit the ambit of the monopoly claimed, inasmuch as the word "large" used in the claim did not sufficiently define the dimensions of a filament coming within the combination claimed.

Sir Arthur Colefax, K.C., Mr. Hunter Gray, and Mr. James Whitehead appeared in support of the appeal (instructed by Messrs. Bristow, Cooke and Carmichael; while Sir Duncan Kerly, K.C., Mr. Robert Frost and Mr. J. E. Walker (instructed by Messrs. H. C. Morris, Woolsey, Morris and Kennedy) were for the respondents.

The hearing is proceeding.

CLAIM BY MR. A. SIEMENS.

Last week the Anglo-German Mixed Arbitral Tribunal heard the claim of Mr. Alex. Siemens against Siemens & Halske (A.G.), of Berlin, for the value of 390 1000-mark shares in the latter firm (which on Aug. 4, 1914, were stated to be of the value of £37 464), and interest at 5 per cent. thereon, and a sum by way of dividend on the shares due on July 31, 1914.

Mr. HUGHES, K.C. (for Mr. Siemens) said his client was a former director of Siemens Brothers & Company. He had been in England since 1867, and was naturalised in 1878. In 1908 the Berlin company acquired a controlling interest in the English firm, and part of the arrangement was an exchange of shares in the two companies, the Berlin firm transferring to Mr. Siemens 506 shares of 1000 marks each. It was arranged that for an indefinite time Mr. Siemens should not have shares, but should receive yearly a sum of money equivalent to the dividends on the shares. Those shares were, in fact, never issued until 1919, and were not introduced on the Berlin Stock Exchange until May, 1920. The chief question between the claimant and respondents seemed to be whether those shares were in fact issued or not, respondents alleging that the shares were in truth issued. Mr. Siemens, requiring money, had received the value of 116 of the shares, and the claim was in respect of the balance of the 506 shares. From 1909 to 1914 he received each year money equivalent to the dividends on the remaining 390 shares. In the meantime his name remained on the shareholders' book of the English firm, although the real owners were Siemens and Halske. During the war the real ownership of the shares was disclosed, and they were placed in the hands of the custodian appointed by the authorities. Respondents said that the claimant had in fact had his shares in Siemens and Halske; that they were now at the Deutsche Bank ready for him, where there were also standing to his credit dividends amounting to 322 000 marks. That would be worth only about £300 if remitted to claimant to-day.

After evidence by Dr. E. J. Schuster and Mr. Siemens.

Dr. BARANDON (for respondents) said that the claimant became a shareholder of 506 1000-mark shares in Siemens and Halske because he signed the application form, received dividends on them, sold some of them, and exercised all the rights of a shareholder in that firm. Therefore respondents had fulfilled their side of the agreement up to the period of the outbreak of war.

Dr. ALBERT BERLINER, managing director of respondent firm, said that claimant, by selling 116 of the shares, made money on the deal, for up to 1914 the mark stood at par value with English currency. He could have sold the lot had he wished to do so.

The decision of the Court has not yet been given.

Water-Power Stations in Denmark.

The Committee which was formed in DENMARK in 1920 to investigate the question of WATER-POWER STATIONS has presented its report, from which it would appear, states the Commercial Secretary to H.M. Legation in Copenhagen (Mr. R. Turner), that seven or eight such stations could possibly prove economically justifiable so long as the price of coal does not go below 30 to 35 kroners per ton. Seven stations together would be able to produce 14 000 kW. or 27 000 000 units yearly for an average price of 10 ore per unit, and the capital necessary for the erection of the stations (on the price basis of 1920) is estimated at 30 000 000 kroners. The seven stations in question are at Raunstrup, Vesthirk, Holstebro, Bur, Ahlersgaard, Skjern, Karlsgaard, and Ansager, and if the recommendation of the Committee for their construction is followed, it is estimated that, together with the existing water-power stations in Jutland, there will be a yearly production of 40 000 000 units. The present total consumption of electricity in Jutland is estimated at 50 000 000 units, but, in the opinion of the Committee, the consumption is likely to grow, so that on the completion of the proposed stations practically the whole output of the works would be in use. If the seven new stations are completed, all the important water-power stations in Jutland are to be connected together, at an estimated cost of 15 000 000 kroners.

Parliamentary Items.

KEY INDUSTRIES.

THE SECRETARY to the DEPARTMENT of OVERSEAS TRADE has informed Major Kelly that no legislation amending or extending the SAFEGUARDING OF INDUSTRIES ACT is contemplated for next session.

In reply to CAPT. WEDGWOOD BENN, who asked for particulars of the steps being taken to manufacture in this country articles protected by Part I. of the Safeguarding of Industries Act which are at present only obtainable abroad, SIR P. LLOYD-GREAME stated that, apart from the activities of certain industrial research associations, such information on this subject as has come to the knowledge of the Board of Trade had been given confidentially by manufacturers engaged in, or intending to take up, particular lines of production, and he did not think it right to make such information public.

ARC-LAMP CARBONS.

MR. MOSLEY asked the President of the Board of Trade whether the Islington Borough Council published, prior to the passing of the Safeguarding of Industries Act, particulars of tenders for arc-lamp carbons, showing that the French price was £14 8s. per 1000 and the German price £10 15s. 6d. per 1000; and, seeing that the effect of the flat-rate duty is to impose a heavier charge on French than on German commodities in such cases, will he reconsider the policy of the Government?

SIR P. LLOYD-GREAME: I was not aware of the publication of the particulars stated in the first part of this question; the answer to the second part is in the negative.

ELECTRIC LAMPS (TUNGSTEN WIRE).

CAPT. W. BENN asked the President of the Board of Trade whether difficulty had arisen over the amount of duty to be levied on tungsten wire contained in electric lamps; whether figures had been submitted to H.M. Customs proving by exhaustive analysis of figures as relating to lamps of various voltages and wattages, showing that the value of the tungsten averages less than 1 per cent. of the c.i.f. value of the lamp; whether in London H.M. Customs have accepted as a full settlement payment of duty on such a basis; and whether H.M. Customs at Goole have refused to release consignments of these lamps unless safeguarding of industries duty is paid on the basis that the tungsten wire represents 10 per cent. of the total invoice value?

MR. YOUNG: The Commissioners of Customs and Excise have before them figures given by various importing firms, and are considering how far it is possible to establish standard values for the wire in question. They have not yet established any general standard of value, and any settlement in London on the basis suggested in the question must have referred solely to a particular consignment. The case at Goole referred to cannot be identified without further particulars.

PROPOSED GENERATING STATION AT BARKING.

Replying to CAPT. MARTIN, MR. NEAL stated that the County of London Electric Power Company have made application to the Electricity Commissioners for permission to erect a large generating station on land at Barking, which will give work to a large number of unemployed, and that the Commissioners hope to announce their decision on the application shortly.

ELECTRICITY (SUPPLY) SPECIAL ORDERS.

The House of Commons has approved the Special Orders made by the Electricity Commissioners and confirmed by the Minister of Transport in respect of (1) BEDFORTH and BULKINGTON, (2) STEYNING, BRAMBER and BEEDING, (3) BELPER and HEAGE, (4) DUNBLANE and part of the parish of Dunblane and LECROFT, (5) for the amendment of the HOYLAND NETHER Electric Lighting Order, 1912, (6) DORCHESTER, and (7) ABERSCHECH.

TRADE FACILITIES ACT, 1921.

The Royal Assent has been given to the Trade Facilities Act, 1921.

Obituary.

The death is announced, at the age of ninety, of MR. EDWARD WINDSOR RICHARDS, J.P., D.L., of Plas Llecha, Caerleon, Mon., one of the best-known South Wales ironmasters. Mr. Richards was a past-president of the Iron and Steel Institute and the Institution of Mechanical Engineers.

We regret to record the death, on the 13th inst., of SIR DOUGLAS FOX, M.I.C.E., the eminent civil engineer. He was the son of Sir Charles Fox, and was born at Smethwick in May, 1840. He was articled to his father, and in 1863 became a partner in his father's firm of consulting engineers. On the death of his father, Sir Douglas Fox, with his brother (Sir Francis), succeeded to the business. The firm have been especially active in railway construction, both at home and abroad. Among the lines constructed by the firm were the Liverpool Overhead Railway, the Mersey Railway and its tunnel under the river, and the two London tubes—the Great Northern and City and the Charing Cross, Euston and Hampstead lines. For many years they have also been consulting engineers for the Channel Tunnel, and they have carried out hydro-electric work in North Wales. In 1866 Sir Douglas Fox became a member of the Institution of Civil Engineers, and served as its president in 1899-1900. He took part in the establishment of the British Engineering Standards Association, and represented the Institution of Civil Engineers upon the main committee of that organisation until March last. He was knighted in 1886, and his only son, Francis Douglas Fox, is a partner in his father's firm.

Electricity Supply.

YORK Electricity Committee has received sanction to borrow £10 000 for electricity mains.

MANCHESTER Electricity Committee have been authorised to borrow £11 725 for sub-station equipment.

Owing to present trade conditions BEDWAS electric lighting scheme has been deferred for twelve months.

WILLESDEN Urban Council have been authorised by the Electricity Commissioners to borrow £30 000 for mains extensions.

The residents of ACKWORTH are taking steps to obtain a supply of electricity from the Yorkshire Electric Power Company.

YARMOUTH Town Council announce a reduction of 15 per cent. as from the Christmas quarter in the cost of electric current.

BRENTWOOD Urban Council has appointed a committee to consider the details of an electric lighting scheme submitted to them.

SPALDING Council have appointed a committee to report upon the advisability of applying for a Special Electricity Supply Order.

EAST GREYSTED Council have instructed the Gas and Water and Electricity Committee to prepare a scheme of electric lighting for the town.

WORKSOP Urban Council have borrowed £27 000 from the Liverpool Victoria Friendly Society at 6½ per cent. for electric light extensions.

The Minister of Transport has revoked the PORTPATRICK ELECTRIC LIGHTING ORDER, 1904, as to the whole of the area of supply, as from the 10th inst.

The MYNYDDISLWYN Urban Council has appointed Mr. Arthur Ellis, consulting engineer for the electric lighting of the new houses on the Bryn site.

WORKSOP Urban Council has applied for sanction to borrow £4 500 for carrying overhead electrical wires to the new model village of Rhodisia, near Shireoaks.

AYLESBURY Town Council have received sanction from the Electricity Commissioners to loans of £24 922 for electricity plant, and £4 500 for mains and services.

AMESBURY Rural Council has granted permission to the Amesbury Electric Supply Company to erect overhead wires for the public supply of electricity.

The price of electricity for power, heating and cooking purposes in DUBLIN has been reduced by ½d. per unit, the reduction to take effect from Oct. 1.

HYTHE (Kent) Town Council has entered into an agreement with the Folkestone Electric Lighting Company to supply electricity to the council houses being erected.

MAIDSTONE Council has sanctioned cable extensions, including one to Hermitage-lane, for the supply of electricity to thirty-five bungalows of the Industrial Settlements, Ltd.

The Electricity Commissioners have approved of the application of the Yorkshire Electric Power Company to establish a new generating station at FERRYBRIDGE, YORKS.

WINCHESTER Corporation has applied for sanction loans of £1 000 for a water-spraying plant and £1 200 for an "Olipel" remote control gear and switches for the street lighting.

A protest has been made by SEVENOAKS Urban Council against an application to cancel that portion of the local electric supply company's Provisional Order relating to Oxted district.

DUNDALK Urban Council have adjourned until February a motion by Mr. J. Coburn to affect a certain reduction in the salaries and wages of those employed at the Council's electricity station.

As the Gas Company at DEAL has decided not to proceed with the carrying out of their electric lighting order, the Town Council is to consider the question of carrying out a municipal scheme.

AYR Corporation is proceeding with the scheme for the utilisation of the water power of Loch Doon, and plans are being prepared by Messrs. Preece, Cardew & Rider preparatory to the promotion of a provisional Order.

The question of extending the SOUTHAMPTON electric supply system to Eastleigh and Bitterne is at present under consideration by the Electricity Committee, and it is anticipated that supply will be available in these districts within a short period.

The Mersey Power Company, Ltd., have applied to the Electricity Commissioners for a Special Order to authorise the company to supply electricity in the Ellesmere Port and WHITEY URBAN DISTRICT, and portions of CHESTER RURAL DISTRICT.

SOUTHEND Borough electrical engineer reports that the cost of generation of electricity by means of Diesel oil engines, which were taken from captured or surrendered German submarines, is approximately 2.47d. per unit, as compared with 3.98d. per unit for steam plant.

LINCOLN City Council have decided to approach the Electricity Commissioners with a view to obtaining the suspension of payment for three years to the sinking fund loan sanctioned in respect of their electricity scheme. This would effect a total saving of about £12 000.

After a three hours' discussion, LLANFAIRFECHAN Urban Council decided to abandon the proposed £10 000 electricity scheme for an indefinite period, as it was feared that before it was finished £15 000

might have to be paid out, and the Council's total borrowing powers only amount to £13 504.

WORCESTER Corporation have sanctioned extensions of plant at the Hylton-road station. It is proposed to acquire generating plant at the Southampton Rolling Mills, which has been inspected by the electrical engineer (Mr. Shaw). The scheme will involve an expenditure of about £56 000.

On Sunday afternoon there was a failure of the electricity supply in the Fleet-street area owing to an explosion of gas in an inspection box of the CITY OF LONDON ELECTRIC LIGHTING COMPANY near Blackfriars Bridge, London. Several newspaper offices were deprived of light and power for two or three hours, but the service was completely restored by 5.30 p.m.

The Electricity Commissioners notify that the local inquiry which was fixed to take place at Sheffield on the 29th inst., into the schemes for the reorganisation of electricity supply, &c., into the NORTH-EAST MIDLANDS ELECTRICITY DISTRICT, has been postponed in consequence of a request from various interested parties for further time to consider supplementary technical particulars. No date has yet been fixed for the inquiry, but official intimation will be given in due course.

On Tuesday the Electricity Commissioners opened an inquiry at Birmingham into the schemes submitted for the reorganisation of electricity supply in the SOUTH-WEST MIDLANDS ELECTRICITY DISTRICT. Sir H. Haward presided, and the other commissioners present were Mr. H. Booth and Mr. A. Page. The joint scheme of Birmingham Corporation and the Shropshire, Worcestershire and Staffordshire Electric Power Company was explained by Mr. Clode, K.C., and evidence in support was given by Councillor Beale, of Birmingham. The inquiry is proceeding.

To consider the question of the provision of a bulk supply of electricity to the urban and rural districts adjoining CHESTER, a conference has taken place between representatives of Chester Corporation, Hoole Urban Council, and the Chester and Tarvin Rural Councils. The Town Clerk of Chester has been in communication with the Electricity Commissioners with regard to the formation of a joint committee for the district, and the Commissioners had expressed the view that a scheme of the kind suggested appeared to them to be cumbersome and complex. They advised that it would be simpler and far more expeditious for Chester Corporation to obtain a Special Order to extend their supply area. It was agreed that the representatives of each authority should obtain the views of their Councils, and in the meantime Chester Corporation would take the preliminary steps towards obtaining a Special Order. The proposed order would come into operation before the Order for the North Wales electricity district came into operation, and in the extended area the Corporation will become the authorised undertakers. Provided the Rural Council of CHESTER is allowed representation on a consultative committee, it does not intend to oppose an application by Chester Corporation for a Special Order to distribute electricity in an extended area.

Electric Traction.

ISLINGTON (London) Borough Council has decided to raise a loan of £8 237 for the purchase of four "Edison" electric vehicles and the installation of charging plant at the municipal garage.

On Monday a new system of ELECTRIC SIGN SIGNALLING, similar to that installed on the London Underground systems, was put into operation on the Mersey underground electric railway between Liverpool and Birkenhead.

The Metropolitan Railway Company have submitted a scheme to the Government for a NEW RAILWAY TO WATFORD. The work, it is estimated, will cost about £300 000, of which practically 80 per cent. will be spent on wages.

To prevent sixty of their number—guards and conductors—who had been served with notice of dismissal, from being thrown out of work, MANCHESTER TRAMWAYMEN recently held a mass meeting, and decided to suggest to the tramway management that each guard and driver should take a day between now and Dec. 31. Mr. McElroy, the general manager of the tramways, has agreed to the proposal. In this way regular work will be found for the sixty men who were threatened with unemployment. This arrangement is to stand until Dec. 31.

DUDLEY Town Council have received a letter from the Birmingham and Midland Joint Committee of Electricity, Tramways, and Motor Omnibus Undertakings as to the BLACK COUNTRY TRAMWAYS being combined into one undertaking. The companies concerned are about to promote a Bill in the ensuing session of Parliament with this object, but if the local authorities concerned are desirous of forming a Joint Board to acquire and operate all the local tramways, the Joint Committee will co-operate with the local authorities to that end. The Mayor and another member will attend any conference of local authorities convened for the purpose.

The NATIONAL JOINT INDUSTRIAL COUNCIL for the TRAMWAYS INDUSTRY last week discussed the question of the revision of the national agreement of March, 1919, which guarantees a forty-eight-hour working week. The employers urged that the agreement should be revised, but no decision was reached, and the meeting was adjourned for the employers to consult their constituents. A conference of all the municipal tramway authorities in the kingdom represented by the Municipal Tramways Association, and of the private companies represented by the Tramways and Light Railways Association, is to be held. The Transport Union threatens to resist any attempt to enforce a longer working week.

Institution Notes.

THE LONDON ELECTRICAL ENGINEERS' OLD COMRADES' ASSOCIATION, during their second season with a smoking concert at the Bridge House Hotel, London Bridge, on Friday, Nov. 22, at 7 p.m. F. Frankling (hon. secretary), 108, Heathwood-gardens, Charlton, S.E. 7.

At the meeting of the ROYAL INSTITUTION on the 7th inst. the special thanks of the members were returned to Mrs. Williams for her gift of personal notes of Davy's Lectures at the Royal Institution made by Thomas Harrison (secretary, 1813-24), and twenty-two books of the works of Cicero, Horace, Hippocrates, and Waring, formerly in his possession.

Mr. R. N. Eaton presided at the meeting of the IRISH CENTRE OF THE INSTITUTION OF ELECTRICAL ENGINEERS in the College of Science, Dublin, last week, when the report of the Fuel Research Board and that on the Water Power Resources of Ireland were discussed, the former in relation to the peat supply. Amongst the speakers were Sir John Griffiths, Professor Purcell, and Professor Jeffcoat.

Arrangements have been made for the members of the INSTITUTION OF ELECTRICAL ENGINEERS to dine together at the Engineers' Club, Coventry-street, W., after the ordinary meeting of the Institution, to be held on Dec. 1. The charge per cover is 5s. 6d. Members wishing to be present at the dinner are requested to send their names to the secretary a day or two in advance.

A proposal for a sub-division of the WESTERN CENTRE of the INSTITUTION OF ELECTRICAL ENGINEERS has been well received by the members. At present the centre holds its meetings in Bristol or Cardiff, with an occasional visit to Swansea, but the attendance is naturally restricted to those who reside more or less near to the point of meeting. It is suggested that there should be a separate centre for members living south of the Severn, which could hold its meetings at Exeter.

The Christmas course of Juvenile Lectures at the ROYAL INSTITUTION will be delivered this year by Prof. J. A. Fleming, F.R.S., on "Electric Waves and Wireless Telephony." The lectures, which will be experimentally illustrated, will be given on the following days at 3 o'clock: Thursday, Dec. 29, "Surface Waves on Liquids"; Dec. 31, "Waves in Air"; Jan. 3, "The Telephone"; Jan. 5, "Electric Oscillations"; Jan. 7, "Electric Waves"; and Jan. 10, "Wireless Telephony."

The first sessional meeting of the INSTITUTE OF ELECTRICAL ENGINEERS (WESTERN CENTRE) was held at the Engineers' Institute, Cardiff, last week. Mr. A. C. McWhirter, in his presidential address, called attention to the work of the contracting centre of the institute, and urged that established firms should be supported in their endeavour to work against the crowd of nondescripts who had nothing at stake, but who styled themselves electrical contractors. The Electrical Contractors' Association was endeavouring to raise the status of the electrical contractor to a higher standard, and the assistance of all who placed orders for contracting work was required to bring this about. Only responsible firms should be employed. The association was hopeful that in the near future contractors would require to be registered, and he believed their institute would welcome and support such a reform. At the outset a hearty vote of thanks was accorded to Mr. A. J. Newman, the retiring president.

At a meeting of the West of Scotland Iron and Steel Institute, held last week at Glasgow, Mr. Andrew Gray presiding, Mr. Harry Etchells read a paper on "THE PRESENT STATUS OF ELECTRIC FURNACES IN STEEL MAKING." Ten years ago, he said, there were only about four furnaces in Great Britain devoted to electric steel making, and no large development had taken place in other countries. The latest available figures showed that the United States had now 287, Canada 43, Great Britain 135, France and Belgium 70, Italy 146, and Germany and Austria 70. The points he wished to make were that electric steel was a desirable material, that electric furnaces were not necessarily limited, either in capacity or cost of production, to making high-grade steels; that the demand for electric steel was likely to increase as the properties and manufacture of the material became better understood; that a day might come when electric steel would compete with open hearth steel in price; that it was necessary to get the cost of electric power down in this country; and that the comparatively low load factor of electric steelmaking furnaces gave them a chance of competing against hydro-electric power.

The annual dinner of the FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION, which was held at the Engineers' Club, London, on Saturday last, was a joyous affair. Though joyousness is not unusual at such gatherings, on this occasion there was the added reason for its presence in the postponement for five years at least, and we hope indefinitely, of the closing of the college. The Old Students' Association may pride itself on its scheme in bringing about this happy result, and we have no doubt that its influence on the welfare of the college will continue to be profound. In order to increase this influence it is necessary that old students from all over the world should take more interest in the affairs of the association. Considering the hundreds of men who have passed through Finsbury, the attendance last Saturday night was very small, because the Council of the Association find it a difficult task to keep in touch with all those who ought to be members, and make those who are not see the error of their ways. The latter class of individual should communicate with the honorary secretary, Mr. H. P. Guy, 209, Northumberland-park, Tottenham, London, N. 17.

Personal and Appointments.

THE NOBEL PRIZE FOR CHEMISTRY for 1920 has been awarded to Prof. Walther Nernst.

Norwich Town Council have re-elected SIR GEORGE M. CHAMBERLIN director of the Electric Tramway Company.

COUNCILLOR J. BELL, chairman of the local Electricity Committee since 1913, has been elected Mayor of West Bromwich.

Mr. E. FRIGGLE has been appointed manager of the electrical business of Wellman Brothers, Windsor.

Mr. R. HOGGARD, traffic manager of the Lincoln Corporation tramways, has now been appointed general manager of the undertaking.

Mr. F. C. WILSON has been re-elected chairman and ALDERMAN F. SMITH deputy-chairman of the Liverpool Tramways and Electricity Committee.

Mr. R. L. McCULLOCK, chief engineer of the North of Scotland Power and Lighting Company, has been appointed manager of the Hobart (Tasmania) Tramways Department.

Mr. T. P. STRICKLAND, assistant chief electrical engineer of the New South Wales Railways and Tramways Department, has been appointed chief electrical engineer to the Melbourne Metropolitan Tramways Board at a salary of £2 000 a year.

Mr. R. L. WEDGWOOD, deputy general manager of the North-Eastern Railway Company, has been appointed general manager, as from Jan. 1 next, in the place of Sir Alexander Butterworth, who is retiring after having held the post since 1906.

ALD. DAGNALL, ALD. BOWES, and COUNCILLOR JOHNSON have been re-elected chairmen of Manchester electricity, tramways, and watch committees respectively. ALD. WALKER, ALD. CHAPMAN, and COUNCILLOR GRIME have been elected deputy chairmen.

Mr. E. P. BEALE continues chairman of the Birmingham Electricity Supply Committee, and Mr. J. B. BURMAN returns to this committee, of which he was formerly chairman. At the last meeting of the Birmingham City Council the latter was appointed an alderman.

The following awards have been made by the President and Council of the Royal Society:—The Copley Medal to SIR JOSEPH LARMOR, M.P., F.R.S., for his researches in mathematical physics; the Davy Medal to PROF. PHILIPPE A. GUYE, for his researches in physical chemistry; the Hughes Medal to PROF. NIELS BOHR, for his researches in theoretical physics.

Mr. F. H. MANN has now joined the firm of Messrs. Moffett & Rosher, consulting engineers, of Birmingham, as a partner. Mr. Mann formerly associated with the firm as assistant engineer. During the earlier period of the war he served in the R.N.D. at the Dardanelles, and later was a lieutenant (E.) in the battle cruiser H.M.A.S. Australia, where he was in charge of the electrical generating plant and equipment. Early in 1919 Mr. Mann was engaged to engineer the extensions to the Grimsby Corporation Electricity Works, and has been occupied on this work and on the construction of sub-stations until resigning to rejoin his old firm.

Business Items, &c.

HADFIELD'S, LTD., has associated itself with the Australian Electrical Steel Company, Ltd., of Alexandria, Sydney, and is reforming with a capital of £500 000.

The new Birmingham works of the BRITISH ELECTRICAL REPAIRS, LTD.—a subsidiary of the British Engine Boiler and Electrical Insurance Company, Ltd.—were formally opened last week.

The Belfast depot of the EDISON SWAN ELECTRIC COMPANY, LTD., has now been removed to more commodious premises at 41, Chichester-street, to which address all communications should be sent.

Mr. F. H. MANN has now joined the firm of Messrs. Moffett & Rosher, consulting engineers, of Birmingham, as a partner, consequent upon the retirement of Mr. N. B. Rosher. The new style of the firm will be MOFFETT, ROSHER & MANN.

Cross Brothers, Ltd., ironmongers, CARDIFF, have opened a department devoted to heating and lighting apparatus and electrically operated labour-saving devices. Demonstrations of the latter, which attracted large crowds, were given daily last week.

THE SWEDISH GENERAL ELECTRIC LIMITED announce that the prices of "Century" single phase repulsion induction motors have been considerably reduced, and the firm will be pleased to furnish enquirers with new prices and discounts on application.

MESSRS. C. A. VANDERVELL & COMPANY, LTD., have supplied 2 000 dynamos since Jan. 1 to the London General Omnibus Company. In addition to this, during the same period they have supplied 1 500 dynamos to the various oil companies in the metropolis. After a long period spent in testing all and every kind of ANTI-DAZZLE DEVICE submitted to them for motor lamps, the company have decided that the one which will meet the requirements and is nearest to the ideal of the Transport Ministry, is that made under the Grubb patents. Messrs. C. A. Vandervell have, therefore, arranged to take over the world's right for manufacture. The lamp in future will be known as the C.A.V. non-dazzle lamp. Models were on view at the Olympia Motor Exhibition last week.

Miscellaneous.

The London Underground Companies have sent a contribution towards the restoration of Rheims Cathedral.

The memorial tablet to the late Lord Rayleigh in Westminster Abbey is to be unveiled on Wednesday, Nov. 30, at 2 p.m.

The next regular meeting of the KELVIN LODGE will be held at Mark Masons' Hall on Friday, Nov. 25, at 4 p.m. Morning dress.

The No. 7 District (East Midlands) Electricity Joint Industrial Council have asked the National Council to arrange a national settlement of the overtime rates' question.

In giving details of the new Blackburn Meadows station in our issue of Nov. 4, we omitted to state that the makers of the patent self-cleaning circulating water screens are Messrs. F. W. BRACKETT & COMPANY, LTD., of Colchester.

It is stated that three of the mill furnaces at MESSRS. BEARDMORE'S works in PARKHEAD are to be re-started this week, and it is anticipated that several of the furnaces at Mossend will also be re-lighted to cope with section and plate orders.

The following companies will be STRUCK OFF THE REGISTER OF JOINT STOCK companies, unless cause to the contrary is shown before Feb. 11, 1922: Blackpool Electric Tramways (South), Electric Generating Stations, Electromotor Equipment Company, Simplex Insulators (Bourke's Patent).

The Home Secretary has made an Order authorising the EMPLOYMENT OF WOMEN AND YOUNG PERSONS OF SIXTEEN YEARS OF AGE AND OVER in machining iron electrical fittings at the Bath-street Works of Messrs. Henry Moseley & Sons, Walsall, on two day shifts, subject to the conditions that no worker shall be employed in the afternoon shift in consecutive weeks, and that suitable cloakroom and mess-room accommodation shall be provided.

The Admiralty have decided that the ELECTRICAL ARTIFICER BRANCH OF THE NAVY shall in future be divided into two branches. Under the new system the titles will be as follows:—Electrical lieutenant and ordnance lieutenant (T.), commissioned electrical officer and commissioned ordnance officer (T.), warrant electrical officer and warrant ordnance officer (T.), chief electrical artificer and chief torpedo artificer, and electrical artificer and torpedo artificer.

Batteries, Ltd., have offered to SURRENDER the following LETTERS PATENT which were granted to the Svenska Akkumulator Aktiebolaget Jungner: No. 5 545/12, for "Process of manufacturing negative electrodes for alkaline accumulators"; No. 72/14, for "Process for restoring the activity of a positive electrode mass for alkaline accumulators"; and No. 123/14, for "Improvements relating to electric accumulator cells." Any person desiring to be heard in reference to such surrender should notify the Comptroller-General, Patent Office, 25, Southampton-buildings, W.C. 2, by Dec. 9.

Referring to statements which appeared in the Press as to what happened at the meeting of the National Joint Board in respect to an AGREEMENT between the ELECTRICAL POWER ENGINEERS' ASSOCIATION and the ELECTRICAL TRADES UNION, Mr. W. J. Webb, London district secretary of the E.T.U., states that the facts of the case are as follows:—An agreement was entered into between the E.T.U. and the E.P.E.A., provided that it could be arrived at on lines of demarcation of membership. Agreement has not, however, been reached on the point, and therefore there is no agreement between the two bodies.

Foreign Notes.

The PARIS Municipal Council are going to establish, at a cost of about 1 200 000 francs, a MUNICIPAL INSTITUTE OF ELECTRO-THERAPY.

Owing to the exchange situation, HAEFFEL & COMPANY, manufacturers of electrical fittings, are leaving Basel. Two other firms are reported to be ready to leave also.

In order to celebrate the twenty-fifth anniversary of its registration the TOKIO ELECTRIC LIGHT COMPANY is giving a donation of 1 000 000 yen (about £102 000) to the City of Tokio for the purpose of conducting ELECTRICAL RESEARCH.

It is reported that during the year ended March, 1921, the GERMAN SALES OF METAL FILAMENT LAMPS for home consumption totalled 51 200 000, and for export 29 200 000 lamps. The corresponding figures for carbon filament lamps were 3 500 000 and 1 900 000 lamps.

THE ELECTRIC STEEL OUTPUT OF THE UNITED STATES OF AMERICA in 1920 amounted to 747 724 tons, an increase of 32 per cent. over the 1919 production. The electric steel ingots and castings totalled 502 152 tons (against 384 452 tons), and the electric alloy steels 245 572 tons (against 181 632 tons).

The Chamber of Commerce Fan Kia Tsung, Fengtien, CHINA, propose to establish a telephone company, and the Ministry of Agriculture and Commerce has been petitioned for its approval. The Yung Yau Electric Power Company of Ningbo has increased its capital; the Tsung Sing Electric Company of Sin Chen, Kailien, has petitioned the Ministry of Agriculture and Commerce for registration; and the Tsung Hua Electric Machine Manufacturing Company, Ltd., has been registered by the Ministry of Communications.

We learn from the "Manchester Guardian Commercial" that the Italian Technical Commission for Unemployment has approved the urgent execution of works in connection with the exploitation of

the River Simeto, in SICILY, for GENERATING ELECTRIC POWER. The Consiglio Superiore delle Acque has authorised a concession for the purpose and has approved the scheme submitted by the engineer, Signor Omodeo. The scheme provides for the formation of an artificial lake at Valle di Aderno capable of storing 100 million cubic metres of water. The total expenditure is estimated at 60 million lire. About 14 000 h.p. is expected to be produced and 35 000 hectares of land will also be irrigated.

In a report to the Department of Overseas Trade on the commercial and other aspects of SOUTHERN PERU, H.M. Consul at Callao (Mr. H. A. Richards) points out that, with the exception of the people living in the big towns such as Cuzco, Arequipa, Puno, &c., the mass of the population are peasants, and of these a large proportion are almost entirely self-supporting in everything they require. Expansion of trade is hampered by lack of means of transport. The financial position of the merchants of the south is not, perhaps, at present so good as in other parts of Peru, owing to the fact that the south is the principal wool district. Mr. Richards lays stress upon the importance of British commercial travellers calling at the British Consulate at Callao as soon as possible after landing in the country, so that they can be advised as to the general conditions in the country at the time, and he also attaches importance to the correct distribution of well-illustrated catalogues (in Spanish). Catalogues relating to machinery, &c., should be sent to the owners of sugar, cotton and mining estates and agricultural farms. With this end in view he is compiling a list of such estates.

Companies' Reports, &c.

THE CHLORIDE ELECTRICAL STORAGE COMPANY has declared a dividend of 5 per cent. actual on the ordinary shares, tax free.

The directors of the INDIAN ELECTRIC SUPPLY AND TRACTION COMPANY have declared an interim dividend of 3 per cent. on the ordinary shares.

THE ELECTRIC CONSTRUCTION COMPANY has declared interim dividends at the rate of 7 per cent. per annum on the preference shares, less tax, and at the rate of 6 per cent. per annum on the ordinary shares, less tax.

The ordinary meeting of the MANAOZ TRAMWAYS AND LIGHT COMPANY will be held at 9, Cloak-lane, E.C. 4, on Monday, Nov. 21, but in consequence of the appointment of the receiver and manager there are no accounts available for presentation to the shareholders.

Meetings of the holders of the five and a half per cent. first mortgage bonds and income bonds of the BARCELONA TRACTION, LIGHT & POWER COMPANY are to be held at Winchester House, E.C., on Friday, Nov. 25, for the purpose primarily of modifying the rate of interest payable on the first mortgage bonds.

THE BRITISH MANNESMANN TUBE COMPANY, LTD., announces that it will not be possible to complete the accounts for the year to June 30 last before the end of the year. The directors have declared an interim dividend on the ordinary shares of 4 per cent. (free of tax), and they do not anticipate that any further dividend will be recommended.

The trading profits of HEAD, WRIGHTSON & COMPANY for the year ended April 30 were £63 033, and £19 642 was brought forward. Debenture interest absorbed £6 750, and directors' fees £1 000. A final dividend of 2½ per cent. is proposed on the ordinary shares, making 7½ per cent. for the twelve months, £30 000 is to be added to reserve, leaving £19 028 to be carried forward.

The report of the CONSOLIDATED SIGNAL COMPANY for year ended Sept. 30, 1921, states that the accounts submitted include dividend received from Westinghouse Brake and Saxby Signal Company in respect of 1920. The next accounts of that company will cover nine months to Sept. 30, 1921, and as these are not yet available it is not possible to include any dividend which may accrue in respect of such period. The sum available, including £1 260 brought forward, is £15 207. The directors recommend payment of balance of dividend on the preference shares at the rate of 6 per cent. per annum, less tax, to Aug. 16, 1921, carrying forward £6 211. In view of the general trade conditions the directors do not feel justified in recommending a dividend on the ordinary shares.

The ordinary general meeting of the MONTE VIDEO TELEPHONE COMPANY, LTD., was held last week at Winchester House, E.C., Viscount St. Davids (the chairman) presiding. In moving the adoption of the report and accounts, the chairman said that during the summer he had visited Monte Video and had made a careful inspection of the company's property. Old shareholders knew that the board did not boast that the company gave a perfect telephone service. They gave what was a good service in the conditions under which they were permitted to work. That had been the outstanding position for a long time past, but the Government had lately made up their minds that they wanted a system of their own, and had made a contract with the Western Electric Company to put in a system; but the contract had been made subject to ratification by the Legislature, and, as far as he knew, that ratification had not yet been given. The contract was also made subject to the capital being raised, and when he was over there, there seemed to be no prospect at all that the Government would agree to the terms, as the conditions that the Americans were seeking to impose were undoubtedly somewhat onerous. So far nothing had been done at all. They were practically in the same position as last year, subject to what he had said. A final dividend of 5 per cent., making 8 per cent., tax free, for the year, was declared.

Tenders Invited.

UNITED KINGDOM.

CARLISLE CITY COUNCIL. Nov. 21.—Wiring and installation of electric light in twenty-eight houses. Particulars from the City Engineer and Surveyor, Mr. Henry C. Marks, 35, Fisher-street.

TENNESSEE WELLS ELECTRICITY SUPPLY COMMITTEE. Nov. 21.—(1) Wooden cooling tower, and (2) c.i. circulating water piping and valves. Form of tender, &c., from the Borough Electrical Engineer.

BELFAST ELECTRICITY COMMITTEE. Nov. 21.—Four months' supply of mill furnishings, packings, and asbestos goods, steam, gas, and water tubing, &c. Form and tender, &c., from the City Electrical Engineer.

YORK, NORTH-EASTERN RAILWAY. Nov. 21.—(1) Telegraph apparatus; (2) telegraph wire and line stores, during six or twelve months from Jan. 1, 1922. Particulars from Mr. C. H. Ellison, the company's Telegraph Superintendent, York. Tenders to Mr. R. F. Dunnell, Secretary, at York.

NORTH-EASTERN RAILWAY. Nov. 21.—Electric wires and cables, electric lighting, sundry fittings, signal wire and signal cord, castings, tubes, lead, oils, &c. Specifications, &c., from Mr. E. H. Clark, Stores Superintendent, Gateshead. Tenders to the secretary.

GREAT WESTERN RAILWAY COMPANY. Nov. 21.—Supply of three months' stores, including telegraph instruments, telegraph ironwork and tools, electrical apparatus, wires and cables, &c. Samples and patterns may be seen at the Company's Stores, Swindon, and tenders are to be addressed to the secretary, Mr. A. E. Bolter, Paddington Station, London, W.

CARLISLE CORPORATION. Nov. 21.—Wiring and fitting twenty-eight houses at Longsowerby. Forms of tender, &c., from the City Engineer and Surveyor.

METROPOLITAN ASYLUMS BOARD. NOVEMBER 23, 2.30 p.m.—Installation of electric lighting cables, &c., on the training ship "Exmouth," off Grays. Specification, &c., can be obtained at the Board's Offices, Embankment, E.C. 4.

MANCHESTER ELECTRICITY COMMITTEE. Nov. 25.—Supply and erection at Barton power station of circulating water flow and level recorders. Specification, &c., from Mr. F. E. Hughes, Town Hall, Manchester.

SHEFFIELD HEALTH COMMITTEE. NOVEMBER 26.—Plant and machinery for refuse-disposal works, including cranes and grabs, d.c. switchboard, feed pumps and feed-water heaters, steam-driven electrical plant and condensers, electric motors and starters (contracts Nos. 9, 10, 11, 14 and 15), &c. Specifications from Messrs. Mortimore, Lyon & Company, Mansfield-chambers, Manchester.

BURGHES OF ANDROSSAN AND SALICHAIS. Nov. 28.—Electric wiring work in connection with reconstruction and extension of Springvale Joint Hospital. Schedules, &c., from Mr. Hugh Thomson, Architect, Saltcoats.

WEXFORD CORPORATION. Nov. 28 (noon).—Overhead low-pressure distribution mains, street lanterns, &c. Specifications from the consulting engineers, Messrs. MacEntee, Lovell & Gregory, 22, Nassau-street, Dublin, and tenders to the Town Clerk, Mr. Wm. A. Browne.

GLASGOW HEALTH DEPARTMENT. Nov. 28.—Electric wiring and fitting of doctors' and workmen's houses at Robroydon Hospital. Specifications, &c., can be obtained at the Office of Public Works, 64, Cochrane-street, Glasgow.

FULHAM (London) Borough Council. Noon, Nov. 29.—Supply of 11,000 yds. of 2 sq. in. h.t. (3,300 V) concentric paper insulated and lead-covered cable. Forms of tender from the Borough Electrical Engineer, Townmead-road, and tenders to the Town Clerk, Town Hall, Fulham, S.W. 6.

GLASGOW GAS DEPARTMENT. Nov. 30.—Two electric locomotives, gauge 30 in., height 68 in., to haul 30 tons. Particulars from the Manager, 45, John-street, Glasgow.

WIMBLEDON CORPORATION. Nov. 30, noon.—Supply, delivery and erection of high-pressure sub-station switchboard at Raynes Park sub-station. Specification and tender form from Mr. H. Tomlinson-Lee, Chief Electrical Engineer, Electricity Works, Durnsford-road, Wimbledon, S.W. 19. Tenders to the Chairman of the Electricity Committee.

WHITEHAVEN CORPORATION. Dec. 1.—Two water-tube boilers, with superheaters, economisers, pipework, &c., for the Electric Supply Department. Specification, &c., from the Borough Electrical Engineer and Manager.

THE COMMISSIONERS OF H.M. WORKS. Dec. 6.—(1) Electrical and (2) mechanical engineering labour in day work in connection with the maintenance of installations in the Birmingham, Bristol and Liverpool districts. Forms of tender (separate for each district), &c., can be obtained at the Contracts Branch, H.M. Office of Works, London, S.W. 1.

AUSTRALIA.

COMMONWEALTH OF AUSTRALIA. Jan. 4 and 17, 1922.—Telegraph instruments and telephone apparatus and material (schedules 1718 and 604), returnable in Australia by Jan. 4 and 17, 1922, respectively. Particulars from Supply Officer, Australia House, Strand, London, W.C. 2.

DEPT. OF POSTMASTER GENERAL, ADELAIDE. Jan. 4, 1922.—Supply and delivery of telephone apparatus and material, including cords, hand sets, supervisory lamps, plugs, jacks, &c. (Schedule No. 604.) Local representation is essential.

Arrangements for the Week.

FRIDAY, Nov. 18th (to-day).

INSTITUTION OF MECHANICAL ENGINEERS.
6 p.m. At Storey's Gate, London, S.W. Paper on "The Machinery of Floating Docks," by Dr. E. H. Salmon.

JUNIOR INSTITUTION OF ENGINEERS.
7 p.m. At Caxton Hall, London, S.W. Annual General Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS.
(STUDENTS' SECTION.)

7 p.m. At Savoy-place, London, W.C. Paper on "Modern Hydro-Electric Practice," by Mr. E. E. Butten.

JUNIOR INSTITUTION OF ENGINEERS.
(MIDLAND SECTION.)

7 p.m. At the Birmingham Chamber of Commerce, New-street, Birmingham. Lecture on "Coal Mining in Great Britain," by Prof. K. N. Moss.

BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION.

8 p.m. At the Chartered Institute of Patent Agents, Staple Inn-buildings, London, W.C. Salesmanship Conferences. No. 1.—"Salesmanship in Wiring and Installation Work," by Mr. E. H. Freeman.

MONDAY, Nov. 21st.

INSTITUTION OF ELECTRICAL ENGINEERS.
(INFORMAL MEETING.)

7 p.m. At Savoy-place, London, W.C. Discussion on "Hydro-Electric Power," to be opened by Mr. A. J. Hainsworth.

INSTITUTION OF ELECTRICAL ENGINEERS.
(LIVERPOOL SUB-CENTRE OF THE NORTH-WESTERN CENTRE.)

7 p.m. At the University, Brownlow-street, Liverpool. Paper on "Telephone Line Work in U.S.A.," by Mr. E. S. Byng.

TUESDAY, Nov. 22nd.

WOMEN'S ENGINEERING SOCIETY.
5.30 p.m. At the club-room, 25, George-street, Hanover-square, London, W. Lecture on "Women and the Conquest of the Air," by Miss Mary Abbott.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.
7.30 p.m. At the Mining Institute, Newcastle-on-Tyne. Paper on "The Maag Gear," by Eng.-Lieut.-Comdr. L. J. le Mesurier, R.N.

WEDNESDAY, Nov. 23rd.

ROYAL INSTITUTE OF PUBLIC HEALTH.
4 p.m. At 37, Russell-square, London, W.C. Lecture on "Do We Neglect the Industrial Skin Sufferer," by Dr. R. Prosser White.

INSTITUTION OF ELECTRICAL ENGINEERS.
(SOUTH MIDLAND CENTRE.)

7 p.m. At the University, Edmund-street, Birmingham. Paper on "Some Notes on the Design of Liquid Rheostats," by Mr. W. Wilson.

INDUSTRIAL LEAGUE AND COUNCIL.
7.30 p.m. At Caxton Hall, London, S.W. Lecture on "The Industrial Revolution in England," by Mr. H. E. Blain, C.B.E.

INSTITUTION OF ELECTRICAL ENGINEERS.
(SHEFFIELD SUB-CENTRE.)

7.30 p.m. At the Royal Victoria Hotel, Sheffield. Chairman's Address and Smoking Concert.

ROYAL SOCIETY OF ARTS.
8 p.m. At John-street, London, W.C. Truman Wood Lecture on "The Coming of Age of Long-distance Wireless Telegraphy and Some of its Scientific Problems," by Prof. J. A. Fleming, F.R.S.

THURSDAY, Nov. 24th.

INSTITUTION OF MECHANICAL ENGINEERS.
(NORTH-WESTERN BRANCH.)

7 p.m. At the Memorial Hall, Albert-square, Manchester. Paper on "The Machinery of Floating Docks," by Dr. E. H. Salmon.

INSTITUTION OF MECHANICAL ENGINEERS.
(MIDLAND BRANCH.)

7.30 p.m. At the University, Edmund-street, Birmingham. Paper on "The Equipment of a Modern Boiler House," by Mr. T. A. Pain.

OPTICAL SOCIETY.
7.30 p.m. At the Imperial College, S. Kensington, London, S.W. Lecture on "The Polariscopes from a Historical Standpoint," by Prof. F. J. Cheshire.

FRIDAY, Nov. 25th.

ELECTRICAL POWER ENGINEERS' ASSOCIATION.
(SOUTHERN DIVISION.)

7 p.m. At the Central Hall, London, S.W. Lecture on "Some Notes on Boiler House Plant," by Mr. A. W. Bennis.

JUNIOR INSTITUTION OF ENGINEERS.
8 p.m. At Caxton Hall, London, S.W. Lecture on "Electro-Magnetic Instruments," by Mr. G. F. Shotton.

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Notes of the Week.

Reparations and the Electrical Industry.

By studying Sir HENRY STRAKOSCH's proposals that the Germans should pay their reparation debt in "supplementary capital goods" rather than in money, it is possible to experience a full cycle of emotions. Primarily, on hearing that German labour is to be utilised to provide material for British railway construction, port works and power stations, the feeling is one of the liveliest opposition. It is bad enough to be faced with German competition at prices which, under the present industrial conditions, we cannot hope to reach, but it is still worse to be asked to submit to the free importation of such raw material and finished products in the hope that by so doing Germany may meet her treaty obligations and avoid bankruptcy. But a further consideration of the subject leads to the view that the idea has its good points. To take the electrical industry alone, one of the chief of the obstacles to further development is the high cost of equipment. If this cost could be lowered the price of electricity supply could also be lowered, the demand would be increased, and the industry generally would be stimulated.

Further Government Interference.

As regards railway electrification, the case is very similar. As was pointed out recently in THE ELECTRICIAN, a large proportion of the cost of electrification is absorbed by direct labour employed in this country. If, then, the raw equipment can be provided cheaply, as is admittedly difficult at present, wide employment can be given with correspondingly good results, and instead of the Government having to guarantee a high rate of interest on capital raised for this purpose, as is now proposed, they would be obtaining revenue which would help to reduce taxation. But the matter does not end there. Passing round our

cycle, we are reminded that such a scheme would mean further Government interference with industry. And to our cost we know that of all obstacles to progress that is the very worst.

Neutralising British Brains.

BUT more important than that is the fact that one of the inevitable results of such a scheme would be the recreation of German goodwill in the electrical industry of this country. In the past we have relied too much on German enterprise, freely accepting the results of their knowledge and research, and gradually being reduced to a greater and greater state of dependence upon it. As it is, in any railway electrification scheme we are still too largely dependent on the work of foreign designers. For technical no less than commercial reasons, then, it would be unwise to add further to our shackles when there is every chance of our being before long able to strike them off altogether. The same argument applies equally to the skilled worker, who, under such a scheme, would be gradually less and less required until he deteriorated into a mere labourer. It has often been preached that our commercial welfare in future, as in the past, must largely depend on the recovery of our export trade. To adopt such proposals as those of Sir HENRY STRAKOSCH would inevitably prevent that recovery and increase unemployment.

Taxation and Ruin.

It is the most platitudinous of platitudes to say that the present oppressive taxation is gradually ruining the industries of the country. The trader no less than the buyer knows it only too well. Many a man—and especially many a woman—would willingly buy many a piece of domestic electrical apparatus were the price lower. But when a large fraction of income of both firm and individual goes direct every six months to the tax collector such luxuries are impossible. And the price will never be lower while the manufacturer of electrical

apparatus continues in his turn to be bled of colossal sums for income tax and Corporation tax and drained of money which in happier times would go to reserve or be used for the expansion of the business, both wise contributions to stability which in themselves cheapen production and bring down selling prices.

How Taxation Prevents Enterprise.

BUT, although all that we have said is platitudinous, that is no reason why an effort should not be made to alter the existing state of things. In fact, if British industry is not to fail altogether they must be altered. And the only way in which they can be altered is by showing the Government by the force of actual example what taxation is doing for industry and insisting on a radical change in policy. The sort of thing that is happening under present conditions is well illustrated by the case of a big premises, which are at present empty because as soon as the front door is opened a liability of £6 000 in rates and taxes is incurred. The natural result is that the premises remain shut, industry is strangled and unemployment increases. Meanwhile, work is waiting to be done. It is examples such as these, which could be infinitely multiplied, which speak louder than much argument.

Telephone Engineering in the United States.

THE Paper read by Mr. E. S. BYNG before the Institution of Electrical Engineers last week on "Telephone Line Work in the United States" is so long and so detailed that it is a little difficult to discover in it any guiding argument which may be helpful to those readers who, not being specialised telephonists, have little time to consider the Paper. But, taking the Paper itself and the course of the subsequent discussion jointly into consideration, it appears to us that Mr. BYNG would have us recognise that the fundamental difference between American and British practice in telephone work at the present time lies in the relative use made of labour-saving devices. In many other ways the differences in practice in the two countries are not very marked, and this is not a little due to the generosity of the research department of the American Telegraph and Telephone Company in placing the results obtained by them freely at the disposal of our own telephone engineers.

The Place of Labour-saving Appliances.

THIS generosity is a reason for supposing, as a speaker remarked during the discussion, that American and British telephone practice will gradually approach each other. Another reason why this approach is likely to occur is that labour conditions in this country are gradually forcing the wider use of labour-saving appliances, though, as Sir WILLIAM NOBLE said, the high price of labour in America and the greater stretches of country to be covered will probably always make the use of such devices more attractive there than in the British Isles. Nevertheless, at a time when telephone development is an urgent necessity we hope that the question of the further employment of such equipment will not be lost sight of wherever it can be economically used.

Loans for Revenue-producing Undertakings.

THE new Local Authorities (Financial Provisions) Act contains some provisions which should render it easier for municipalities to embark upon schemes for the extension of electricity supply undertakings, tramways, light railways and other revenue-producing works, and, incidentally,

enable them to find useful work for the unemployed. Hitherto, municipal councils have had, somewhat naturally, considerable hesitation in increasing their obligations by borrowing money, except in cases where there was no risk of a call upon the rates to make up a deficiency on the year's working. Consequently, many promising electricity supply schemes have had to be postponed. As our readers are aware, one of the principal disabilities of electricity undertakings in the first few years of their existence is the obligation to provide for the interest and sinking fund on the borrowed capital. This is a serious burden upon new undertakings which have not reached the revenue-earning stage. As a matter of fact, the operation of these clauses is frequently suspended by private Acts for a number of years, and the Electricity Commissioners, as the sanctioning authority under the Electricity Supply Acts, occasionally exercise a similar power.

Suspension of Sinking Funds.

THE new Act, therefore, introduces no new principle when it expressly lays down that where money is borrowed by a local authority for the construction of new, or the extension or alteration of existing, works forming part of a revenue-producing undertaking, the annual provision for the repayment of money so borrowed may, subject to certain conditions, be suspended for five years. It is also provided that where any local authority, owing to circumstances arising out of the war, has been unable to make the required provision for the discharge of a loan, a modified scheme of repayment may be approved.

Assistance for Payment of Interest.

PROBABLY the most useful legislative provision is that which allows aid to be given in paying the interest on the loans which are to be raised for the works indicated. At first there was doubt as to the scope of these proposals, but Sir ALFRED MOND made it quite clear to the recent deputation, headed by Mr. LLEWELYN ATKINSON, that assistance would be given in cases of municipal loans for extensions of electricity supply. In many districts there are still long lists of consumers awaiting connection owing to the shortage of plant or mains, and we hope that now the financial position is made easier local authorities will not hesitate to embark upon the necessary works, and thus relieve the present unsatisfactory industrial situation. There is the more reason for doing this, as the Postmaster-General has already mapped out a large scheme of telephone extensions, and, as the telephone department will also benefit by better financial conditions, a great development of the telephone service should soon be possible. Taken as a whole, there is no industry which will benefit so much from the recent Government legislation and administrative proposals as our own, and we hope, therefore, that immediate steps will be made to take full advantage of the situation, and inaugurate a great and combined forward push in all branches.

The South-West Midlands Inquiry.

THE Electricity Commissioners had a comparatively simple task in investigating the organisation of electricity supply in the South-West Midlands Electricity District, and consequently the inquiry lasted only three days. Nevertheless, two or three weak points were disclosed in the major scheme during the course of the proceedings. In the first place, the Birmingham Corporation and the Shropshire, Worcestershire and Staffordshire Electric Power Company, who had submitted a scheme covering

practically the whole of the area and dividing it into what has been termed two spheres of influence, accepted a new clause, which will impose upon them a direct obligation to carry out the technical scheme outlined in all particulars. Undoubtedly this will improve the position, and it will give the authorities in undeveloped areas a better chance of getting a supply of electricity.

The Council of Four.

THERE was also a good deal of discussion as to what would happen in case the Joint Advisory Committee of four, which the two promoters proposed to set up, differed as to the merits of any scheme of development. Ultimately, a clause was added, providing that the respective representatives should, in the case of a two and two division in the Committee, report the matter to the Corporation and Company respectively, with an ultimate appeal to the Electricity Commissioners in case the two promoters failed to agree. There is no reason to anticipate an acute conflict of opinion between the two promoters, but in the event of such a situation arising we are afraid that even the new clause will not provide an adequate remedy. We would suggest the addition of a neutral chairman and of a couple of representatives of county councils, railway companies and other interests as an alternative and better method of dealing with the matter without unduly increasing the size of the governing body.

Supply in Rural Areas and Railway Electrification.

NATURALLY, the Commissioners showed much interest in the suggestions for supplying electricity to undeveloped districts and in rural areas. These areas can only be served by means of overhead lines, to the use of which there is still very great opposition. The Commissioners have already done much to remove this, but we believe they might do still more to compel the grant of way-leaves. This, in fact, must be done before there can be any extensive use of electricity in country districts. It is preposterous, for instance, that any supply authority should be asked to pay £15 per pole for carrying an overhead line, and if, as the result of further statutory powers, the recalcitrant landholder gets nothing, it will be what he deserves. Within fifty miles of Birmingham there are about 2 000 route miles of railway, and, though there is no immediate suggestion of converting these to electric traction at the moment, it is probable that the question will be considered as soon as the present railway fusion schemes are completed. If this were done the railway companies intimated that their requirements would exceed the 60 000 kW. estimated by the promoters, but they were satisfied that their demands could be met by the proposals submitted.

The Brighton Railway Electrification.

It has for long been an open secret that the London, Brighton & South Coast Railway have had in preparation a comprehensive scheme for the extension of electric working, not only to the outer London suburban area, but to Brighton, Worthing and Eastbourne. It was further known that this scheme, which had been submitted to the Ministry of Transport, contained the results of a number of interesting comparative tests between steam and electric working which had been undertaken by Sir PHILIP DAWSON and the Company's engineers. This report has now been made public in the columns of "Modern Transport," to which we are indebted for permission to

give the summary, which we publish on another page of this issue. As regards the electrification scheme itself, the single-phase system will, of course, continue to be employed by special dispensation, and, naturally, the multiple unit system will be used for suburban trains and locomotives on the main line passenger and goods trains. But the figures, which show that a saving of operating expenses of from 6 to 7 per cent. on existing traffic could be obtained by electric working, are what will attract most attention. It has long been known, as a result of actual working experience, that electrification means increased revenue, and in that way increased financial prosperity. Sir PHILIP DAWSON's figures indicate, however, that electrification for the London, Brighton & South Coast Railway will also mean saving money. As there seems no reason why this optimism should not be justified in practice, it makes an additional argument for proceeding with the conversion with the least possible delay.

Researches on Aluminium Alloys.

A PAPER recently read before the Institution of Mechanical Engineers by Messrs. W. ROSENHAIN, S. L. ARCHBUTT and D. HANSON, summarises a comprehensive research on various aluminium alloys which has been conducted at the National Physical Laboratory. Knowledge on this subject has increased considerably of recent years, largely owing to the demands for alloys of this kind in aircraft construction. The researches cover both wrought and cast alloys, and such matters as the effect of temperature, ageing, permanence and corrosion are discussed. As regards alloys for use at ordinary temperatures, those containing much zinc are liable to become weak and brittle when heated, though considerable tensile strengths have been maintained. Hence a relatively low zinc content in combination with 2 to 3 per cent. copper is preferred. The use of aluminium alloys as pistons in aeroplane and other high-duty internal combustion engines has attracted much attention. The advantage of using this metal is due not only to the saving in weight obtainable, but to the greater heat-conducting power. Some curious results are recorded, notably the effect of 1 per cent. manganese in increasing the tensile strength at 250° to 350°C.

Some Properties of the Alloys.

It may be observed that the addition of aluminium in casting needs care. Apparently the metal is best added in fairly large pieces, which must be pushed quickly under the surface so as to avoid contact with air. Magnesium has been used with wrought alloys to improve hardness, but other difficulties arise with this metal, some of which can be overcome by the employment of the extrusion process. A feature of special interest is the good permanence of the selected alloys. Ageing apparently only results in some greater ultimate hardness. Some years ago serious difficulties were caused by changes in the dimensions of castings made with certain so-called aluminium alloys, which, in fact, consisted largely of zinc. Tests have shown that approved alloys of aluminium and copper possess great stability of dimension, and no signs of disintegration have been noted. One curious effect in regard to corrosion deserves notice. Machined surfaces of the binary zinc-aluminium alloys were found to be practically immune from corrosion in salt water, whereas machined portions suffered appreciably. The addition of copper to such alloys increases the tendency to corrosion very

greatly, but rapid corrosion does not occur when ternary alloys are exposed to air. Such alloys have been used indoors for many years without signs of deterioration. Altogether the Paper affords evidence of much patient research, and there are doubtless still possibilities of further useful discoveries.

Steam and Electric Drive for Auxiliaries.

A SUBJECT upon which a discussion can usually be raised with some ease, because upon it there is great difference of opinion, is whether it is better to drive power station auxiliaries by small turbines or by electric motors. There is, it is evident, a good deal to be said on both sides. On the score of continuity of supply and easy starting up in case of breakdown, it is clear that at least one complete set of auxiliaries should be steam-driven so as to get the station going with the least possible delay after any accident. On the other hand, it is probable that, taking all in all, the electric drive requires less steam per horse power, though when the exhaust steam from the auxiliary turbine is used in the feed-water heater the actual quantity of heat employed may be slightly in favour of turbine operation. But there are other ways in which the electric drive scores. For driving the pumps motors may, for example, be considered ideal, as they require hardly any attention, and if alternating current supply is available, as is now nearly always the case, the speed is practically constant on varying loads. On the other hand, the governing of small steam turbines on varying loads is by no means all that can be desired. To us, therefore, it seems, with the exception noted above, that greater economies both in capital charges and in running costs can be obtained by using the electric drive to the greatest possible extent.

Regulations for Factory Lighting.

IN this country and in the United States much attention has been given to industrial lighting. In America various States possess quite detailed legislative codes. In this country, while more caution has been exercised in making legislative enactments, the Home Office, through its Departmental Committee, has been studying the requirements of factory lighting in detail. As illustrating the similar trend of work in different countries, it is interesting to see that this same subject is exciting attention in Germany. In a Paper read at the recent annual meeting of the German Illuminating Engineering Society, Dr. Lux remarked, truly enough, that "it is easier to frame regulations than to carry them out." While general rules in the interests of safety can be laid down, the preparation of recommendations covering requirements for individual industrial processes is a complex matter. One thing, we think, is becoming increasingly recognised—the importance of avoiding glare. It may be that much higher illumination than is at present used would be economically justified, as some American statistics appear to show. But it is certain that the amount of light required depends much on the state of adaptation of the eye, and that an apparent need for more light may be due largely to the fact of the standard being artificially raised by the proximity of bright lights in the field of view. In the case of large rooms with ample space overhead, semi-indirect lighting and light surroundings are helpful in avoiding glare. The most difficult problems, both as respects intensity and correct positions for lights, arise in rooms where bulky machinery forms an obstruction to light from above. In such cases local lights seem essential, but

their exact position with respect to the machines (and possibly their adoption as an integral part of the machinery) does not seem to have been fully worked out.

The E.T.U. Dispute.

THE acute domestic quarrel in the ranks of the Electrical Trades Union, which has culminated in the suspension of the London District Committee by the Executive Council, will not, we fancy, come as a surprise. In the past some of the London officials have frequently acted in a most reckless manner, every chance of causing industrial strife being seized with avidity, much to the annoyance of the more sober brethren in Manchester and other parts of the country. We have no ill-will towards trade unionism, which has, we recognise, performed much useful work; but reckless conduct such as that alleged in the reasons given for suspension is not only most detrimental to the best interests of trade unionism, but militates against the efforts to produce that industrial harmony which is essential for both employers and employed at all times, more particularly now. Twelve reasons are alleged for the suspension, including the following: Repeatedly instructing members to cease work without consulting the members involved or obtaining the sanction of the Executive Council, ordering strikes without making the slightest preparation, violating certain rules of the Union and destroying its financial stability by reckless expenditure, and disclosing the internal business of the Union in "The Electron." It is not for us to pass judgment upon the merits of the dispute, but we trust that it will have the effect of placing the organisation and its branches in a better position to pursue their own proper activities in future. If so, the E.T.U. and the whole Trade Union movements will benefit considerably.

Advertising Electricity.

IT has often been our theme that electrical manufacturers would do better to advertise the use of electricity rather than the advantages of particular electrical appliances, and that this can best be done by co-operative rather than personal effort. The British Electrical Development Association are, therefore, to be congratulated on reserving for themselves at this season of the year a page of that widely circulated journal the "Daily Mail" in which to display, both pictorially and in print, the extent to which electricity can make a brighter Christmas, not only for the industry but for the public at large. Besides advertisements of a high quality, though of the usual kind, the page contains a short article on "Electricity—the Perfect Servant." This makes an appeal for the "all-electric" house, which cannot fall on deaf ears. The convenience, the cleanliness, labour-saving possibilities of electricity combine, as Mr. HIGHFIELD recently said, to make its use a luxury. But it is a luxury which is within everyone's reach.

Electricity Supply as a Trade Barometer.

IT will be agreed that no better barometer of trade conditions can be found than the load curves of electricity supply stations in industrial areas. It is, therefore, encouraging to learn that in one particular district, at any rate, the general tendencies of these curves for some months has been upward. The slow and gradual rise of this year makes an interesting comparison with conditions last year. Then the load curves showed abrupt transitions from positive to negative and back again within quite short spaces of time. But then trade was bad and getting worse. Now this is the influenza season, and influenza patients

know that an abrupt fall in temperature, followed by an equally abrupt rise, is no sign of progress towards recovery, but rather an indication of continued ill-health. They also know that when the temperature gradually and successively falls the road to convalescence is clear. With the appropriate modifications we hope that this analogy may be justly applied to the industry of the country as indicated by electricity supply conditions.

Municipal Trading at Liverpool.

THE various aspects of municipal trading have been discussed so frequently in these columns that we had thought more or less general agreement had been reached in the electrical industry as to how far municipal councils should engage in competing for orders with their own ratepayers. At all events, we believed that, in consequence of Sec. 23 of the Electricity (Supply) Act, 1919, there would be no more litigation on the question. It is common ground that not only are legal proceedings very costly for the parties concerned, but they engender friction in the industry, and prevent that hearty co-operation of all branches of it which is essential for the progressive development of electricity supply. Consequently, we regret to see that there has been a recrudescence of this useless litigation at Liverpool, the Corporation of which city has been sued by ten local contractors to obtain an injunction to prevent it from carrying on business in the manufacture, supply and fixing of electrical fittings.

Exceptional Liverpool Case.

The facts of the case are somewhat exceptional, and arise out of the purchase by the Corporation of two local electric supply companies in 1896 and 1902 respectively. Both the Liverpool Electric Supply Company and the Garston and District Electric Supply Company carried on, in addition to their statutory electricity supply undertakings, an extensive business in the manufacture and sale of electric light fittings and apparatus, and each had an electric fittings department, which was purchased by the Corporation when the supply undertakings were acquired. The question was whether the Corporation had power still to carry on this fittings business under the circumstances.

Decided Cases.

It had already been decided that Sec. 10 of the Electric Lighting Act, 1882, did not confer power upon a municipal corporation, which was an authorised undertaker, to supply and erect fittings upon a consumer's premises, as the authority conferred by the section only related to matters outside the consumer's terminals. If, therefore, the Corporation could legally do the things complained of it had to show that they were being done under special statutory powers. Unfortunately for the electrical contractors, the Corporation was able to prove to the satisfaction of Mr. Justice RUSSELL that it had those special powers, and the action was, therefore, dismissed with costs.

Reasons for Decision.

We must say that we agree with his Lordship in the view that he took of the case, and we believe that his carefully considered and closely reasoned judgment is sound law. It appears that a section of the Liverpool Electric Supply (Transfer) Act of 1896 authorised the Corporation to purchase not only the "statutory undertaking," but the whole of the undertaking and other works

of the Company at the date of the completion of the purchase, and the judge held that it was the intention of the Act that the Corporation should step into the shoes of the Company and carry on all their businesses. The Company had to carry on all its businesses for the benefit and at the expense of the Corporation, and if on the completion of the purchase the business of electrical fittings was to be struck with sterility, why, asked his Lordship, should it be carried on? He distinguished the decision in *Attorney-General v. Sheffield Corporation*, and he came to the conclusion that the Act of 1896 gave the Corporation all the powers it required.

Changes Made by 1919 Act.

His Lordship went on to examine the position created by Sec. 23 of the Electricity (Supply) Act of 1919, which, as will be remembered, authorises a joint electricity authority and any authorised local authority to connect, repair, maintain and remove (but not, unless expressly authorised to do so, to manufacture or sell) electric lines, fittings, &c. On this point also the decision was against the contractors, for the Judge held that it was not intended to deprive local authorities of powers granted to them, and, as a section of the 1896 Act had given the Corporation the necessary authority, it was unnecessary to find exact words of express authorisation in the Act of 1919.

Scope of Municipal Wiring.

While we sympathise with the contractors in their position, we think it a pity that they allowed a period of nearly twenty-five years to elapse before challenging the claim of the Corporation. It must also be acknowledged that the latter only carried out a limited amount of wiring work, as several important municipal contracts were let to private firms, and what was undertaken by the municipal fittings department was on a competitive basis, all establishment charges being included. It is only in very exceptional circumstances that municipal wiring work can be justified. Co-operation—and not competition—with contractors should be the aim of all local authorities. We cannot agree that there is any need for the municipal supply authority of a big city like Liverpool to engage in wiring work when there are a sufficient number of competent local contractors able and willing to carry out all the available work.

Need of Showrooms.

There is, however, a class of business which it, as well as all other municipal undertakers, can take up with great advantage to itself and to nearly every branch of electrical engineering. We refer to the provision and maintenance of well-equipped showrooms for the display of all electric fittings, modern domestic apparatus and household labour-saving appliances. Wherever showrooms have been established they have proved very useful in increasing the demand for electricity for domestic purposes. In addition, we think there should be full authority to let out on hire-purchase agreements the more expensive apparatus, such as washing machines and domestic appliances. Some authorities already possess these powers, which seem to us more useful and desirable than the right to engage in simple wiring work which has been conferred on all municipal undertakers by the 1919 Act. There is no doubt authorities can let apparatus on hire, but the prohibition against sales has raised a doubt as to whether hire-purchase agreements are also covered by the section. In these cases it is desirable to have uniformity of law as well as practice, and it is to be hoped that an early opportunity will be taken to bring this about.

Industrial Research on Pressboard.

By A. P. M. FLEMING, C.B.E., and ALLAN MONKHOUSE.

Amongst the many insulating materials the supply of which was seriously affected by the outbreak of the war, one of the more important was the material variously known as pressboard, presspahn or fullerboard. Previous to 1914 this material was largely obtained from German and American manufacturers, and, although the latter source of supply was still open to Allied countries, the official procedure entailed in obtaining the necessary import licences and shipping space nevertheless made it extremely precarious. Under these circumstances, electrical manufacturers naturally sought to obtain their requirements from British makers, and as a result several British firms who were already makers of an almost exactly similar material for wool finishing and other purposes began to study and to supply the electrical market.

B. S. & W. Whiteley, of Pool Paper Mills, Pool, near Leeds, were of this number, and, anticipating a demand for a really first-class insulating board of British manufacture, they set to work to investigate the subject thoroughly, and with this in view sought the technical co-operation of the Research Department of

getting into the beaters with old rags, rope ends, packings and other fibrous raw materials used for making the boards.

Micro-Chemical Analysis.

The micro-chemical analysis showed that the boards on the market contained very varying admixtures of linen,

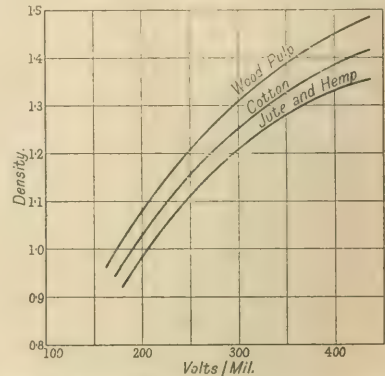


FIG. 2. CURVES SHOWING RELATIONSHIP BETWEEN DENSITY AND VOLTS PER MIL FOR PRESSBOARDS MADE FROM VARIOUS FIBRES.

cotton, hemp, jute, mechanical wood pulp and chemical wood pulp fibres. In some cases traces of esparto, straw and ramie were observed, although these had probably been introduced with waste paper used for making the pulp of the boards in question.

Electrical tests appeared to indicate that the nature of the fibre employed was an important factor in determining the dielectric strength. Consequently, experimental batches of pressboard were made from carefully chosen raw materials, and the results of tests on these led to the conclusions that:

1. Wood-pulp boards were too stiff for most purposes and liable to age rapidly, although their dielectric strength was good.
2. Cotton boards were soft, porous, yielded a high dielectric strength, and were also very pliable.
3. Jute and hemp boards, although they showed a high dielectric

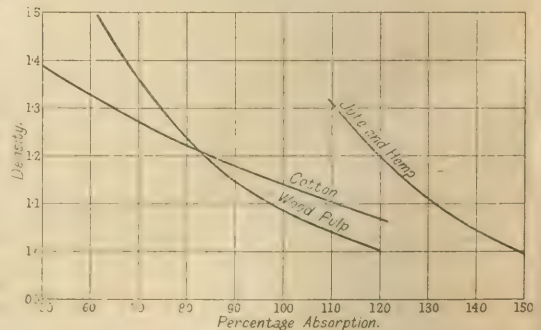


FIG. 3.—CURVES SHOWING THE RELATIONSHIP BETWEEN DENSITY AND PERCENTAGE ABSORPTION FOR PRESSBOARDS MADE FROM VARIOUS FIBRES (UNGLAZED).

strength, had this disadvantage that they became very brittle after prolonged immersion in hot oil.

4. Linen boards were tough, pliable, and showed a high dielectric strength.

Furthermore, the results of the tests taken, when viewed in comparison with the previous results obtained on boards

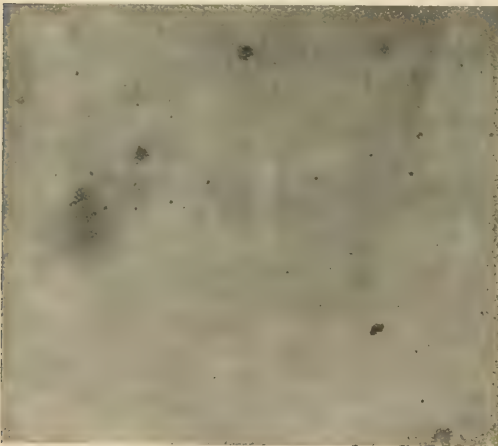


FIG. 1. X-RAY PHOTOGRAPH OF A PIECE OF FOREIGN PRESSBOARD SHOWING METALLIC PARTICLES INCLUDED.

the Metropolitan-Vickers Electrical Company, Trafford Park, in conjunction with whom the research programme indicated in this article was carried into effect.

Preliminary Studies.

As a preliminary step a careful study was made of the requirements of electrical manufacturers, and it was obvious from the outset that these could be divided into two general classes:

- (a) A hard, strong, non-porous board for use as washers, packing pieces, &c., where it would not be impregnated with oil or varnish.
- (b) A strong, porous board for use in transformers and other apparatus where it would be impregnated with oil or varnish.

Samples of board obtained from no fewer than thirty different manufacturers both at home and abroad were carefully examined under the microscope, and differences in fibre structure and manufacture noted and considered in relation to dielectric strength and other properties of the boards. X-rays were also employed in this work, and some startling examples were observed of boards containing metallic particles, as shown in Fig. 1. These particles were probably due to buttons, hooks, metallic fastenings, &c.,

bought on the open market, led to the further conclusion—that:

1. The dielectric strength of pressboard is directly proportional to its density for any class of raw material. (See Fig. 2.)
2. The porosity and ability to absorb liquids also bears a direct relationship to density, but that the exact nature of that relation—

strengthened by the fact that under normal conditions cotton rags for making pulp cost, approximately, 50 per cent. more than jute and hemp scrap.*

Various admixtures of jute and cotton fibres were put through the mill and made into boards. Based on the results obtained with these trial mixtures of fibres, a final

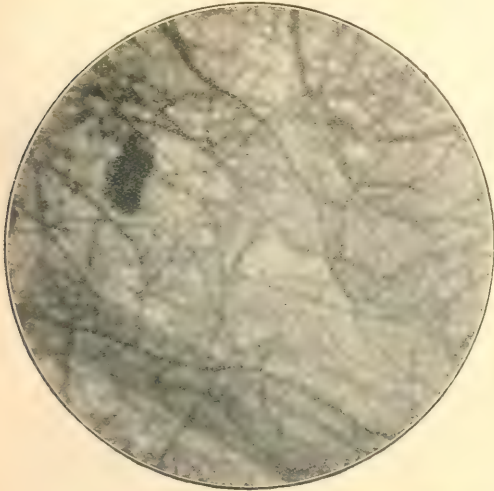


FIG. 4.—PHOTOMICROGRAPH OF PURE COTTON PRESSBOARD.



FIG. 5.—PHOTOMICROGRAPH OF JUTE PRESSBOARD.

ship is dependent on the finish imparted to the board, and the method employed to obtain the denser board. It was also observed that the jute boards were the most absorbent of those tested. (See Fig. 3.)

Study of Fibre Structure.

After the above conclusions had been reached, microscopic photographs of the cotton and jute boards were taken to study the fibre structure of the boards after different methods of manufacture had been adopted. Figs. 4 and 5 show characteristic photographs of cotton and jute boards respectively. The magnification in each

mixture was decided upon which combined the maximum dielectric strength with a maximum of strength and flexibility.

"Elephantide."

B. S. & W. Whiteley have now put these new pressboards on the market under the name of "Elephantide." The new boards are made in two distinct grades:

Elephantide No. 2, which is a hand-pressed unglazed board suitable for washers and general use.

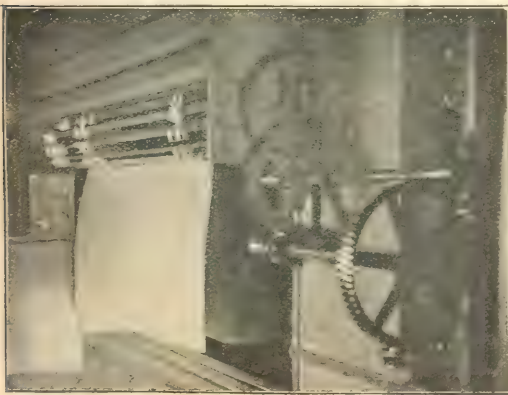


FIG. 6.—DRYING PLANT AT THE POOL PAPER MILLS.

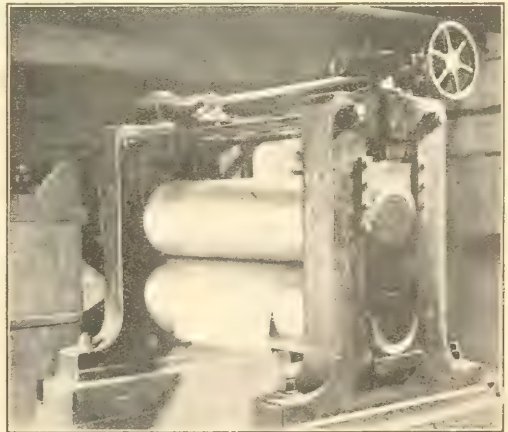


FIG. 7.—CALENDERS AT THE POOL PAPER MILLS.

case is 60. It was felt that if the strong interlaced structure of the cotton board (due to the long bast fibres of the cotton) could be blended with the close-knit characteristics of the jute board a satisfactory insulating board would result. This decision was further

Elephantide No. 3, which is a more porous board, having a lower density and consequently a lower tensile strength and a lower dielectric strength. This board is suitable for transformer work

* Under present conditions the difference in price of these two raw materials is not so marked.

... desired to use the material for immersion in oil without previous oil boiling.

Table 1 shows the leading characteristics of the boards made by Whiteley's, including the Elephantine Nos. 2 and 3 boards.

Table 1. Results of Tests of Pressboards 2 in. Thick.
English.

	Wood pulp pressed board.	90 per cent. cotton pressed board.	Latex and hemp pressed board (third Elephantine No. 1).	Elephantine No. 2.	Elephantine No. 3.
B.D.V. in volts mil in oil after drying at 165°C. for three hours (immersion for ten minutes only before testing).	300	322	348	400	275
B.D.V. in volts/mil in air after drying at 165°C. for three hours.	219	280	280	325	213
Density in grammes per cubic centimetre.	1.15	1.175	1.22	1.2	1.05
Tensile strength in tons per square inch with grain.	3.2	3.63	4.4	4.52	3.59
Ditto across grain.	3.12	3.5	3.95	3.95	3.27
Percentage absorption by weight after 24 hours in water.	90 per cent.	83 per cent.	122 per cent.	90 per cent.	120 per cent.
Minimum bend on 1 in. sample after 24 hours in transformer oil at 100°C. without sign of crack.	$\frac{1}{2}$ in. radius.	$\frac{3}{4}$ in. radius.	$\frac{1}{2}$ in. radius.	$\frac{3}{4}$ in. radius.	$\frac{1}{2}$ in. radius.

The development of insulating pressboards for the electrical trade, with the corresponding development of the plant at the Pool Paper Mills, which has included the purchasing of extensive water rights on the River Wharfe and the installation of hydraulic turbines to cope with the new processes, is a very instructive example of what well-directed industrial research can accomplish, particularly when the work is jointly undertaken by the manufacturer and the consumer of the product in question. In this connection a special experimental beating and paper-making plant is being installed at the Pool Paper Mills in order that further problems connected with the supply of thoroughly reliable electrical papers may be carefully studied without interrupting the production of the mills themselves. The drying-plant and calenders at the Pool Paper Mills are shown in Figs. 6. and 7.

Mr. R. A. Chattock on Electricity Supply.

The address of Mr. R. A. Chattock to the SOUTH MIDLANDS CENTRE of the I.E.E. was devoted to an exposition of the scheme for the reorganisation of electricity supply in the South-West Midlands District, into which the Electricity Commissioners recently held an enquiry. After giving an outline of the present organisation he said the difficulties of the situation led the Birmingham Corporation and the Shropshire, Worcestershire and Staffordshire Electric Power Company to think that, in view of their great electrical preponderance in the district, they were justified in suggesting that the control of generation in the whole of the district should be placed in their hands, and that this could be effected without the formation of a Joint Electricity Authority. The district was to be divided into two sections, that section within the county of Warwickshire being under the control (as far as generation is concerned) of the Corporation, and the remaining section under the Power Company. The systems of the authorities promoting the scheme were identical as regards frequency, voltage, &c., and it was proposed to connect their capital stations together by a substantial electrical link. There

would be a small advisory committee, composed of representatives of the two bodies, who would advise upon the operating time-tables of the undertakings with the object of securing an ample supply of electricity in the district, the best load factor obtainable, the conservation of fuel, the standardisation of systems. The advisory committee would make recommendations to its constituent authorities, but it would not be competent for the committee to incur any capital expenditure.

Capital Stations.

It was proposed to retain so much of the plant in the existing generating stations as was sufficiently economical in operation and gradually to scrap the uneconomical plant. It was also proposed ultimately to build three capital stations; the first of these had already been commenced by the Corporation at Neshells, and would have an ultimate capacity of 105 000 kW. Plant of 45 000 kW was being installed and the balance would be put in as the demand required it. A station of about similar capacity would be built at Stourport by the Power Company, and would be connected to the Neshells station by 33 000 V underground trunk cables. In order to meet further developments, a large site had been acquired to the east of Birmingham at Hams Hall, where a station having an ultimate capacity of 300 000 kW was contemplated, and that would also be linked up with the other capital stations. Provision had therefore been made for meeting a demand of 500 000 kW and upwards in the district, which should be ample for many years. Those stations would be equipped with large capacity turbo-alternators of the most modern construction. Three-phase current would be generated at 5 500 V between phases and having a periodicity of 25 cycles per second. It would be distributed (1) partly at the pressure of generation to large power consumers and sub-stations in the neighbourhood of each generating station; (2) partly at a pressure of 33 000 V to outlying centres where it would be transformed down again to a convenient voltage for distribution; and (3) partly at a pressure of 66 000 V by overhead transmission lines to the more remote portions of the district, where it would again be transformed down and distributed in detail.

Economies and Demand.

By centralising the generation of electricity in that way and locating the stations as near as possible to the bulk of the demand, advantage could be taken of the very low cost of production and the cost of transmission was brought to a minimum. The demand in 1920 was 92 650 kW; in 1925 a demand of 150 000 kW was expected, and in 1930 214 250 kW. The corresponding outputs would be: 199.08 million units (load factor, 24.6 per cent.), 359.9 million units (load factor, 27.5 per cent.), and 562.7 million units (load factor, 30.0 per cent.). The estimate was exclusive of any demand for railway traction, which might well reach 60 000 kW within a radius of 50 miles from Birmingham. The thermal efficiencies of the existing stations in the district varied between 5.5 per cent. for the smaller stations and 10.7 per cent. for the larger stations. The thermal efficiency of the new capital stations would be approximately 16.5 per cent. The bulk of the load would be dealt with in the latter, whilst the older stations would be utilised to meet the short hour peak load demand. The figures for the saving of coal were as follows: In 1925, 458 000 tons would be consumed, showing a total saving of 118 200 tons; and in 1930, 655 000 tons, or a saving of 256 700 tons. The cost of generation is now about 0.96d. per unit; in 1925 it would be about 0.44d., a reduction of 54 per cent; and in 1930 the cost would be about 0.33d. per unit, or a reduction of 65.7 per cent.

Mr. Chattock concluded his address by giving a short description of the leading features of the Neshells station, which is laid out for an ultimate capacity of 105 000 kW, comprising seven 15 000 kW turbo-alternator sets. Three of these are being installed at present, and the first one should be available early in 1922. The boilers are pressed to 325 lb. per sq. in. and the total temperature of the steam is 700°F. The surface condensers are designed to maintain a vacuum of 28 in., and the circulating water is cooled by a system of wooden cooling-towers erected over ferro-concrete reservoirs. The switchgear control has been sectionalised as far as possible by reactances, chiefly with a view to limiting the heavy strains that the switches are called upon to meet when emergencies occur.

Dictionary of Applied Physics.

The "Dictionary of Applied Physics," which Messrs. Macmillan have arranged to publish under the editorship of Sir Richard Glazebrook, is now in an advanced stage of preparation. The work, which is elaborately illustrated, will appear in five large octavo volumes, containing some 600 to 700 pages each, dealing respectively with: (I.) Mechanics—Engineering and Heat, (II.) Electricity, (III.) Metrology, Meteorology and Measuring Appliances, (IV.) Metallurgy and Aeronautics, and (V.) Optics, Sound and Radiology. The editor has secured the assistance of a distinguished body of contributors, and it is hoped that Vol. I. will be published in the early part of 1922.

A Sensitive Method of Determining the Frequency and Amplitude of H.F. Oscillations.

By JOHN J. DOWLING, M.A., F.Inst.P., and JOHN J. McHENRY, M.Sc.

For certain purposes a wavemeter which indicates both the frequencies and relative intensities of the oscillations in H.F. circuits is required. The following device possesses at once the merits of simplicity and great sensitivity, while it involves the use of no apparatus of an unusual type, so that it can be readily set up in any laboratory.

The principle employed is perhaps not new, but does not seem to have received much attention. It was employed by one of us for another purpose,* and has since been used in several other applications.

Circuit Arrangements.

A wavemeter circuit of the usual type, consisting of an inductance (L) and capacity (C), either or both being variable, is shown on the left of the diagram. The terminals of C are connected to the grid and filament of the valve. The valve should be operated close to the lower bend of its characteristic and it may be necessary to bring the grid to a suitable negative potential by a few cells (P).

The indicating device is an ordinary d.c. aperiodic galvanometer G , in parallel with which the "zero-shunt" device (E, R) is introduced in the anode circuit. This "zero-shunt" has the following property.

Suppose that the anode current has a valve I (say 1 mA), and that R is adjusted so that $\frac{E}{R} = I$. There will then be no current through G . But if I increase (or decrease) by an amount i , there will then be a current $\frac{R}{R+i}i$ through G ; g being galvanometer resistance. The "zero-shunt" therefore enables a galvanometer of great sensitiveness to be employed to detect minute variations of the anode current.

Anode Current and Grid Potential.

It was found (*loc. cit.*) that the relation between the anode current and the applied alternating grid potential, although not linear, is appreciably so over small ranges. As long as we are employing a sensitive galvanometer we may regard its

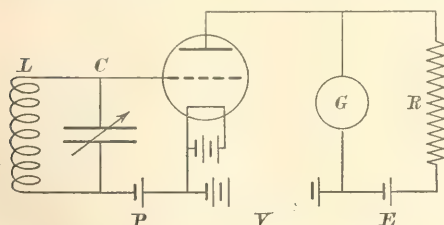


FIG. 1.

deflections as proportional to the alternating p.d. (e) set up across C due to the oscillations induced in the circuit LC .

When the wavemeter is adjusted to resonance, we have :

$$e = \frac{E}{2\pi n R C} = \frac{2\pi n L}{R} E = \frac{E}{R} \sqrt{\frac{L}{C}}$$

Where E is the amplitude and n the frequency of the e.m.f. due to the coupling (loose) between the wavemeter and the tested circuit; while R is the resistance of the circuit LC .

It is clear that the galvanometer maximum is proportional to n if L is constant, and to $\frac{1}{n}$ if C is constant. This has to be taken into account in comparing the amplitudes (E) of oscilla-

tions of different frequencies in a circuit at a fixed distance from the wavemeter. Subject to this consideration the maximum galvanometer deflection, besides indicating the resonance point also measures the strength of the oscillation.

Testing Too Close Couplings.

An interesting property of the instrument is that its readings show when the coupling between the wavemeter and the tested circuit is too close. The curves (Fig. 2) illustrate this condition. The heavy line represents the wavemeter reading; the dotted line the variation of the plate current in the tested circuit. Owing to close coupling the wavemeter circuit reacts on the oscillating circuit and shows in consequence two

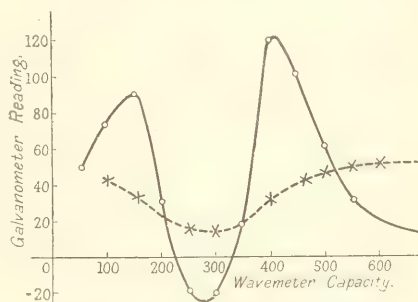


FIG. 2.

maxima which of course are not characteristic of the oscillation circuit operating freely. On moving back the wavemeter these two maxima coalesce and the resultant single maximum is much sharper; at the same time the dotted curve ceases to show an appreciable dip.

We may remark that the galvanometer had to be heavily shunted in the above experiment; with looser coupling little or no shunting would be employed.

We trust that other workers may find a use for this apparatus. As an indication of its sensitiveness we may state that at several metres away from a valve circuit oscillating with only 20 volts on the plate, deflections of from 50 to 100 galvanometer divisions were obtained.

The Imperial Wireless Chain.

Ever since the Imperial Conference in the summer there have been a number of notices in the Press regarding the scheme for the provision of an Imperial wireless system. Though some of these paragraphs contained a certain basis of fact, the majority of them have been pure guesswork. In regard to the latest of these statements (in an issue of the "Westminster Gazette") that the scheme for the Imperial wireless chain had collapsed, the Postmaster-General announces that it is devoid of foundation. The scheme was approved by the Government and was endorsed by a Committee of the Imperial Conference in the following resolution:—"It is agreed that H.M.'s Government should take steps for the erection of the remaining stations for which they are responsible as soon as the stations are designed; that the Governments of Australia, the Union of South Africa, and India should take similar action so far as necessary, and that the Governments of Canada and New Zealand should also co-operate."

The scheme was accepted by the Prime Minister of the Commonwealth, subject to giving full freedom to Australia to decide the method of co-operation. No change in the policy of the Government has since taken place. The first two stations in the Imperial chain (Leafeld and Cairo) will be working by the end of this year, and a commission of experts has been engaged in designing the remaining stations. Their report is expected within a few weeks, and on its receipt the construction of the stations will be proceeded with as quickly as possible.

* Dowling: "Sensitive Method for Capacity Measurement." Proc. Roy. Dub. Soc. XVI. 17. Feb. 1921.

Telephone Line Work in the United States.*

By E. S. BYNG.

After the author's return from a recent visit to the United States of America, it was suggested that a description of the methods of telephone line construction adopted in the United States would prove of interest to British telephone engineers. In America, the home of the telephone, its possibilities were quickly appreciated and expert skill was bestowed upon its scientific development from its inception. Progress has accordingly been rapid in the United States, which now contains about 70 per cent. of the telephones of the world. Work has been carried on in new and developing cities and among people who regarded the telephone not as a luxury but as a business necessity.

Organisation of "Bell" System.

The American Telephone and Telegraph Company (the "A. T. & T. Co.") and its associated companies, constituting the Bell System, control approximately 12,600,000 telephone stations. In addition, there are about 9,000,000 stations owned by independent companies. Each company has its local organisation, generally divided into (1) engineering, (2) plant, (3) traffic, and (4) commercial divisions.

In the original Paper the author summarises the work of the divisions in detail. The Engineering Department deals with technical standards, prepares exchange plans, specifications and estimates, recommends sites for buildings, reviews plans for extensions, &c. The Plant Department deals with outside plant extensions, keeps plant records, obtains rights of way, deals with construction of line and station plant, undertakes maintenance and orders and distributes material and supplies. The Traffic Department recommends all additional central office equipment and trunk and toll circuits, handles traffic and obtains data thereon, supervises training of operators, &c. The Commercial Department deals with such matters as determination of local rates and areas, compilation, publication, and distribution of directories, publicity and advertising, commercial relations with connecting enterprises, canvassing and collecting, &c. Each associated company furnishes the exchange service for the towns and cities in its area and provides trunk lines within the territory. Long distance trunks between towns in different areas are furnished by the Long Lines Department of the A. T. & T. Co. The latter constitutes the central controlling organisation for the whole Bell system. Besides the technical department of the central organisation, the engineering staff of the Western Electric Company develops new devices and carries out laboratory investigations and tests. This company manufactures all apparatus and acts as purchaser for auxiliary supplies.

Development Studies.

In the next section of the Paper the author proceeds to review development studies, which are naturally important with a view to future progress of a telephone system. The "commercial survey" involves an analysis of existing telephone subscribers and the preparation of ordnance maps of the town and its various divisions classified according to the nature of the demands for service. Local characteristics as revealed by census data are also studied, with a view to forecasting growth in the next twenty years. Next the design and lay-out of plant is considered over a period of fifteen to twenty years. The actual type of plant is based largely on considerations of economy, but the degree of safety and quality of service aimed at must be taken into account. Subscribers' cables are divided into "main" and "distribution." In all cases a colour-code is adopted, paper distinctive colour-combinations being used for various groups. As regards sheathing, an alloy of 97 per cent. lead and 3 per cent. tin has requisite strength, but in view of the increasing price of tin 99 per cent. lead and 1 per cent. antimony was eventually adopted.

Ever since the days of overloaded open-wire routes the advantages of the aerial cable under certain conditions have been realised, but it was at one time considered to be a transition stage between open wire and underground construction. Owing to ring cuts, crystallisation of the lead sheath at poles, and other defects, it was deemed advisable in many cases to place important long-distance cables underground in order to ensure continuity of service. However, the defects mentioned were gradually eliminated and it is now settled policy, where local conditions permit, to run all long-distance cables aerially.

Engineering and Construction.

The next section of the Paper is devoted to engineering and constructional details. The author describes the poles, at present invariably of wood, and usually creosoted, as this increases the

life by five to fifteen years. Telephone routes usually follow public highways, but short cuts across country are adopted, when rights can be economically obtained; a lump sum per pole is preferred to annual rental per pole. Poles range from 30 to 35 ft. high for main routes, and 25 ft. for rural lines, and are spaced from 100 to 150 ft. apart. Details are given in the original paper of types of arms, brackets, staying, &c. Glass insulators are best suited to American conditions, double petticoat types being used in running or transferring all loaded circuits and for unloaded circuits exceeding 100 miles in length. For toll lines No. 8 B.W.G. or No. 12 B.W.G. is used. Galvanised wire is used in certain cases, but iron wire will not last more than eight years in a moist or smoky atmosphere, and copper wire is used in the majority of open air installations in the Eastern States. On a long-distance line practically every pair of physical circuits is used to obtain a third or phantom circuit by installing repeating coils at terminating ends. A further step is the use of each of the four wires forming a group, separately compositised for telegraph operation. By applying "carrier" currents each pair of wires may be used for simultaneous telephone or telegraph circuits. For long distance lines a system of transposition is adopted with a view to eliminating electrical interference; measures for suppressing inconvenient higher harmonics are frequently suggested to supply companies. The standard numbering of wires on a pole route of two ten wire arms is illustrated in the original Paper and typical pole fittings, stay rods, &c., are also shown. Prior to the introduction of repeaters long distance lines were loaded in many cases, but in the case of No. 8 wire circuits, wires have now been unloaded. In smaller sizes of wire, however, loading coils are still needed and are fitted in conjunction with repeaters.

Aerial Routes.

The author next devotes attention to aerial routes. Cable containing small gauge No. 22 B. & S. conductors are supplied in two types—for aerial and underground use. The sheath is the same in both cases, but the dielectric strength of the aerial type is greater. Sheaths containing conductors of 20 lb. or heavier are identical. In the original Paper methods of suspension are illustrated, and the author also describes methods of strand jointing, fixing metal cable rings (now a round section steel ring), and devices for clamping and erection.

Advantages of Aerial Cables.

The following summary of advantages claimed for aerial toll cables is of interest:

- (1) The initial investment for aerial cable in place is less than for similar cable placed underground, where both pole route and underground route are specially constructed. The annual cost of aerial cable is also smaller.
- (2) Where the ultimate traffic is uncertain, there is less risk in the smaller investment. This applies also to the factor of obsolescence.
- (3) The work of installation can be completed much more rapidly, hence there is an earlier return on the investment and earlier service for the public.
- (4) Aerial cable may be erected over rocky or mountainous country where underground construction is impracticable.
- (5) A more direct route which may frequently be followed aerially, leading to reduction in cost and lower transmission losses.
- (6) Short river and canal crossings can be negotiated more easily by aerial than by submarine cable.
- (7) Although there is a greater possibility of faults with aerial cable, repairs can be effected more readily, the cable being readily accessible; service is therefore quickly restored. Further, underground cable is more liable to total breakdown from the flooding of ducts or manholes, due to defects in plumbing and other causes, than is aerial cable.
- (8) Aerial cable is always open to inspection, and breakdowns due to street operations are avoided. When roadways are being re-made, raised, or lowered, an aerial cable route may easily be diverted.
- (9) There is practically no risk of electrolysis.
- (10) During winter, underground cable is liable to be crushed within the ducts by the freezing of water. Aerial cable is exposed to no such danger.

The chief drawbacks to the use of aerial cable are:—

- (1) The line may be objected to on aesthetic grounds. If, however, the construction work is carried out in a proper manner, a pole route carrying cable only is perhaps less objectionable than a heavy route of open wires.
- (2) Ring cuts and crystallisation of the lead sheath (due to expansion and contraction of the cables) may occur, but can now be largely avoided.

* Abstract of a Paper read before the Institution of Electrical Engineers.

(3) Injuries caused by malicious damage—linesmen's spurs, beetles and squirrels, &c., have been mentioned, but in practice very few breakdowns are due to these causes.

(4) On account of the prevalence of wood buildings there is a possibility of damage to aerial cable by fire. This danger is minimised by skirting the villages and by underground "dips" through towns.

(5) Damage from blizzards has been feared, but during recent years it has been found that where only cables are carried the route is practically immune from storm damage. The calculated strength of a new route is such that with $\frac{1}{2}$ in. of ice on the suspension strands and cables, and a 70-lb. wind pressure, there is a factor of safety of 4.7. After nineteen years' life, with a loss of $\frac{1}{2}$ in. per year in the circumference of the pole, the factor of safety would still be 2.9.

In general it is claimed that the stability of an aerial cable route is assured by the precautions taken during installation. The chief points to be observed in planning such a route are: Short spans, extra-stout short poles, removal of trees immediately adjacent to route, suspension strand at correct tension, the right class of ring at short, equal distances apart, marine ties to prevent crystallisation and ring cuts, and grade clamps to avoid creeping. By the adoption of these measures many of the past weaknesses of aerial cable have been eliminated.

Conduit Routes.

In dealing with conduit routes the author describes types of conduits of vitrified clay, creosoted wood, and iron and steel. Creosoted wood is often used, but if more than four to six ways are needed vitrified clay is preferable. Metal conduits are used only for the lateral or "riser" at distribution points where their use is unavoidable in avoiding obstructions. Among other classes of conduit fibre-tubing is mentioned, but as an alternative duct is considered less satisfactory than the methods mentioned above. Concrete ducts have not proved successful owing to increased friction during the cable installation and prejudicial alkaline effects on the lead sheath. Manholes were formerly made of brick, but are now composed of concrete. Typical constructions are illustrated in the original Paper.

Labour-Saving Devices.

For the installation of cables in ducts a motor truck fitted with a power-driven winch is used by telephone companies. In city work a small petrol-driven engine is used for drawing out the galvanised wire. Thick motor oil or graphite grease is used as a lubricant for the cable during installation. But no lubricant constitutes an effective preservative against chemical or electrolytic action.

Joining.

The author also illustrates the lay-out of cables in the exchange cable vault, and an account is given of methods of joining adopted in American telephone practice. All joiners are also fully qualified plumbers. It is interesting to observe that as a result of various labour-saving devices in joining and plumbing it is possible to deal with over 100 pairs an hour on a subscriber's cable, and the more experienced men can even deal with as many as 150 pairs an hour. Thus it is often possible to complete a 600 pair 10-lb. cable joint in an eight-hour day. The chief features of the process are the use of either a "crank-handle" or "organ barrel" twist, while in making a stub-joint the wires from the two main cables and the wire of the stub cable are twisted together in one joint, known as a "bridge splice." Woven cotton sleeves are used in preference to paper for insulating wire joints. After the joint is made and boiled out, it is bound with 4-in. muslin strip prior to plumbing. The cleaned portion of the lead sleeve and sheath is covered with stearine which acts as a flux for plumbers' metal. The maximum length of sleeve is 20 in. In general the maximum number of cables entering a wire is two. Complicated plumbing is avoided by the use of stub-cables. Electric lamps fed by portable accumulators are exclusively used for illumination in manholes. Y-joints are filled with paraffin wax after making as an additional safeguard against moisture, but straight joints are not so treated. The method of joining in loading coils by means of a "balloon joint" is also described.

No attempt is made to remedy insulation breakdown by desiccation, either by dry air or CO_2 . There is no reason why faults should develop between one joint and another apart from rare cases of mechanical injury or corrosive action. Such a breakdown would probably involve complete replacement of the cable, except in the case of a purely local fault, when the section could be boiled out with paraffin wax. Cables are so carefully racked when placed in manholes that there is little risk of injury to joints.

The differences between the various types of joints used in America are briefly summarised as follows:—

(1) The boiled-out joint is *not* solid. Wax at the temperature specified is run through the open joint like water, merely to avoid low insulation. The quantity of wax remaining in the joint is

small, and free passage of air is not impeded if a pressure-test is at any time required.

(2) A Y joint filled with wax is also not solid in the true sense of the word. Probably a sustained pressure-test could not be made, but the joint serves as a fairly effective block to passage of air and, if the plumbing were defective, water would take an appreciable time to penetrate into the cable.

(3) The pot-heads formerly used for terminating paper-insulated lead-covered cable in some of the cable terminal boxes are *practically* solid, as a black insulating compound is used, with the object of preventing moisture creeping along the rubber leads to the paper cable.

(4) In submarine cable work, where paper-insulated cables are used, joints are required which will *absolutely* prevent moisture getting to the cable. Such joints are made on a principle entirely different from that of merely filling with compound, even under pressure, as there is always the possibility of water penetrating the cable owing to the contraction of the compound.

House Cabling Methods.

In a further section of the Paper details of methods pursued in house-cabling are given. It is interesting to observe that practically every room (in some cases as many as 2 500) in hotels is fitted with a telephone. The private service is handled by a special switchboard, from which all circuits (except junction lines) radiate. Installations in hotels are broadly similar in plan, though two distinct types of distribution are in vogue. In large office buildings, however, arrangements vary considerably. Some require many out-going lines with little or no internal service, others demand branch exchanges with a large number of internal extension lines. Flexibility is usually attained by providing a distribution case or cross-connecting frame at some convenient point, usually in the basement. In one large New York building, containing about one million square feet of area, four main cables, each of 900 pairs, are brought in from a neighbouring exchange; approximately 600 pairs in each cable are taken to riser cables direct; the remaining 300 pairs are taken to the connecting frame resembling the intermediate distributing frame on a large telephone exchange.

Attention is drawn to the advantages of the American "block system" from a distribution standpoint, and this system is adopted where telephone density is not sufficient to justify internal house cabling schemes.

"Drop-wiring" for distributing from pole routes to subscribers' premises plays an important point in distribution. The standard method of distribution is to erect short poles (20 to 24 ft.) in alleys within blocks or on the roadways. From these poles covered drop-wires are run to consumers' areas.

In "thin" areas, where the telephone density does not justify external or internal block cabling and wiring, a carefully-designed aerial cable system, liberally provided with cable terminals, forms an economical system of distribution. Plant of this type is neat and inconspicuous, and does not raise any objection on aesthetic grounds, hence the necessity for underground work may remain dormant for many years. Formerly cables were tapped as little as possible, but to-day there is nothing to be feared from a multiplicity of cable terminals, which makes possible a system of covered drop-wire distribution.

The terminal is a vital part of the distribution system; and has been carefully and substantially designed. Speaking generally, a terminal is used if 300 ft. of drop-wire will thereby be saved. Hence, if it is expected that three subscribers' lines will radiate from each pole, a terminal is fitted initially on each pole, or at least on each alternate pole. In addition to the factor of annual cost, the number of men engaged and the time spent on installing the subscribers' lines is reduced by the generous provision of terminals.

Advantages of Drop Wiring.

The advantages claimed for this drop-wiring method of distribution may be briefly summarised:—

(1) Short poles may be used, as foliage and other obstructions do not affect covered drop-wires in the same way as they would open wires.

(2) Pole arms are not required, and the system of brackets and insulators involves the minimum of material.

(3) There is less danger of contact with high-tension wires.

(4) Short-circuits and contacts are avoided, and therefore maintenance costs and interruptions to service are reduced.

(5) The subscriber's loop between the terminal and the subscriber's premises is free from joints.

(6) The possibility of "humming" is lessened.

(7) Induction effects are reduced, as the wires are perfectly transposed.

(8) Telephone service can be supplied at short notice.

(9) The cost of running individual circuits after the main scheme has been completed is small.

In regard to (4) it might be mentioned that the last span of open

more than a proportionate number of faults.

Motor transport is more used on telephone work in America than in England because (a) initial costs of trucks and cars are less, (b) petrol is retailed at about one-third the British price, (c) greater distances have to be covered, (d) construction and maintenance hands are paid at very high rates, (e) it is difficult to obtain convenient accommodation in country districts. Three-ton trucks are commonly used for conveying small bodies of workmen and materials. Each gang foreman, controlling 10 to 20 men, is usually supplied with a two-seater car and motor-cycles are used to a limited extent for maintenance work. The truck used by an overhead construction gang is fitted up as a travelling store-room. The great use made of motor transport has led to the maintenance by telephone companies of large garages and a special staff of men dealing with repairs. Thus the New York Telephone Company has a fleet of over 1,000 vehicles and a staff of 259 men engaged on maintenance and repairs. The expense, however, is considered fully justified by the resulting improvement in efficiency.

The high wages usual in the United States have also led to the adoption of many labour-saving appliances. Amongst these are excavating machines for trench work, back-fillers (a modified form of farmer's plough for pushing the ground back into the trench for ramming), tamping machines (a substitute for hand-ramming), concrete mixers, pole erectors, air-driven drilling machines, &c.

The Importance of Maintenance.

In American practice maintenance plays a most important part and, under pre-war conditions, the time taken for clearing faults for large cities was reduced to an average of about two hours per fault. This was made possible by the concentration of all testing and localising apparatus in one central office. Thus, in New York, one central office does all the testing for twenty exchanges,

embracing about 260,000 stations, just as if the testing apparatus were installed in the apparatus room of each. Breakdowns of telephone line owing to heavy sleet storms are being reduced by the extended use of cable instead of open wire, but there is little danger of an overhead route being brought down when carrying cable. As it is not customary to impose pressure-tests on completed cable works, or to use desiccators for raising low cable insulation, it might be expected that the maintenance of underground cables would suffer. In practice, however, this is not the case.

High Quality and Rapid Output.

In conclusion, there is one feature which might be emphasised in connection with telephone construction work in the States. When the speed at which the work is carried out was first realised it was imagined that the quality of the work would necessarily suffer. However, that was not so. There are several reasons for this unexpected combination of high quality and rapid output. The ready acceptance of machinery and labour-saving devices by the working man, and the fact that they have been used to their full capacity, have been conducive to high efficiency. Trade unionism exists to some extent, but there is no desire to hamper output. The men readily accept any suggestion for speeding up the work, as they believe it will be to their advantage to reduce costs. In consequence it has been possible to place the majority of telephone workmen on the staff of the various companies rather than on an hourly basis. They receive a good weekly wage and enjoy privileges in regard to holidays, sickness, pensions, &c., which attract a good class of man. Another important point is the prospect of promotion to the higher grades for all ranks. It is a fact that any position in the Bell system is open to anyone who becomes qualified for it. Amongst the joiners are men who have graduated in a university; they have started at the bottom, but are not content to remain there. The actual hours worked are not long, but while the men are on duty they work hard and well.

FURTHER DEVELOPMENTS IN RAILWAY ELECTRIFICATION.

Details of an Extended Suburban and Main Line Scheme.

It has for some time been common knowledge that Sir Philip Dawson, M.P., and the officials of the London, Brighton and South Coast Railway have been carefully considering the possibilities of extending electric working on that system, not only in the outer London suburban area, but as far afield as Brighton, Eastbourne and Worthing. It has also been known that this investigation has shown the great advantages, from every point of view, of undertaking a comprehensive scheme of electrification, and that as a result a report was submitted some months ago to the Ministry of Transport. Particulars of this report, which contains a large amount of useful data based not only upon experience, but upon special experiments, have been published in "Modern Transport," to whom we are indebted for permission to reproduce the information we give below.

The Area of Electrification.

The area of electrification covered by the present scheme includes the whole of the Brighton Company's system in the London district north of Coudon and Epsom and the main lines Coudon to Brighton, Keymer Junction to Eastbourne, and Preston Park to Worthing, as shown on the accompanying sketch map.

In order to arrive as accurately as possible at the figures of cost, enabling a comparison to be furnished between steam and electric haulage, practical time tables were prepared on which the calculations were based. It was also necessary to investigate very thoroughly the conditions of working and to carry out a number of tests in order to ascertain, particularly with respect to shunting and marshalling operations, the energy required and the comparative savings effected by electric operation.

In order further to obtain accurate information as to the conditions of goods working, a complete analysis of services in the areas proposed for electrification was extracted from the Locomotive and Traffic Departments' journals. These showed very clearly the proportion of train (locomotive) miles and hours spent in running, wayside shunting, and light running, time standing, and number of seconds when miles and ton miles under the headings "running" and "wayside shunting." The figures thus obtained, together with other data obtained separately in respect of the northern and southern areas of the Brighton Company's system, afforded a key to goods traffic requirements for estimating the extent of necessary electrification.

Electrification Existing and Proposed.

Before the war, contracts had been let for the electrification of practically all the company's suburban passenger services in the London area north of Coudon and Cheam, involving the equipment

of 141 single-track miles in addition to the 70 single-track miles already equipped and in use. Up to the outbreak of war, and during its earlier stages, 42 single-track miles were equipped with overhead line, but, due to increasing difficulties in obtaining labour and materials and the impossibility of securing rolling-stock and train equipments, the additional lines had not been completed and brought into use before the present conditions rendered progress impossible without readjustment of the financial position. Schemes were also in active preparation before the war for the electrification of the main lines to Brighton, Eastbourne and Worthing.

It was anticipated that the electrification of the suburban area would be completed during 1919, and that the facilities afforded would thus relieve the traffic congestion which, even at that time, was becoming acute; the postponement of electrification has thus added considerably to the difficulty of handling the further increased traffic.

Relief of Congestion.

The manner in which electrification will enable this congestion to be overcome is clearly shown by the following approximate percentage increases in the number of trains which it will be possible to run on congested terminal sections during the hours of maximum service:—

	Per cent.
Main line "all electric" over "all steam" at Victoria . . .	228*
Main line "all electric" over "mixed steam and electric" at London Bridge . . .	152*
Suburban line "mixed steam and electric" over pre-electric "all steam" at Victoria . . .	58
Suburban line "all electric" over pre-electric "all steam" at Victoria . . .	94*
Suburban line "all electric" over "mixed steam and electric" at Victoria . . .	100
Suburban line "all electric" over "mixed steam and electric" at Victoria . . .	225*
Suburban line "all electric" over "mixed steam and electric" at Victoria . . .	68*
Suburban line "all electric" over "mixed steam and electric" at Victoria . . .	53
Suburban line "mixed steam and electric" over pre-electric "all steam" at London Bridge . . .	38*
Suburban line "all electric" over pre-electric "all steam" at London Bridge . . .	21
Suburban line "all electric" over pre-electric "all steam" at London Bridge . . .	204*
Suburban line "all electric" over "mixed steam and electric" at London Bridge . . .	86
Suburban line "all electric" over "mixed steam and electric" at London Bridge . . .	121*
Suburban line "all electric" over "mixed steam and electric" at London Bridge . . .	53

(Note.—Figures marked with asterisk are increases over loaded traffic; other figures are increases over all trains, loaded and empty.)

It should be noted that, in dealing with increased services, the seat miles per hour provided must be considered in conjunction with the train mile basis. Thus, the average number of coaches, and therefore of seats, per steam train is greater than that of either

existing or proposed electric trains; the overall schedule speed of electric operation is, however, considerably greater than that of steam operation, with the result that, despite the shorter average trains used, the electric service affords considerable advantage in actual passenger carrying capacity (i.e., seat miles per hour).

Goods Train Working.

With regard to the future working of goods trains, the estimates have been based on the assumption that all such trains in the proposed electrified area (with a few minor exceptions) will be hauled by electric locomotives, and that all goods yards and sidings will be equipped with overhead contact wires for this purpose. The abandonment of steam locomotive sheds is a very important factor in the saving due to electrification, and to effect the best results it is essential for this reason alone that goods as well as passenger services should be operated electrically, apart from the better haulage efficiency obtained by electric locomotives, the elimination of the corrosive effects of steam locomotives on the electrical equipment and the obstruction caused by the slower movement of steam trains.

Electric v. Steam Locomotives.

So far as actual haulage is concerned the advantages of the electric as compared with the steam locomotive are very considerable in goods working, owing to the reduced standing time, the greater ratio between tractive efficiency and adhesive weight, the more continuous service obtainable, the less diversity of types of locomotive and the reduction in the actual number of locomotives required. With regard to the first point it is estimated that the maximum economical time a steam locomotive can be in service continuously is sixteen hours a day for seven days a week, with approximately three weeks per annum for overhaul and repairs. As against this it is estimated that an electric locomotive could perform continuous duty for 22 hours per day of seven days a week, with two weeks per annum for overhaul and repairs. With regard to the second point, on a particular day in 1920 the 153 steam locomotives employed in goods service in the proposed electrified area had a total weight of 9,281 tons of which only 6,742 tons were effective for adhesion purposes. An electric

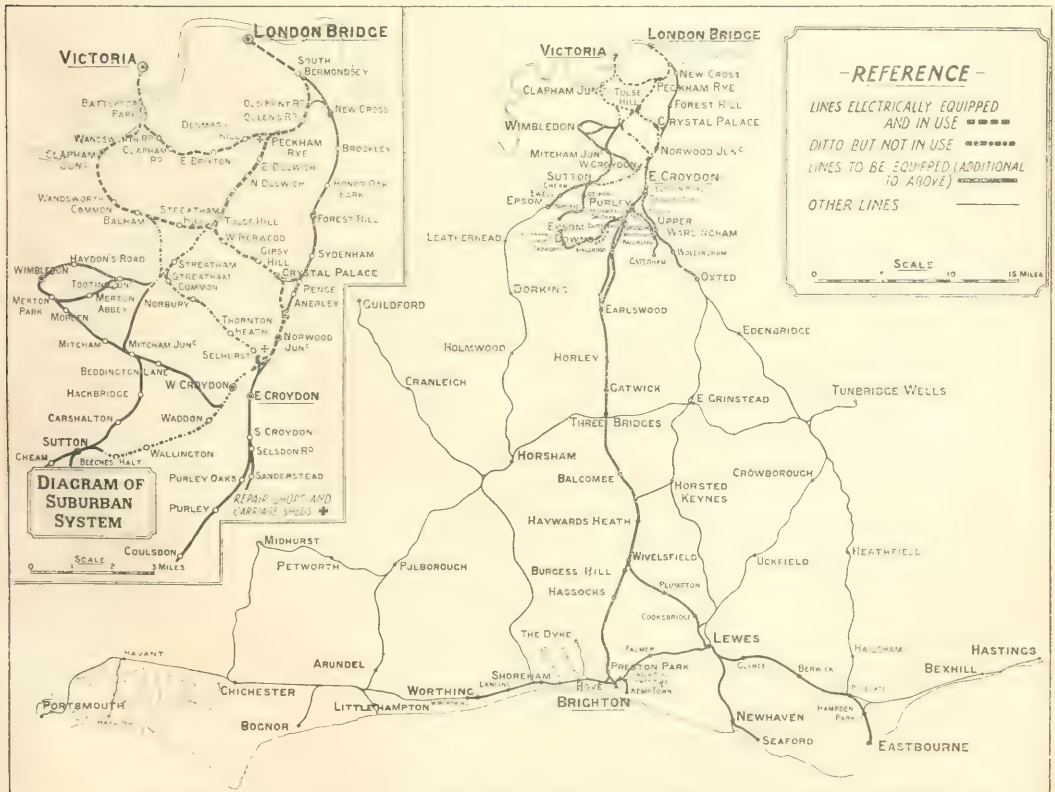
locomotive such as suggested for this service would weigh 45 tons, the whole of which would be available for adhesion, and while in the steam locomotive the relation of draw bar pull to adhesive weight is about 16 per cent., in an electric locomotive it is approximately 25 per cent. It would, therefore, be possible to perform with a 45-ton electric locomotive the same service as is now performed by a 105-ton steam locomotive. The better acceleration afforded by the electric locomotive is also capable of improving the scheduled scale of all classes of goods service, with a result that it is estimated it will be possible to reduce the number of locomotives employed by 46 per cent.

Working Costs.

Careful estimates have been prepared as to the savings in working costs derivable from electrification. Calculations have shown that the cost of electrical operation on the London suburban passenger service is 45 per cent. less than for steam locomotion, on main line and country local services 36 per cent., on local goods services 41 per cent., and on main line goods 21 per cent.

The figures utilised for the comparisons are based on the prices of labour, fuel and materials at the end of 1919, and do not include increases in the cost of wages and fuel which have become effective since that time. It is pointed out, however, that, with regard to fuel, the higher the cost of coal the greater the proportion of saving effected by electrical operation, due to the facts that an inferior quality coal can be utilised for steam-raising purposes in the stationary boilers of a power station than on a steam locomotive, and that coal is more efficiently employed in the former than in the latter. As regards wages, a similar remark applies, since the better schedule speeds result in more efficient employment of train crews and staff. Efficiency in this respect is obviously of more importance having regard to the introduction of the eight-hour day.

Attention is also called to the point that the chief gain from electrification is not financial, but is to be found in the improved services and traffic facilities thus made possible. This is supported by figures recently submitted by Sir William Forbes, general manager of the Brighton Company, to the Electrification of Railways Advisory Committee.



MAP SHOWING DETAILS OF LONDON-BRIGHTON & SOUTH COAST RAILWAY ELECTRIFICATION SCHEME.

INSTITUTION OF ELECTRICAL ENGINEERS.

Winding-up the Old Institution—A New Honorary Member—An Interesting Paper on American Telephone Practice.

The ordinary meeting of the INSTITUTION OF ELECTRICAL ENGINEERS on Thursday in last week was preceded by a special general meeting to pass two resolutions (whose terms have already been published in THE ELECTRICIAN) for winding up the affairs of the Institution as a company and for transferring the assets and liabilities of this company to the Institution as incorporated by the Royal Charter.

The PRESIDENT, in proposing the resolutions, said that it would be recommended at a special general meeting, in May last the Council had been authorised to take the necessary steps to apply for a Royal Charter, and that it was conditional on the granting of that Charter that the affairs of the old Institution should be wound up and its assets and liabilities transferred to the Chartered body.

Mr. LLEVELYN ATKINSON seconded the resolutions, which were, needless to say, carried with unanimity.

A New Honorary Member.

After a short interregnum, during which members had the opportunity of admiring the splendid new carpet in front of the Council table, whose warmth of colour tends to counteract the dullness of the mercury vapour lamps above, and during which those interested in telephony, but not in business, entered the room, the ordinary meeting was opened by the PRESIDENT announcing that the Council had elected the Right Hon. Lord Southborough as an honorary member. This was the greatest honour, Mr. Highfield said, that it was in the power of the Institution to confer. The Council could elect one honorary member per annum, and they had elected Lord Southborough for many reasons. He had had close connection with the electrical industry. They knew him best, perhaps, as Sir Francis Hopwood in the days when he was Permanent Secretary to the Board of Trade. In that position he had a great deal to do with the Parliamentary stages of electrical enterprise. Lord Southborough was a member of the Privy Council, and he was the British delegate to the International Railway Congresses in 1895 and 1910. He was Vice-Chairman of the Development Commission of 1910; he was a member of the Board of Control of the National Physical Laboratory, and at the present time was a director of the Underground Railway. In most of these positions he had been able to be of very great service to engineering and electrical engineering, but there was one particularly interesting piece of business in which Lord Southborough had a very great hand. He was one of the signatories of the last Report of the Board of Trade on Electrical Units and Standards. On this Report was based the Order in Council of 1894. This Order in Council gave legal authority for the electrical units and standards, which the world had since adopted. There was, probably, hardly a single piece of legislative work that had been of more importance to the science of the electrical engineer. Other signatories to the Report were such historic names as Ayrton, Carey Foster, Kelvin, Cardew, Preece and Glazebrook.

Most of the honorary members of the Institution were men of science or famous in engineering. Lord Southborough was not quite in the same category, but as that Institution grew older its base must broaden; it must come more in contact with the outside world, which, after all, had a good deal to do with its prosperity, and it was a matter of the first importance to them that Lord Southborough had that same outside connection. Lord Southborough, he thought, was the first honorary member who had been present when his election was announced. Lord Southborough was also the first honorary member of their new Incorporated Institution. His election was peculiarly fitting, because no one had helped more in obtaining the Charter than he.

An Example in Elocution.

LORD SOUTHBOROUGH, whose elocution was an example which might be followed by many electrical speakers, said he did not propose to interrupt the course of the Institution's business by making a speech, but he could not pass the moment by without rising to express his deep sense of the honour which had been conferred upon him. It was the highest honour the Chartered Institution could confer, and he was bound to say he had not anticipated that at any time the administrative side of the electrical life of this country would be so recognised in him. It would be his aim and object to interest himself in all the Institution's proceedings from the point of view which had been described by the President. He trusted that as the time went by they might teach the uncultured mind of their honorary member something of their concerns and that he might, on his part, make many friends.

Mr. E. S. Byng's Paper on "Telephone Line Work in the United States," an abstract of which will be found on another page of this issue, was then dealt with by the author in a summarised form.

The PRESIDENT preface the discussion by a double appeal, first to speakers to be both short and interesting, and secondly to Mr. H. W. Dipple to perform his duties as scrutineer. At first we thought this change of procedure was due to a realisation of the necessity for tact in the conduct of meetings, but we found out later the real reason was that no bell had been provided. This was a matter for regret as, untrammelled by its music, certain of the speakers rather let themselves go.

An Envious Critic.

SIR ANDREW OGILVIE pointed out that the figure of 12 600 000 telephone stations given by the author as being controlled by the American Telegraph and Telephone Company included about 4 000 000 stations which belonged to independent undertakings. He thought that fuller reference might have been made to the splendid research organisation the A. T. and T. Company maintained at its headquarters. At least 1 200 experts were engaged on nothing but the scientific problems arising out of the study of telephone work. The extraordinarily rapid growth of American cities, and, consequently, of the telephone system, made it important to study probable development for a considerable time ahead. One of the reasons why our methods so closely followed American practice was the generosity with which the results of their investigations were placed at our disposal. The wide use of glass insulators in America made him feel envious, but he thought their use in this country, together with wooden pins, would be quite impracticable owing to climatic conditions. The costs of maintenance in America and in this country was to some extent equalised by the higher American wages. Climatic conditions in this country also prevented the installation of loading coils in the way described in the Paper, and desiccators, for the same reason, were neither necessary nor used in the United States. The lay-out of the American cities and the greater simplification of the cabling also made him envious. A great deal of the expense which had been incurred in introducing the underground system in this country would probably not have been necessary had these methods of lay-out been followed. American practice differed from ours in the greater use of overhead cables. He had always had a leaning towards this system, and wondered whether its wider adoption in this country was not possible.

Underground Complications.

After those who were modestly standing at the back had been instructed to come down and occupy the empty front rows Mr. A. O. GIBBIN asked a number of questions regarding certain figures in the Paper. He thought the American practice of providing large stubs at branching points was an excellent one, though there was also a field for the diminishing or tapering system, which was standardised in this country, and which from one of the author's diagrams also appeared to be used in America. Turning to the question of underground work, Mr. Gibbin showed some interesting slides illustrating conduit lay-outs which had recently been adopted in London, illustrating the flexibility which was possible and necessary with British conduit construction owing to the small spaces often available owing to the prevalence of water and other pipes. For instance, at Ludgate Circus, the distance between the top of a culvert and a 48-in. water main was only 18 in., and 36 ducts had to be taken between them.

Difficulties of Predicting Development.

Mr. J. M. SHACKLETON was an illustration that to the English all that an Irishman says is humorous. He began by asking some questions regarding the organisation of the A. T. and T. Company, and pointed out the difficulty in the ancient parts of London, where old houses might be replaced by new buildings, of predicting what telephone service would be required even two years hence. He took it that as a general rule about 50 per cent. of the cable was lying spare in the United States, as was the practice in this country. He noticed that in the United States they did not use earth wires on the poles, and he thought that practice might also be followed in this country. He emphasised the point Mr. Gibbin had made about the need for flexibility in duct construction, and asked what was the experience in America with silk and cotton-covered cables, ie being, in this country, difficult to provide a suitable leading-in cable which did not take up too much room and yet maintained its insulation. As regards routing and cross-connection work generally, it would be interesting to know the practice in America with regard to miscellaneous circuits such as private wires, exchange extensions, fire alarm circuits, which were all additional to any exchange system, and were troublesome to deal with. A large portion of Mr. Shackleton's remarks was made up

with comments on points in the Paper conducted in a species of verbal shorthand with author which makes them difficult to report.

An Advocate of Glass Insulators.

Mr. FRANK GILL objected to Sir Andrew Ogilvie's criticism of glass insulators. At any rate, they had a wide application both in the United States and in other parts of the world, and in parts of the States the climate was just as bad as in this country. It might be pointed out that the insulation of the porcelain insulators was on the surface, and that surface was not very different from glass. He also advocated aerial cables if they had the right sort of sheath; but the right sort of sheath was not a pure lead sheath.

Major H. BROWN said that the Post Office had made a standard practice of waxing joints, though contractors were left to use wax or not as they pleased. To some extent it was an economic question, but there was also the difficulty that if wax was used it was hard to identify the circuits, especially with coloured insulations, while it made the cable unpleasant to deal with if the joint had to be opened. Wax also had the disadvantage of slowing down the work, of being inflammable, and of emitting harmful fumes. He criticised adversely the American practice of depending on the wax as an indication of the soundness of the joint. An experiment on an obviously faulty joint, using this method of testing, had shown that the joint was apparently sound, and to adopt this practice was really to depend on the wax for protection instead of on the lead. On the President hinting that Mr. Brown had spoken long enough he tactfully sat down without the stimulus of the bell.

The Subways Question.

Mr. A. MOIR asked whether Americans were building subways for their cabling lay-outs in congested streets. In Paris the sewers had been satisfactorily used for this purpose, and in some of the London streets special subways were in use. The mix-up of cables and pipes under some of the busier parts of London where subways were not provided, must be seen to be believed. Such a subway, which could be constructed when the street was being repaired would be a really paying proposition, as it would afford facilities for extensions in an appropriate manner and prevent the present obstruction and waste of time caused by a frequent opening of the streets.

Some American Figures.

Sir WILLIAM NOBLE thought that some of the figures given for workmanship of joints and pole erection were a little American. With regard to aerial cable he had been surprised, during his recent visit to America, to find how largely it was used in that country. An investigation which had been taken after his return proved conclusively that the British practice was not only correct but efficient and economical. For if a cable was brought down by a storm, repair work was much more serious than stringing up aerial wires, and in towns and villages it was better practice to lay underground. The advantages of labour-saving devices had not been forgotten, but they were more suitable for the long stretches of country that had to be dealt with in America. Trenching machines were not always satisfactory, and in one case in this country it had been found that a gang of labourers could do the work more cheaply. Nevertheless, it doubtless paid Americans to use such equipment because of the high cost of labour, and the present high rates here might also make its employment an advantage in certain cases.

Mr. J. E. KINGSBURY said it was a governing principle of the A. T. and T. Company that they would not connect up with other people's lines unless there was a certain standard of transmission and a certain type of instrument and lines of a suitable quality were employed. The A. T. and T. Company had no financial control over the subsidiary companies with which they were connected, though, of course, they had an engineering control.

An Appropriate Paper.

The PRESIDENT, before calling upon the author to reply, said that it was appropriate that the first Paper which should be read at the Institution after the granting of the Royal Charter should be on telephone work, considering that the Institution had started as a Society of Telegraph Engineers.

Mr. E. S. BYNG, in reserving his full reply for the "Journal," said that, from his own observation, jointers in America could make from 150 to 175 pairs per hour, and they did not consider that a 300-pair 20 lb. joint a day's work. He thought the figures he had given for pulling in cables were also possible. There was no doubt that the large use of labour-saving devices meant a greatly increased speed in working.

Discussion at Newcastle.

Mr. BYNG's Paper was also discussed in Newcastle, and we give below a short account of the proceedings.

Mr. J. R. M. ELLIOTT considered that even when allowance was

made for the different climatic conditions of America and the higher quality of work insisted upon here, our efforts, compared with the American, were very puny, and that, although our methods of working were sound, we had much to learn. The low cost of petrol and the high cost of labour had much to do with the expensive adoption of mechanical appliances in America. It must not be taken for granted that the use of such appliances in this country would cheapen the work. The joint use of poles for power and telephone cables was open to serious objections and was not liked by the Post Office. The methods of constructing conduits on a 4-in. concrete bed, and in some cases of covering and surrounding them with concrete, was unnecessarily expensive as compared with spigot and socket conduits, which had proved highly satisfactory in this country. The average length of duration of faults before repair was entirely a question of the number of men on the maintenance staff, and the pre-war figure of two hours would probably be found to have increased by 100 per cent, since the war.

Rough and Crude Construction.

Mr. C. WHYLLIS pointed out that the great popularity of the telephone in America was in itself a great aid to development study. The American open-line construction was very rough and crude, and the spans were exceptionally small. Apparently there could not be any mischievous youths in that country. Such construction would rapidly be pulled down or destroyed in England. Boring tools had been used here some fifty or sixty years ago, but were abandoned because of the trouble encountered with large stones, which were always present and also because the ground round the hole used to fall in again. The aerial construction work in America was good but not aesthetic. The practice of taking cables round the outside of the pole at a corner was peculiar, as much trouble had been experienced here due to the abrasion of the cable, and the practice had been abandoned. Many of the good results obtained with aerial cable were due to the very short spans employed.

Essentials of Successful Suspension.

Mr. C. VERNIER was surprised at the size of the cables used for aerial work in America. When suspending telephone cables on power transmission lines here it had always been found necessary to use lead-covered cable to avoid inductive effects. When a cable was suspended in this country, about ten years ago, it very soon cracked all to pieces. It was subsequently found that the essentials for successful suspension were: (1) Short hangers, so that the cable and suspension wire would swing together; (2) prevention of displacement of suspension wires; and (3) the provision of a hardening material, such as tin, in the cable sheath. The hangers in general use were leather strips with spring wire grips on to the suspension wire, and extra care was given to angle or corner work, where the cable was invariably taken on the inside of the pole. It was found that leather hangers tended to damp out oscillations in the cable. The practice here was not to draw the cable through the hangers but to lower the catenary wire, fix the cable to it, and then haul up into position. It had never been necessary to dry out any cables, and the speaker suggested that it would probably be cheaper to scrap and renew a faulty length than to dry it out.

Insulation Resistance.

Mr. F. G. C. BALDWIN stated that between 1909 and 1911 much lead-covered cable was erected in this country, but the experiences were not happy owing to great trouble with deep ring cuts, although pigskin slings were used.

Mr. J. STIMPSON inquired whether any method was in use for indicating when the insulation resistance of the multi-pair cables was getting low, in order that the cable might be dried out in time to prevent the necessity of letting in a new piece.

Mr. G. E. GILPIN did not see the object of bonding the aerial cable to the suspension wire when no earth wires were provided on the poles, even though the latter were also carrying lighting and power wires. Earth wires were always found necessary here to take care of lightning discharges. The practice of superimposing circuits was cheap and nasty and also suffered from the drawback that no automatic clearing signal could be given over such circuits.

Telephones per Head of Population.

Capt. F. W. GASKINS stated that it was also the practice in this country to make complete development studies before commencing any work. The number of telephones in use in America was approximately 1 in 10 of the population. In London the corresponding figure was 1 in 15.7, and in Newcastle 1 in 26.

Mr. J. PEEL remarked that the American record for the erection of poles worked out at 3.12 man-hours per pole. In this country a rate of 5.3 man-hours per pole had been attained without the use of any of the labour-saving devices. The American methods of excavating trenches could not be employed here owing to the number of light and power cables, gas and water mains, &c., already installed.

Correspondence.

"THE ELECTRICIAN" DIAMOND JUBILEE NUMBER.

To the Editor of THE ELECTRICIAN.

SIR: Whilst laid up in bed I have been glancing through your highly interesting Jubilee Number, and, as this may be frequently turned to in the future—and possibly reproduced in book form in the way that your 2 000th Number was—I am venturing to call attention to certain inaccuracies and omissions:

1. On page 597 the portraits of "Samuel Finley Bruce Morse" should read "Samuel Finley Breese Morse."

2. On page 598, column 1, line 3, the "Atlantic Cable Company" should read the "Atlantic Telegraph Company."

3. At the end of the same paragraph, when speaking of the Report he is writing about, my friend, Mr. G. L. Addenbrooke, says he finds it to be "almost unknown." I can assure him, however, that it is very familiar to most telegraph engineers, the majority of us possessing at least one copy.

4. Page 598, column 2, line 5.—The introduction of gutta-percha as an insulator certainly had a great deal to do with the successful establishment of submarine telegraphy. It not only "behaved in water as well as india-rubber," but a great deal better as a rule. On the other hand, rubber rather than gutta-percha is "the harder" and tougher, hence its use sometimes in teredo-infested waters. Rubber, too, is usually better adapted to underground land cables than gutta-percha.

5. Page 598, column 2, line 10.—Though Jacob and John Watkins Brett—great bric-a-brac shopkeepers—originated the idea of a cable across the English Channel, the 1851 cable was actually laid by the late Thomas Russell Crampton, an eminent railway engineer.

6. Six lines lower down reference is made to the cable laid between Dover and Ostend, but this came later than is stated, and was preceded by the first cable to Ireland laid by my father in 1853 at the age of 21.

7. On page 599, top of first column, Mr. Addenbrooke makes some interesting remarks under the heading "Insulation and Capacity." He is apparently still dealing with "the 'fifties," but if he had pursued his investigations, at any rate, to 1859, he would have found that the electrical testing of the Malta-Alexandria cable was made a close study of by Mr. (afterwards Sir C. W.) Siemens. Then, again, in 1863 the first cable to India—laid across the Persian Gulf in 1864—was submitted to electrical and mechanical tests of a still more abundant and systematic kind. In fact, this undertaking is usually considered as the example subsequently followed in the matter of supervision during construction. I would refer Mr. Addenbrooke to an Institution of Civil Engineers' Paper of Nov. 14, 1865, on "The Telegraph to India, with Extensions to Australia and China," by the late Sir Charles Tilston Bright, M.P., M.Inst.C.E.* Messrs. Bright and Clark were the engineers of that undertaking, and Mr. Henley was the manufacturer of the line, which has often been spoken of as "the turning point of submarine telegraphy."

8. Near the bottom of the same column, whilst Latimer Clark's name is spelt correctly, his elder brother Edwin is given an "e." The "Mr. Douglas Galton" referred to here was, of course, Capt. Sir Douglas Galton, K.C.B., F.R.S., the Chairman of the Committee.

9. The mis-spelling of names occurs elsewhere in the number, the same name being spelt differently by different writers. This is notably the case with "Elliot" in Glass, Elliot & Co. (now the Telegraph Construction & Maintenance Co.), certain writers spelling it "Elliott," which might lead to confusion in some minds with the firm of Elliott Bros., the famous instrument makers.

* Inst.C.E. Minutes of Proceedings, Vol. XXV.

Some controlling hand seems to be needed over these E's and L's, &c.

Trusting the above notes may be of use,

I am, &c.,

CHARLES BRIGHT,

F.S.S., F.R.Hist.S.

Bishops Stortford, Nov. 13.

P.S.—It may be of some interest to note that previous to the birth of THE ELECTRICIAN in 1861 the only journals existing for dealing with electrical matters were "The Engineer" and "The Athenæum." Strange to say, "Nature" did not make its first appearance till some years later—not, indeed, till 1869. In fact, "The Athenæum" was at first alone available for the purpose. It was in that almost purely literary journal that the now classic dispute occurred between Dr. Wildman Whitehouse and Prof. William Thomson (afterwards Lord Kelvin), following on the former's British Association Papers of 1855 and 1856, when various mistaken views were enunciated. These, unfortunately, took shape in the electrical working of the first Atlantic cable after it had been successfully laid. The Thomson "mirror" instrument, combined with a suitable cable core, saved the situation later.

May I say finally I am very glad to see Oliver Heaviside's early and important contributions to THE ELECTRICIAN properly recognised in your splendid Jubilee number.

To the Editor of THE ELECTRICIAN.

SIR: In the extracts which you published on Nov. 11 from my notes on the history of THE ELECTRICIAN during the period of my editorship, I seemed to make an ungrateful reference to the assistance afforded me by three old friends, Dr. Eccles, Mr. Monckton and Mr. Pearson. Of the seven junior assistants who succeeded one another on the editorial staff between 1897 and 1902, and left to fill posts of greater responsibility and higher remuneration, I selected for mention the three whose help I had valued most. The omission by you of a sentence in my original notes has made it appear that the contrary was the case. I am, &c.,
Enfield, Nov. 12. F. CHARLES RAPHAEL.

ELECTRICITY METER v. CURRENT LIMITERS.

To the Editor of THE ELECTRICIAN.

SIR: Your correspondence columns have recently contained many interesting letters descriptive of current-limiting devices, and claiming particular advantages for each type. I should, however, like to point out that current limiting is a very simple matter not requiring any separate piece of apparatus.

In an ordinary installation we often have a collection consisting of supplier's switch and fuse, consumer's switch and fuse, meter or limiter, or both. If a contract system of charging is adopted, the function of all these appliances can be performed by one fitting, such as the "Heemof" overload switch.

This device is a small, inexpensive, free handle, overload circuit breaker. The setting of the overload is adjustable, and can be sealed. It thus gives the supplier and consumer protection against overload, and is a means of isolating the installation. It also acts as a current limiter, because its overload setting is adjustable to such a fine point that, for example, in a six-light installation the switching in of one additional lamp will cause it to operate. All that is then required to restore the circuit is to turn the switch on again.

Could there be anything simpler—or better? I am, &c.,
London, Nov. 19. ALAN WILLIAMS.

UNCOMMERCIAL TELEPHONE CHARGES.

To the Editor of THE ELECTRICIAN.

SIR: The Post Office appear to have no desire to give telephonic facilities, at reasonable rates, beyond their ordinary schedule. Recently I ordered an extension instrument with more than the regulation lengths (two of

4 ft. 6 in.) of flexible cord, and, therefore, two 12 ft. lengths were included (or 15 ft. extra of single cord). In due course I found I was required to pay £1 4s. per annum for this additional 15 ft. Inquiry showed that the extra length of cord was obtainable from the manufacturer for 15s.

Surely it does not encourage the subscriber to make full use of the telephone when he is charged a rental of £1 4s. per annum for something which costs only 15s. to purchase outright. I am, &c. W. R. TONNELIER.

London, Nov. 25.

POWER FACTOR OF ELECTRIC FURNACES.

To the Editor of THE ELECTRICIAN.

SIR: We notice on page 630 of your issue, Nov. 18, there is an incorrect statement with regard to electric furnaces. It is stated that: "The power factor seldom averages 50 per cent., and may be much lower."

In the "Greaves-Etchells" electric furnace, which is extensively used for steel manufacture, the power factor in the small furnaces averages 0.88 to 0.90, and in the larger furnaces averages 0.85.

It will be realised from this that an electric furnace load is preferable to the average motor load from power factor point of view. We are, &c.,

T. M. WATSON & COMPANY (OF SHEFFIELD), LTD.

Sheffield, Nov. 18.

Electricity at the Motor Show.

There was ample excuse for optimism about the revival of the automobile trade, at any rate, at this year's Motor Show, which was held at Olympia and the White City. No matter in which direction one turned, it was a difficult matter to claim the attention of any one of the salesmen at any of the stands, and bombardment of questions and enquiries was continuous.

The Electrical Side.

On the electrical side there was a large assortment of accessories and "gadgets," although, on the whole, there was not very much that was new since last year's show. There were a very large number of electric lighting and starting sets, and the majority of the cars exhibited were fitted with one or other of the large variety of these. A feature of many of the lighting sets which were to be seen was the addition of a dimming switch, enabling the motorist to dim his headlights when passing other cars. We noticed that S. SMITH & SONS (M.A.), Ltd., had evolved an entirely new electric lighting set, a new set of lamps suitable for commercial vehicles, and a dimming switch. The dynamo for the small lighting set was only 3½ in. in diameter, and was made in two lengths, one capable of an output of 6 V, 7 A, and a shorter one of 6 V, 6 A. The larger machine cuts in at about 900 revs. per min., and gives its full output at about 1 900 revs. per min., while the smaller machine cuts in at 950 revs. per min., and gives its full output at 2 000 revs. per min.

At the commutator end of the machine a simple cut-out has been embodied, which replaces the magnetic type of cut-out necessary for use with dynamos of larger output. A combined field fuse and switch is carried on the terminal block of the machine. The field fuse protects the dynamo from damage should it be run with the battery disconnected, and, by withdrawing the fuse carrier altogether, both the main and field circuits of the dynamo are broken, thus enabling the machine to be switched off charge if any very extended runs are being made without using the lamps. The earthed or single-pole system of connection is used, which makes the wiring exceedingly simple, one terminal being all that is necessary on the dynamo.

The BRITISH THOMSON-HOUSTON COMPANY has a "Sparklight" combined lighting and ignition system, developed primarily for use on two-stroke motor cycles. This has already been described in THE ELECTRICIAN. The CONNER MAGNETO & IGNITION, LTD., have a lighting set for lorries for headlights alone. It consists of a magneto dynamo designed to rotate in either direction without altering any connection. This enables it to be fixed in any position near the engine, where it can be driven from some existing rotating shaft, such as the end of the crankshaft or the fanshaft. On either of these a pulley is fixed, which gives a ratio of three and a half times the speed of the crankshaft. No electric switch is necessary, for, there being no batteries to feed, the dynamo only needs to run when lights are actually required. C. A. VANDERVELL & COMPANY,

LUCAS, A. GRAHAM & COMPANY, and a host of other accessory firms, have a large number of exhibits of this character.

Starters and Ignition Systems.

BROLT, LTD., have an interesting starter on view. This is positive in action, the method of transmitting the power being by means of a gear-ring fitted to the flywheel. It consists essentially of a series wound motor in which is incorporated a pinion, which automatically engages with a gear on the flywheel by the manipulation of a simple one-movement switch. The moment the engine fires, the pinion automatically disengages, runs completely out of mesh, and remains at rest until the switch is again manipulated.

The VANDERVELL ignition system has been improved, and there are now a number of models. The Model A set is designed for 6 and 12 V insulated return, and consists of a distributor, contact breaker, and high-tension coil mounted on a special bracket, thus forming a self-contained ignition unit. It has been designed to replace the standard type E magneto made by this firm, without altering the drive or fixing bracket in any way. Among the exhibits of J. W. PICKAVANT & COMPANY was the K.H.E. synchronised ignition system. This consists of a properly synchronised magneto-type make and break and combined h.t. distributor mounted on a ball-bearing vertical spindle and driven by case-hardened steel bevel glass from the front end of the cam shaft. The Pitt commutator for the Ford Car, which was to be seen on the stand of MORRIS, RUSSELL & COMPANY, is, it is claimed, a great improvement on the commutator generally used on this make of car. The wires and covers of this commutator have an insulated cover with a hole at the top for the wires to be brought out and carried away over the engine. The cover is made of stabilite, which is guaranteed to be oil, water and heat proof. It has a flat side to give working clearance for the fan belt, and is interchangeable for right or left-hand drive. The commutator has a flat all-metal track instead of alternate fibre and steel. This gives an even mechanical wearing surface, and the segments are of a special high-percentage copper alloy which, with a copper gauze brush, gives maximum electrical conductivity. The brush is fixed rigidly to a clock-spring steel blade, which keeps it in even contact and at even pressure at all speeds.

New Model of Magneto.

On a new model of magneto shown by NORTH & SONS the pole shoes are provided with movable extensions consisting of two segments of readily-magnetisable material, built up by means of rings of non-magnetic material into the form of a sleeve, which is interposed between the pole shoes and the armature. And, as the segments make contact with the pole shoes, it follows that the magnetism flowing through the pole shoes flows also through the segments. These models will spark over a standard 5½ mm. gap in air at low speeds with the spark fully retarded, and the voltage necessary to spark at such a gap is between 6 000 and 7 000 V, but it is not recommended that the setting of the electrodes at the sparking plug should be more than 0.014 in.

The magnets of the M.-L. MAGNETO SYNDICATE are now made of cobalt steel, which gives a magnet more than three times as powerful as the tungsten steel previously used; consequently, the magnets are much smaller, and can be made straight, with the result that the material is much more efficiently employed. Both machines shown at Olympia will give efficient starting at magneto speeds of 50 revs. per min., and can be run at 2 500 revs. per min. for long periods, or at 3 500 revs. per min. for occasional short periods. The weight is approximately 6 lb.

A Useful Service.

THE CHLORIDE ELECTRICAL STORAGE COMPANY showed a wide range of "Exide" batteries of all descriptions, but perhaps the most interesting thing on this stand was a booklet explaining the organisation of Exide Battery Service Depots which has been set up. These depots are existing all over the country, or, indeed, the world, and in this country alone there are already over two hundred. At each of the depots there is a battery expert, trained at the works of the Chloride Company, who will give advice on or repair or replace any battery brought in. Any user, therefore, of "Exide" batteries who has any trouble can call at any one of the depots, which are recognised by standard signs, and is assured of expert attention. The value of such an organisation cannot be over-estimated, especially having regard to the large number of makes of car on which these batteries are standard. The booklet already referred to gives a complete list of the depots in this country as well as those in the Dominions and foreign parts.

Electric motor-horns are also well in evidence, and it is interesting, in at least one case, to note that it has been deemed desirable to fix the diaphragm horizontally instead of vertically, with the object of keeping out water and dirt. The electric horn made by ALFRED GRAHAM & COMPANY has a horizontal diaphragm, and a special feature of this is that it has a shunt coil in order to prevent excessive sparking across the points. The coils are insulated with enamel.

Electricity Supply and the Coal Industry.

MR. W. WALKER, the newly-elected Chairman of the NORTH-WESTERN CENTRE of the INSTITUTION OF ELECTRICAL ENGINEERS, gave an opening address at the first meeting of the session, held on November 15th. The Lord Mayor of Manchester (Mr. E. Simon) was present.

MR. WALKER illustrated by a number of charts the variations in cost of coal and production per man for a series of years, and indicated the effect these had on the cost of electrical energy. The coal strike had greatly affected electricity supply, and the interruptions caused by strikes rendered it necessary for undertakings to maintain ample reserves.

The losses entailed by storing coal comprised deterioration, double handling and extra capital charges. The first and last were largely outside the control of the supply engineer, but the second source of loss was being minimised by systems of pneumatic handling now being developed. Illustrations were shown of plant being installed at the Bankside Station and the Brinsdown Power Station.

It was very difficult to reconcile the figures given by various undertakings for the relative costs of coal and oil, but generally oil must be a little less than double the cost of coal if the change-over was to be justified. The possibilities of coal gas for steam raising had been considered, but it would be necessary to design and erect gas works and electricity works together with this object in view. A gas of lower calorific value and less clean than town's gas would suffice. With regard to pulverised coal, it was suggested that the plant required would have to be much cheaper before any considerable development took place in this country. Pulverised coal had marked advantages over other forms of fuel.

The 1919 Electricity Bill.

It was greatly to be regretted that the Electricity Commissioners had been persuaded to put the barrier of costly and complicated legal procedure between themselves and the managers of electricity undertakings. Each succeeding inquiry has become more prolonged and more costly and similar to the proceedings of a Parliamentary committee. It was also to be regretted that the Government had failed to bring in and pass Electricity Supply Bill, No. 2. In the Manchester area, instead of a Joint Electricity Authority, an Advisory Board had been set up, as it had been considered that the former without financial powers would be useless.

Engineers and Municipal Government.

The newly-elected LORD MAYOR (Mr. E. Simon) in proposing a vote of thanks to the Chairman, said that the city was proud of its Electricity undertaking. It was unusual for an engineer to become Lord Mayor, and he questioned whether it was the fault of the council or of the engineer. There were four engineers out of the City Council of 140 members. Mr. Simon then asked the members, as belonging to one of the great technical institutions of the country, to study the industrial situation very carefully. There were 40,000 unemployed men in Manchester, and the engineering trades were hit worse than most. It was no use protecting the home market, and lowering the cost of production and reducing wages were only partial remedies. Something was wrong with the Peace Treaty, and it could only be put right by the politicians. It was imperative that those engaged in industry should be in a position to help and advise in this complex and difficult matter.

The vote of thanks was seconded by Mr. A. S. BARNARD, after which the proceedings terminated with a very enjoyable smoking concert.

Osram Publicity.

At this time of year even the golfer's reflections turn to thoughts of firesides, books, or rather sporting newspapers, and pipes. But to appreciate these delights to the full it is necessary to have sufficient illumination of the right kind, and to obtain illumination of the right kind it is necessary to use . . . We leave a blank, which can be filled in according to the reader's predilections.

Here we are reminded that the object of this short article is to call attention to what the GENERAL ELECTRIC COMPANY propose to do during the next few months to increase the sale of their well-known Osram lamps by an intensive publicity campaign. Details of what they are doing are contained in an artistic portfolio, which has been prepared for the purpose by Major Clifford Palmer, Manager of the General Electric Company's Publicity Department.

Mapping Out the Country.

From this pamphlet it appears that the entire country has been mapped out, and that all the leading London and provincial dailies and weeklies, the illustrated papers, and the magazines, will carry the Osram story, in other words, the story of economic lighting. Cinemas throughout the country will also be enlisted in the ranks, and will picture the making of this famous lamp for the education and entertainment of their audiences in a film called the "Economist." This is one

particular phase of propaganda work which has up to now unaccountably been neglected by the electrical and cinema industry. We are, therefore, particularly glad to see the General Electric Company are realising its possibilities in this particular way. In addition, illuminated sky signs and other devices will tell the Osram story after dark, and taking advantage of that egoism, which is one of the features of British commerce, every trade of importance will have its own special sort of publicity designed for its own special wants. In this way shopkeepers, factory owners, hotel proprietors, clergymen, schoolmasters, restaurant managers, doctors, and warehousemen will all read the Osram story through the medium of their own special journals. Householders will be told about it at their breakfast tables, railway travellers will be told about it on their journey, and restaurant frequenters will be told about it in the intervals of waiting for the waiter.

The Basic Features of the Campaign.

The basic feature of this campaign, of whose success we have no doubt, is, then, that the General Electric Company will support the retail trade by establishing and maintaining the demand, and that they look to the retail trade to meet that demand when it has been created. It is now up to everyone to get busy at once, and continue busy until the vernal spring makes even Osram lamps unnecessary.

The Application of Electricity to Farming.

MR. R. BORLASE MATTHEWS, M.I.E.E., in response to a special invitation, recently read an interesting Paper on ELECTRO-FARMING before the ROYAL DUTCH INSTITUTION OF ENGINEERS, at Nijmegen (Netherlands). Mr. Matthews contended that an extended use of electricity in farming operations was only a matter of time. Sufficient experimental and practical scale work had now been carried out in Denmark, Germany, Switzerland, Belgium, France, Italy and Great Britain, to demonstrate fully the necessity for the employment of electricity in modern agriculture, if the farms were to be really profitable concerns. It was pointed out that the arguments against the use of electricity on farms were practically identical with those advanced fifteen to twenty-five years ago against its applications to any other industry. Like the railways of Great Britain and other countries, farms lacked greater mechanical assistance owing to the existence of a superabundance of cheap labour. Since the war, however, the day of the cheap labourer had passed, and hence the necessity for electro-mechanical aids. As an illustration, the author's farm of 600 acres, with such assistance, only required three horses and no oxen. Similarly, any other farm could reduce its working animals and men if properly equipped with electrical appliances. Further, the electrical equipment of a farm ensured that the various operations were more independent of the weather, since they could be carried out more quickly when the weather suited; or, in many cases, they could be completed in spite of bad weather—e.g., artificial haymaking, corn-sheaf drying, &c.

Uses of Electricity on Farms.

The uses of electricity on farms could be divided into three main heads: (a) Power uses in the farm buildings and barns; (b) power uses on the fields and arable land; and (c) uses which were specifically and peculiarly electrical, such as electro-culture. Illustrations were given of typical applications of electric drives, emphasis being laid on the fact that the ideal machine for the farmer was one that incorporated its own direct-coupled electric motor, as opposed to operation by means of a line shaft—with its attendant difficulties of fixing in the usual farm buildings, which are generally far from strongly-built structures. Various forms of portable electric motors were then discussed, particularly interesting among which were larger types of 30 H.P., or thereabouts, and the very substantial three-point suspension wagons employed for their support and conveyance. Electric light was referred to as advantageous to the farmer, not merely as a convenient and safe light, but also as a means of producing more eggs in winter, and bringing on young stock to earlier maturity, by more winter feeding and in artificial light. Examples were cited of the electric motor driving of machinery for food preparation for livestock, dairy machinery, and general barn machinery, including pumps, &c. Similarly, cases were given of applications on the land for irrigation, ploughing, cultivation, and other field operations.

Electro-Culture.

The after-treatment of gathered crops, being an important aspect of modern farming, was, of course, dealt with, as were likewise certain rural industries, which could be conveniently operated in conjunction with a farm. Considerable interest was evidenced in the author's account of the present development of electro-culture, which he stated had now arrived at the point where an increase of 10 per cent. in the crop could be confidently expected, at a nominal current consumption and a low outlay for wiring per acre (excepting the initial capital cost of the transforming apparatus, for which he had not yet been able to ascertain the simplest and cheapest design).

The employment of electric vehicles on farms was then touched upon, and also the author's semi-automatic system of keeping farm (or, in fact, any other) accounts by the aid of an electrically-operated machine, the author's contention being that detailed costings were the only true basis upon which it could be proved as to whether electro-farming was or was not a paying proposition: and any method which could produce those accounts without unnecessary expenditure of skill and time should be worthy of adoption.

South-West Midlands Electricity District.

The three-day inquiry held at Birmingham by the Electricity Commissioners into the schemes for the reorganisation of electricity supply in the South-West Midlands District concluded on the 17th inst. Sir Harry Haward presided, and the other Commissioners present were Mr. H. Booth and Mr. A. Page.

On the first day Mr. CLUDE, K.C., opened the case for the Birmingham Corporation and the Shropshire, Worcestershire and Staffordshire Electric Power Company, who had submitted a joint scheme. He said that in the district there was a great industrial area upon the East of Birmingham, with its subsidiary districts, and on the West there was a secondary industrial area, West of Birmingham and East of the Severn. Beyond those regions they got into the more or less agricultural districts, which were not taking any supply of electricity, and whose claims could not be considered as very pressing. The electrical condition of the district was exactly what they might have expected to find, having regard to the somewhat parochial view that Parliament had taken about electricity supply in the past. There were districts unprovided with a supply because they were not in a position to afford a supply for themselves; there were other districts which were now in possession of generating stations which were not as efficient as they ought to be. Then there was the great district of Birmingham, which had certainly risen to its opportunities and was trying in the best possible manner to meet the various needs of its constituents. There was also the Shropshire Company, which came into the district with the best intentions in aid of the undertakings they found there, and in aid of the power users of the district. The Corporation and the Company had divided the entire district into two parts, and, by agreement, it was suggested that the Leicestershire and Warwickshire Electric Power Company should continue to supply the area over which they possessed powers, except that consumers in the portion nearest Birmingham should look to the Corporation for its supply in the first instance. On the other side of the district, Rowley Regis, Lye, and Stourbridge Councils did not want to be included in the district. Birmingham could not supply them, and at present the Shropshire Company had power to supply in that area, subject to the consent of the Midland Electric Corporation for Power Distribution.

Mr. TYLDESLEY JONES, K.C., on behalf of the Midland Corporation, said a provisional agreement had been signed by the companies concerned, whereby the area should be transferred to the North-West Midlands District, in which the Shropshire Company had certain rights, on the understanding that the position of that company in the North-West District was not prejudiced by the scheme. He asked the Commissioners to decide the point at once.

After hearing some evidence, the chairman announced that the Commissioners had decided to exclude from the District the municipal borough of Stourbridge and the urban districts of Rowley Regis and Lye and Woollescote.

Development Plans.

Dealing with the electrical situation of the district, Mr. Clude said it was obvious there was a very large field for development, and he submitted that the district must be developed in the way shown in the scheme before the Commissioners. The two undertakings proposed to act in unison, and to set up an Advisory Committee of four members. The position was exceptional, and it could be more economically dealt with by those undertakings acting in agreement than by setting up a joint electricity authority. Birmingham were willing that Sutton Coldfield (the only other authority generating current) should go on if they desired. Ultimately he supposed they would see the wisdom of shutting down their station and getting their supply from Birmingham. Similarly, Kidderminster and Hales Owen had already seen the advisability of looking to the Shropshire Company for their supply.

COUNCILLOR BEALE, of Birmingham, gave evidence in support of the scheme, and said his Corporation thought a joint authority could not do better for the district than the promoters.

Railway Electrification.

Mr. TYLER, for the L. & N.W. and G.W. Railway Companies, explained that, while the companies could not abdicate any of their rights and privileges under the Electricity Supply Act of 1919, they would prefer, other things being equal, to purchase rather than to generate current. The companies could not state definitely that they would need a supply for traction before 1931. The area which the scheme covered was one suitable for electrification, and the question had been considered. At present the companies were in the midst of a scheme of fusion which made it impossible for them to decide on any immediate scheme. Within fifty miles of Birmingham there were something like 2,000 route miles of railway, and if the promoters were suggesting that on the basis of the electrification of those 2,000 miles the demand would be only 60,000 kW, that demand was very much understated. A figure could only be given when an actual scheme had been decided on.

New Clauses.

On the 15th inst., Mr. CLUDE announced that the promoters had tried to meet the suggestion that there ought to be something in the nature of an obligation placed upon the two undertakings, and they proposed to insert in the scheme a clause "that it should be the duty of the Corporation and the company to provide or secure the provision of a cheap and abundant supply of electricity in the district, and that both parties should comply with any

general directions given to both or either of them by the Electricity Commissioners through the medium of the Advisory Committee." He also suggested the insertion of a clause to obviate the possibility of an *impasse* arising by a two-and-two division on the Committee.

After consultation the chairman said the Commissioners were prepared to accept the first clause, with the addition of the words "or special" in relation to the directions which the parties undertook to comply with. The other clause was also accepted, with minor alterations.

Mr. EMILE GARCKE, deputy-chairman of the Shropshire Company, said the joint scheme would be more compatible for the district than a joint electricity authority, and would be able to make better progress. Adding other representatives would not be advantageous to the general progress of the supply.

Malvern's Opposition Withdrawn.

At this stage Mr. KENNEDY, on behalf of the Malvern Urban Council, said that, as the promoters of the scheme had agreed to the insertion of a clause in the scheme that it should not affect their rights, Malvern's opposition would be withdrawn.

Mr. REAY NADIN, Town Clerk of Sutton Coldfield, asked whether witness had any objection to representation of Sutton Coldfield on the Advisory Committee when any proposals affecting their district came under consideration.

Mr. GARCKE: It would be very inconvenient; it would be opening the door to a large number of similar applications. It was not reasonable to assume that a company would expend many thousands of pounds in getting Parliamentary powers without any intention of making use of them.

Mr. PAGE asked whether the company would be a party to a proper canvass being made of the undeveloped areas, with the object of ascertaining how many of those areas could be supplied.

Mr. GARCKE replied that a complete survey of the district had been made. The expenditure of millions of money would require anxious consideration as to how the situation should be dealt with.

The CHAIRMAN: You are submitting this scheme as a proper and adequate solution of the problem of the electrical supply in the district, and the Commissioners will need to be satisfied that the two promoters are in a position in a reasonable way to meet the demands likely to come upon them.

Witness said the financial position of the company was satisfactory, and capital recently raised would provide for present commitments and for the next year or two.

Worcester's Proposals.

The Hon. R. COVENTRY presented the case for Worcester Corporation, and said an agreement of mutual benefit to the Corporation and consumers had been made with the Shropshire Company whereby, subject to the approval of the Commissioners, the city retained its power station. The agreement also gave them rights to supply an area outside the city boundary. In addition, there was no opposition by the Shropshire Company to a proposal to lay a transmission cable from the generating station to the borders of Herefordshire. Reciprocally, Worcester Corporation offered no objection to the Shropshire Company laying a transmission cable through their streets.

Evidence in explanation of the scheme was given by Mr. W. J. HULL, chairman of Worcester Electricity Committee.

Mr. A. COLLINS, late Birmingham City Treasurer, said that, under the circumstances prevailing in the district, he was of opinion that the scheme propounded was the best.

Mr. R. A. CHATTOCK, City Electrical Engineer of Birmingham, said that with the Stourport station in operation the promoters would have no difficulty in meeting all demands. In the absence of that station, however, the Ham's Hall station would have to be running in about eight years' time. The postponement of the erection of the Stourport station would cast an additional burden upon the Birmingham undertaking, but he did not see how the scheme could proceed if the Stourport station was not to be constructed.

Mr. J. T. H. LEGGE, engineer to the Shropshire, Worcestershire and Staffordshire Electric Power Company, said his company had a scheme for dealing with several of the more prominent towns, like Bromsgrove and Droitwich. But there had not been a keen demand coming from those places, and there would need to be a good deal of canvassing in order to stimulate demand. Those rural areas could not be economically served unless the question of way-leaves was very much eased. Rural areas could only be served by overhead lines. There was no reason for asserting that the company did not intend to proceed with the Stourport scheme, but they were not anxious to commence at present prices. His company were going to take supplies from Worcester for two or three years.

Mr. C. P. SPARKS, consulting engineer, considered that the estimates in the scheme were too conservative. The middle of next year would be the best period to purchase plant for Stourport.

Adjustments of Area.

It was stated that the promoters had no objection to the inclusion of Kinver and Dudley rural district in the area. The Chairman also announced that the Martley Rural Council desired to be excluded; that Upton-on-Severn wished to be included, but desired to take its supply from Worcester; that Tamworth Borough and Tamworth Rural Councils desired the whole of their areas to be included.

Mr. REAY-NADIN (for Sutton Coldfield) held that his borough should be entitled to have representatives attending the Advisory Committee when matters affecting it were under consideration.

Mr. CAPEL LOFT (Stourport) opposed the scheme, as it would not effect any improvement in the existing organisation for the supply of electricity in the proposed district.

How to Encourage Consumers.

Mr. G. H. Nisbett, the new chairman of the Liverpool sub-centre of the NORTH-WESTERN CENTRE, INSTITUTION OF ELECTRICAL ENGINEERS, delivered an address at the opening meeting of the sub-centre at the lecture theatre of the Laboratories of Applied Electricity at Liverpool University. In emphasising the need for the display of more enterprise in seeking for the extension of electric supply, and particularly new lighting consumers, Mr. Nisbett said it seemed to him that the power supply side of the question had been unduly assumed to the neglect of the greater possibilities of lighting. The average man got very little encouragement to become a consumer. In order to induce the lighting consumer to come on to the mains, Mr. Nisbett suggested that the supply authority should make itself responsible for the wiring of his house; that they themselves should quote him a price for the wiring, and see it properly carried out, both as regards quality of work and position and size of lamps. Having obtained a consumer's order they should sub-let the contract without profit to themselves to one or other of the wiring contractors. During the course of the work the authority should visit and inspect, and on satisfactory completion issue a certificate to the consumer on which the contractor should be paid. This advisory work should be free of charge, as the authority received their remuneration in the after-business they would do with the consumer. Another suggestion of Mr. Nisbett was that the supply authorities should themselves pay for the wiring and make no initial charge at all to the consumer, recouping themselves for the cost either by an addition to the price per unit or by a separate rent charge. He also suggested that the supply managers should consider the possibility of offering to wire up to the ceiling roses, or equivalent, any premises for which supply applications were made to them, provided they were satisfied that there would be reasonable usage. A point which Mr. Nisbett urged, in view of the stumbling block of cost, was the simplification of wiring. One had only to look at their institution wiring rules to see how far complication had gone in what was after all a very simple business. "We have," he proceeded, "been hopelessly handicapping our business for the sake of the fire insurance companies."

Rates and Finance.

The first meeting of the new session of the SCOTTISH LOCAL SECTION OF THE INSTITUTION OF ELECTRICAL ENGINEERS was held in Glasgow recently, when Mr. E. T. Goslin delivered his presidential address on "Rates and Finance."

Mr. Goslin thought that those engaged in the central station industry had been most successful in their technical work, but that as merchants they were about the worst. He strongly advocated the scheduling of all rates and the publishing of them openly. It was also important that the scheduled rates should be strictly adhered to, so that all consumers would know exactly what they had to pay and also what others were paying.

A comparative table of working costs of the Clyde Valley Company and the Glasgow Electricity Department was shown. Figures were also given to prove that the charges made by the company were not excessive, and that the feeling of uneasiness regarding rates charged by power companies was unwarranted.

Mr. Goslin referred to the atmosphere of doubt and suspicion which had been created by the passing of the Electricity (Supply) Act, 1919. He did not think this tended to bring about the desired co-operation. He advocated frank and open dealing, and endeavoured to show that those responsible for small undertakings stood to gain by taking supplies in bulk from the large undertakings. The meeting was well attended, but, in accordance with the usual custom, there was no discussion.

Electricity in Mining.

At the annual meeting of the NORTH OF ENGLAND BRANCH OF THE ASSOCIATION OF MINING ELECTRICAL ENGINEERS, the new president, Lieut.-Col. F. R. Simpson, delivered his address. He agreed there was no question as to the suitability of electricity for the general transmission of power, but, when it was a question of replacing existing steam plant for colliery winding, &c., the case was not quite so straightforward and merited careful consideration. The "Waste-ful" steam plant generally in use at collieries is usually wasteful as regards fuel consumption, but it must be remembered that the fuel used for this plant is almost always an unsaleable product; moreover, it may be that the colliery can afford to use existing plant at a slightly increased cost rather than to expend a large amount of capital to gain a small saving in expenditure. If the conditions favoured the use of electricity, then it was preferable for the colliery to purchase their supply of power, unless there should be an available source of waste heat; as this course avoided the expenditure on generating plant of large capital amounts, which could be better employed in extending the electrification of the workings.

In the application of electricity to haulage, the aim of mining engineers was to reduce the number of horses employed. Up to the present no system had been evolved by which the haulage over the first 180 yards from the face could be performed except by hand or by ponies, and the cost per ton mile over that short distance was at present not less than 6s. per ton mile. The introduction of mechanical conveyors to longwall faces had to a great extent relieved that difficulty, and by concentration enabled auxiliary haulage to be applied. Endeavours should be made to eliminate horse haulage, except in the first 180 yards from the working face. At a colliery in which he was interested, experiments were being made with an

Ironclad Exide battery locomotive, with satisfactory results. There were two batteries of 24 cells each, and the locomotive drew 45 sets of tubs, averaging a distance of 20 miles per day, thus doing the work of three ponies, at a cost of 0.96d. per gross ton mile, or 1.74d. per ore ton mile, including interest and depreciation on the loco. The battery loco was working under conditions where safety lamps were required, and special permission had to be obtained for its installation. That method of haulage required the serious consideration of mining electrical engineers. As to pumping installations, Colonel Simpson emphasised the importance of providing, where possible, adequate water standage, and also the necessity for making the pipe communications between the standage and the pump-well of sufficient size to keep the pumps running at their full and most efficient capacity. With regard to the general use of electricity at collieries, he urged the advisability of accurate and systematic measurements of current consumed at each unit of plant, as it was only by such means that losses and waste could be detected.

Permanent Exhibitions.

British Samples, Ltd., of 39, St. James's-street, S.W. 1, has been formed for the purpose of providing British manufacturers and traders with an inexpensive but effective means of bringing their goods to the notice of the overseas buyer through permanent sample exhibitions abroad. The prime motive is to assist, and not to replace, local representatives, to act as a comprehensive foreign "shop-window" for British manufacturers, and as an authoritative source of information for the inquirer for British goods.

Since the war various schemes to recover our markets and to combat competition have proved abortive or fallen through. As a body representing the trade interests of the country in the highest degree the FEDERATION OF BRITISH INDUSTRIES has watched these schemes with interest, but has felt that all have lacked the power to secure immediate material results. In British Samples, however, it sees a scheme that must at once bring British products before actual consumers, and, in addition, it is the cheapest form of exhibition yet initiated, the annual charge for rental of space, cases and other services varying from £20 to £55, or about one-fifth of the expenditure entailed by a fortnight's exhibition at a trade fair. Samples may be changed continually, so that exhibitors will always be abreast of the requirements of their markets. The Federation has, therefore, lent its support to the idea, and has consented to act as sole agents in Great Britain. The first of the exhibitions will be opened in a few weeks' time in Brussels, which has been selected as being one of the most convenient international business centres in Europe.

Edinburgh Electric Tramways.

An important report on the Council's policy and the present position of the municipal tramways department has been prepared by Mr. S. Pilcher, manager of the EDINBURGH CORPORATION tramways, who recommends the conversion of the cable lines to electric traction without further delay. The working expenses of the Leith electric system are 15.4d. per car-mile, against 19.63d. for the Edinburgh cable cars. The margin of 4.20d. in favour of the electric system represents a total of £98,000 per annum on the present mileage, or sufficient to meet the capital charges on the cost of conversion (£44,635), and to leave £53,365 to meet renewals and provide for reduction in fares. In April last, the Corporation authorised the conversion to be made in four sections; some progress has been made, and the first section should be ready for electrical operation in May or June next, when through running with Leith will be introduced.

Overhead v. Conduit System for Princes-street.

Mr. Pilcher, who is of opinion that there should be no hesitation in proceeding with the conversion of the remaining sections as soon as possible, deals with the position of Princes-street at some length. After setting out the merits of the overhead and conduit systems, including the methods employed in Brussels, Vienna, Berlin and elsewhere, reminds the Council that the most efficient method of dealing with the problem is to adopt one system throughout, namely, the overhead system. To change from one system to another in the busiest thoroughfare is taking certain risks which are bound to interfere with the efficiency of the system. If, however, the Council desires to keep Princes-street free from wires, and are prepared to adopt the underground system, with its disabilities, it would be necessary to consider which of the two systems, viz., the London or the Brussels system, to adopt. Of the following five possible methods for Princes-street, Mr. Pilcher recommends the first: (1) Overhead equipment, with side bracket arms, track on the south side of Princes-st; (2) overhead equipment, with side bracket arms, track on the north side; (3) overhead equipment, with span wires, track in present position; (4) conduit system, with Brussels type of plough; (5) conduit system, with London type of plough.

In conclusion, Mr. Pilcher states that it must always be kept in mind that there is an electric system in Leith, and that the cable assets can best be realised in extending that system; also, that for a city the size of Edinburgh it is essential to adopt one system which would embrace, at least, all the main routes of the city. The cost of converting the first section, including the Broughton route, is £172,974, with £6,773 for Grange-road; the second section will cost £135,496; and the third, £302,951, and with overhead equipment on Princes-street (£30,527), the total would be £648,711.

Novel Developments in the Application of Light.

The opening meeting of the ILLUMINATING ENGINEERING SOCIETY at each session is customarily devoted to reports of progress and the exhibition of novelties, and the programme at the gathering on Nov. 15, therefore, contained some interesting items. Mr. GASTER's summary of the progress during the vacation referred to several recent official reports, notably those of the Departmental Committee on Lighting in Factories and Workshops, the Committee under the Ministry of Health dealing with the effect on eyesight of lights in cinema studios, and the M.O.T. Committee on Lights on Vehicles, as illustrating the attention now being given to applications of light by Government Departments. Another event that naturally received notice was the Technical Session of the International Illumination Commission. A report was also presented by the Society's Committee on Progress in Electric Lamps and Lighting Appliances; from this report we gather that difficulties in production that arose during the war and after the termination of hostilities are now being overcome. The exhibits covered a wide field. Mr. Haydn T. Harrison showed a new form of photometer. Several new types of motor headlights were shown, and Mr. Groom and Mr. Lamplough furnished attractive demonstrations of artificial daylight, using respectively the Sheringham method of reflection of light from special coloured surfaces, and the use of the Chance Daylight glass. An interesting fact demonstrated by Mr. Lamplough was that a light may apparently resemble daylight closely in colour, while actually far from satisfactory for the purpose of colour-matching. Another feature of interest was the exhibit of letter-signs, using the new small neon lamps, which are capable of being inserted into an ordinary lamp-holder on 200 V. Mr. Ruthven Murray, on the other hand, showed some developments of the "internatiale" signs, recently referred to in this journal, in which pleasing colour-effects have now been embodied. It is now possible to engrave a coloured picture on the back of the glass, and a model of this kind was shown. Perhaps the most novel exhibit, however, was the demonstration by Mr. W. J. Jones of the use of ultra-violet light to distinguish between different qualities of precious stones. As is well known, most gems fluoresce under the effect of intense ultra-violet light, and the effect can be applied to distinguish a genuine stone from a spurious one. It is even possible to discriminate between gems of the same type, as the colour of the fluorescence varies with the locality from which they originate. A highly interesting fact revealed was that Indian pearls can be quite readily distinguished from the Japanese cultured variety by this means.

Federation of British Industries.

The annual general meeting of the Federation of British Industries took place at the Hotel Cecil, London, on Wednesday.

Sir PETER RYLANDS, in his presidential address, said the prestige of the Federation never stood higher than it did to-day, nor were its views ever received with more sympathetic consideration by the Government, and this must be attributed to the policy that had been pursued. The cry that the capitalist, with his money-bags, was trying to rule the country would be fatal. They only claimed that industry, and consequent employment, was the first interest of the State, and that the views of manufacturers on the subject were entitled to serious consideration. The Federation was confident that the proposals of the Chancellor of the Exchequer eighteen months ago to increase the rate of E.P.D. and to impose a Corporation Tax were unwise. The result of their imposition had been to increase the nation's troubles and difficulties. The Government had squeezed industry financially dry, and by the operation of the income tax based on the three-years' average profits many companies would be hard pressed to meet their commitments. The Chancellor of the Exchequer would be well advised to retrace the unfortunate step as far as possible. They should be no less insistent on the need for drastic economy in the Government service.

Sir PETER RYLANDS proposed the election of Col. O. C. Armstrong (of Greenwood & Batley, Ltd.) as President, and said he had been President of the British Engineering Association for three years. He had been intimately associated with the work of the Council.

Sir R. VASSAR SMITH seconded the proposal, and it was carried. The vice-presidents were re-elected, and the following were added as vice-presidents: Sir John Hunter, Sir Tom O. Callender, Sir Harris Spencer, Sir Wilfrid Stokes, Sir Lennox Lee, Sir Peter Macgregor, Mr. Clive Cookson, and Mr. Alex. Johnston.

Reports were submitted by a Special Committee on German Reparations, and by the Financial Sub-Committee of the Trade Depression Committee, and, in opening a discussion on these, Sir PETER RYLANDS said he thought it was agreed that the reduction of cost and lowering of prices would do more than anything to revive the industry of this country. We had passed through a period when the country had been wasting its assets; wages had been raised, but the productivity per man had been less than before. The incoming stream of foreign commodities could only be maintained by increasing our exports. If necessary, longer hours must be worked, and we must recognise that we were up against an economic difficulty which could not be gainsaid. The instability of exchange was a serious handicap to manufacturers. The policy of endeavouring to restore the old gold standard of our currency had failed to be realised. He did not think there would be any advantage in increasing the value of the "Bradybury," but if it were fixed even as the equivalent of four American dollars, it would be an advantage. The great reason why the mark was so unstable was that the German Budget never balanced.

Legal Intelligence.

HAMILTON v. MARCONI'S WIRELESS TELEGRAPH CO.

The hearing of this action, which was in Mr. Justice Bray's list on Tuesday, Nov. 15, to be heard by his Lordship and a special jury, has been adjourned for a month to give time for mutual discovery.

DISHONEST TRAVELLER IN ELECTRICAL GOODS.

In the Shoreditch County Court, last week, before Judge Cluer, the Western Electric Lamp Company sued Mr. Dunn, dealer in electrical goods, to recover £3 ls. for goods supplied. Mr. Crippwell, for the plaintiffs, said the goods were sold on March 21, and sent on March 23 with an invoice. Later they heard that on April 1 defendant had paid the traveller, a man named Stewart. The invoice clearly stated that travellers were not to be paid, but by an oversight he had omitted to give the defendant notice to produce it, so he could not produce a copy. Mr. Howard Fenelon, of the plaintiff firm, said it was an invariable rule to send out an invoice on the day the goods were dispatched. They could trace no line from their agent to say he had been paid. Witness admitted, on being shown a receipt, that it bore the signature of the traveller. Judge Cluer: Stewart is your traveller, and you must prove you told the defendant not to pay him. He refused to grant an adjournment, and gave judgment for defendant, with costs.

HACKNEY BOROUGH COUNCIL v. DORE.

As announced in our last issue, a Divisional Court (Darling, Sankey and Branson, JJ.) dismissed, on the 14th inst., the appeal of the Mayor and Corporation of Hackney against a magistrate's conviction, under Sec. 26 of the Hackney Electric Lighting Order, 1895, for failure to supply electric current to the respondent.

Mr. Schofield, for the appellants, said that they were convicted upon an information that they had made default in their obligation in regard to the supply of electrical energy, and the question for the Court was whether the default was caused by the action of a trades union, and, if so, whether such default was due to *force majeure*. The Hackney Order provided that the electrical undertakers should, at the request of the owner or occupier of premises, give and continue to give a supply of energy to such premises, but Sec. 26 said that, whenever the undertakers made default in supplying such energy they should be liable to a penalty not exceeding 40s. a day during the continuance of such default. There was, however, a proviso that no penalty should be inflicted if the Court were of opinion that the default was made as the result of *force majeure*. All the employees of appellants were members of the Electrical Trades Union, and on March 29 last appellants' engineer received notice that respondent's premises had been wired by non-union men, and that they would not proceed with the work of connecting. Several communications took place between the parties, and appellants used every endeavour to induce their employees to obey orders and carry out the work. If, under the circumstances, they had used other labour, a large body of men would have been withdrawn from the Hackney works, and therefore they contended that the failure to supply was not consequent upon any default of theirs, and they were entitled to the protecting proviso of *force majeure*. The magistrate was of opinion that the proviso only applied to physical force, and that appellants were liable under the Order.

After hearing Mr. HARDY for the respondent, Mr. Justice Darling said the Court had come to the conclusion that the appeal could not be allowed. In his judgment, the magistrate was right in law. He had found that work up to a certain point had been done by men who were not members of the trade union. Everything had been put into Mr. Dore's house making it ready for the connection, and when that came to be done the Electricity Committee would not connect because persons had been employed who were not members of the trade union. If the work of connecting the main had been proceeded with, the result would probably have been that the union would have given notice to the men to terminate their engagement. The Hackney undertaking was responsible for the supply of electricity to a wide district, and the result of a strike would have been disastrous. The case was very near being a case of *force majeure*, but not quite, and the appeal must be dismissed.

The other judges concurred, and the appeal was dismissed accordingly.

ATTORNEY-GENERAL v. LIVERPOOL CORPORATION.

Mr. Justice Russell delivered his considered judgment in this action on the 16th inst. The facts were stated in our issue of the 11th inst. His Lordship said that the question was whether the Corporation was entitled to carry on the business of providing, fixing and selling electrical fittings at the expense and risk of the ratepayers. Both the Liverpool Electric Supply Company, whose business was transferred to the Corporation under the Liverpool Electric Supply (Transfer) Act, 1896, and the Garston and District Electric Supply Company, whose business was transferred by the Liverpool Tramways and Electric Supply (Garston Transfer) Act, 1902, carried on the business of the manufacture and sale of electric fittings and apparatus of all kinds. By the Act of 1896 the Corporation was authorised to purchase, not only the "statutory undertaking," but the whole of the undertaking and other works of the Liverpool Company, with all their rights, powers and privileges. The Corporation had carried on the business of the supply of electrical fittings since that date. No doubt the intention of the 1896 Act was that the Corporation should step into the shoes of

the Liverpool Company and carry on all their businesses. Under the Act the company had to carry on all its businesses until completion of the purchase for the benefit and at the expense of the Corporation. If on completion of the purchase the business of electrical fittings was to be struck with sterility, why should it be carried on? The decision in *Attorney-General v. Sheffield Corporation*, which had been cited by the plaintiffs, did not cover the present case, as the provisions of the *Sheffield Transfer Act* were different. The *Act of 1896* gave the Corporation all that it required, and, in the circumstances, the second contention of the Corporation as to their common law powers did not arise. As there was a possibility that the case would be taken to a higher Court, he thought it right to express his opinion on the action of the Corporation. Mr. A. Collins, who had analysed the Corporation accounts for many years, and he showed that the matters objected to (establishment charges) had been taken into account, and that in every year, except perhaps in 1913, a profit was shown. There was no charge on the borough fund, but it had, in fact, benefited by the business. The Corporation was not carrying on the business so as to expend borrowed capital or rates, or the borough fund.

Effect of Changes Made by 1919 Act.

His Lordship said that both parties had relied on Sec. 23 of the *Electricity (Supply) Act, 1919*, which enabled a local authority to provide, let on hire, repair and maintain, but not (unless expressly authorised by the Special Act or Order) to manufacture or sell electrical fittings and apparatus. After much consideration he had come to the conclusion that that section had nothing to do with the present case. He thought that it was not intended to deprive local authorities of powers granted to them, though not expressly authorised. But, in any event, he held that the Corporation was expressly authorised to manufacture and sell by the *Act of 1896*, which gave it the rights, powers and privileges of the *Liverpool Company*. The powers being given, it was not necessary to find exact words of express authorisation. The action must, therefore, be dismissed, with costs.

THE GASIFIED LAMP PATENT.

On Tuesday the House of Lords concluded the hearing of the legal arguments in the appeal of the *British Thomson-Houston Company* against a decision of the Court of Appeal upholding a judgment of Mr. Justice Sargant, who dismissed appellants' action for alleged infringement of their patent on the ground that claim one of the specification did not sufficiently define the ambit of the monopoly claimed.

Sir Arthur Colefax (for appellants) said that the question before their Lordships had considerably narrowed down since the action was launched, and the judgments below were challenged only so far as they held appellants' patent to be invalid. The invention consisted in having a filament of tungsten or other refractory metal. That filament was placed, not in a vacuum as was the universal custom at the date of the patent, but in an inert gas or vapour of low heat conductivity, and was caused to incandesce at a very high temperature by passing through it an electric current. An incandescent electric lamp of this type was an entirely novel article of manufacture, and opened up a new field in incandescent electric lighting, with the result that the arc lamp had been largely displaced, and the vacuum lamp was being gradually superseded. Appellants' invention was the result of many years' experiment and research. Expert evidence given at the trial proved that a lamp could be made from the specification without requiring experiments to be made by a workman. There was no ambiguity in the word "large" as alleged, nor was the state of common knowledge such at the date of the patent as to render the invention one an unfit subject for a patent. He then proceeded to read the evidence.

Sir DUNCAN KERLY, K.C., who opened the case for respondents on the 15th inst., said that Mr. Justice Sargant had dismissed the appellants' claim, holding, in effect, that their specification was not the subject matter for a patent, and the Court of Appeal had upheld his judgment. Most of the evidence at the trial was for showing that the subject matter claimed as forming the invention was all common knowledge.

Sir Arthur Colefax, K.C., replied for the appellants, and he concluded his reply on Tuesday.

Lord HALDANE said their Lordships would take time to consider their decision.

INDIAN MACHINERY CONTRACTS.

On the 17th inst., Mr. Justice Bailhache heard an action by Mather & Platt against H. V. Low & Company, for the recovery of the price of machinery sold to defendants.

Mr. Neilson, K.C. (for plaintiffs) said it appeared that defendants had some connection with a Calcutta firm of the same name, who again had some connection with Jute mills in India. There was a company in India called the Behar Jute Mills, formed for the purpose of providing factories for the manufacture of jute, and this firm required machinery. A representative either of Low & Company or of the Behar Jute Mills (a Mr. Skinner) came home from India about the end of 1919, and got into touch with Mather & Platt, with a view to discussing an order for machinery to go to the Behar Jute Mills. The matter was discussed, and Mr. Skinner used Low & Company's offices in London for his negotiations. Eventually a tender was prepared by Mather & Platt, and sent on Feb. 16, 1920, to Low & Company. On Feb. 23 a letter was written upon which a great deal would turn, in which it was stated: "We have much pleasure in accepting your tender." It was signed "W. Skinner"

in his individual capacity, and "H. V. Low & Company" below it. Upon the faith of that Mather & Platt proceeded to manufacture the goods, and get them ready for shipment. Most of the goods were made in time, and some were supplied, but not paid for.

Defendants said they were merely agents to hand such money as they got from the Behar Jute Mills on to plaintiffs, and that they had incurred no personal liability themselves. That was towards the end of 1920, and at the beginning of 1921 the Behar Jute Mills Company went into voluntary liquidation. The question was, therefore, whether Low & Company had entered into such a contract with Mather & Platt as to bind them and make them answerable for damages for having repudiated their contract.

Mr. MACKINNON, K.C., contended that, as Mr. Skinner was known to be manager of the Jute Mills Company, and as Low & Company had only signed as agents, the defendants were not liable.

His Lordship said he came to the conclusion, in the circumstances of the case, that H. V. Low & Company, signing that document, must be taken to have held themselves out as the actual contracting parties, or the parties who were, in fact, guaranteeing the performance of that contract. He sympathised with Messrs. Low, but plaintiffs would have judgment for £5,227 for the goods actually supplied. With regard to the rest, plaintiffs must give credit for the amount they were able to take into stock, while as to that which could only be scrapped, credit must be given for its value as such. The question of damages was referred to a referee.

In another action, Messrs. Belliss & Morcom sought to recover from Messrs. Low & Company the value of some pumping machinery. The facts were similar to those in the above case. The total order amounted to £10,400, and there had been one delivery, amounting to £805.

His Lordship said the same principle applied. He gave judgment for the plaintiffs for the price of the goods delivered, and granted a reference as to damages in respect of the rest of the contract.

In a third action, by Messrs. Urquhart, Lindsay & Company against Messrs. Low & Company, judgment was given for £1,562, the price of goods delivered, with a reference as to the damages for the remainder of the contract.

The Engineering Agreement.

After many conferences an agreement has just been arrived at by the Engineering and the National Employers' Federations and the Amalgamated Engineering Union on the question of consultations with the shop stewards or works committees. The following are the terms of the new agreement, which is subject to a ballot of the men and to approval by the Employers' Associations:—

The trade union shall not interfere with the right of the employers to exercise managerial functions in their establishments, and the federations shall not interfere with the proper functions of the trade union. In the exercise of these functions, the parties shall have regard to the Provisions for Avoiding Disputes of April 17, 1914, which are amplified by the Shop Stewards and Works Committees Agreement of May 20, 1919, and to the terms of other national and local agreements between the parties.

Instructions of the management shall be observed pending any question in connection therewith being discussed in accordance with the provisions referred to. The employers are to have the right to decide when overtime is necessary, the workpeople or their representatives being entitled to bring forward any cases of overtime they desire discussed, but in the meantime the overtime required shall be proceeded with.

Educational.

EDINBURGH UNIVERSITY Court has approved of a proposal to found an independent professorship in the department of natural philosophy, to be called the Tait Chair of Natural Philosophy.

Speaking at a meeting of the Edinburgh Chamber of Commerce last week, Mr. J. Cockburn Miller said that, as a result of the recommendations of the Water Power Resources Committee of the Board of Trade for additional facilities in Technical Colleges and Universities for those who were taking up hydro-electric development, it has been decided to create a CHAIR OF HYDRO-ELECTRIC ENGINEERING in some chosen University, with the necessary laboratories designed and equipped on a scale commensurate with the importance of the work required to be undertaken. Where could that be better done than in Edinburgh? He suggested that they should select a committee of engineers to promote the idea, and that a remit be made to the directors accordingly. This was agreed to.

Rewards for War Service.

The King has given sanction to wear the following decorations conferred in recognition of valuable services rendered during the war:—

ORDER OF THE SACRED TREASURE (JAPAN).—Insignia of the Second Class.—Sir R. A. Hadfield, Bart., F.R.S., Commander Sir A. T. Dawson, Bart., Mr. J. M. Falkner, Mr. J. H. B. Noble, Mr. D. Vickers.

ORDER OF THE RISING SUN (JAPAN).—Insignia of the Third Class.—Sir J. McKechnie, K.B.E.

Electricity Supply.

Steps are being taken to form a local company at AXMINSTER for the purpose of establishing electric lighting works in the town.

The Electricity Commissioners have refused to sanction at present any further extension to the electricity generating station at ILKLEY.

The Minister of Transport has revoked the HESLE ELECTRIC LIGHTING ORDER, 1905, as to the whole area of supply, as from Nov. 16, 1921.

BATH City Council have been authorised to borrow a further sum of £5 500 for electricity mains and services, making a total of £28 500 out of the £30 000 asked for.

WIGAN Town Council have approved recommendations by the Electricity Committee, involving an estimated expenditure of £1 250 000 during the next six or eight years.

LOSSIEMOUTH Town Council have decided to increase by 1d. the charges on heating and power. At a meeting last week the total assets of the electric station were shown to be £14 014 and liabilities £13 766.

The new rotary converter installed at Dockfield by SHIPLEY Urban Council, at a cost of £7 500, was officially started last Saturday by Mr. Fearnley Rhodes, chairman of the District Council and of the Electricity Committee.

To bring to the notice of the public the advantages of the use of electricity, an exhibition, arranged by Mr. J. Turner, superintendent of the Council's electricity department, was held last week at the HOYLAKES and WEST KIRBY Town Hall.

The Minister of Transport gives notice that he proposes to confirm the HEREFORD ELECTRICITY (EXTENSION) SPECIAL ORDER, 1921. Objections can be sent to the Secretary of the Ministry of Transport, 6, Whitehall-gardens, S.W. 1, until Dec. 12.

The lighting of the elementary schools was discussed by ROWLEY REGIS Education Committee last week, and it was decided that the question of lighting all the schools in the district by electricity should be considered in connection with the next estimates.

BLACKBURN Electrical Exhibition, arranged by Mr. P. P. Wheelwright, electrical engineer, and under the direction of Mr. Goodwin, has proved a great success. There have been visitors from towns far and near, and demand for electrical devices is likely to be considerably augmented.

HEMEL HEMPSTEAD Town Council are taking steps to revoke the electric lighting order, held by the Chesham Electric Light and Power Company, Ltd., under which nothing has been done, and Watford Urban Council is to be asked under what terms the Corporation will give a supply of electricity.

WALSALL Town Council approved, with two dissentients, a recommendation of the Electric Supply Committee that in order to provide additional work for the unemployed, and subject to Government assistance towards the cost being forthcoming, the electricity mains be extended in Bloxwich and Leamore, at a cost of £3 070.

At the November meeting of the LOWER WALTON (near Warrington) Council, it was reported that the powers provisionally vested in the Mersey Power Company had been transferred to the Warrington Corporation, and the plan of the sub-station to be erected in West-avenue by the latter authority was recommended for approval.

At a meeting of STEPNEY Borough Council on Monday, it was decided to apply to the London County Council for the advance on loan of a sum of £52 190 sanctioned by the Electricity Commissioners in June for the provision of mains in connection with the Council's electricity undertaking. The loan is to be repaid within twenty years, with interest at the rate of 6½ per cent. per annum.

The electricity scheme for the MID-LANCASHIRE AREA, extending from East Lancashire to the Fylde coast, continues to meet with opposition from the local authorities concerned. As an alternative the local authorities of Accrington, Burnley, Colne, Darwen, Nelson, Rawtenstall, and Brierfield have arranged a local scheme, under which it is proposed to utilise the existing works to their maximum capacity before doing anything further.

As a result of further deliberations in connection with proposed schemes for electrically lighting the town of KELLS (MEATH), the Urban Council at its last meeting had three schemes before it. After consideration it was decided to refer the subject to the Dail Eireann. In the meantime notice of motion was handed in to rescind the permission to a firm to lay cables underground, and no extension of overhead lighting is to be proceeded with in the meantime.

An electricity supply scheme for the TOWNS of BANFF and MACDUFF was recently prepared by Mr. J. A. Bell, of Aberdeen, who is to be invited to discuss the matter with the Councils at an early date. There will be one generating station for the two towns, and the feeder and distributing system will be mainly on the overhead system. The total capital expenditure is estimated at £24 000, and after three years' working a net profit of between £300 and £400 is anticipated.

CANNOCK Urban Council last week decided to apply to the Electricity Commissioners for a loan of £30 000. Subject to the approval of the Electricity Commissioners and to the agreement with the West Cannock Colliery Company, the Council have accepted

the tenders of Ferranti, Ltd., the General Electric Company, the British Insulated and Helsby Cables, Ltd., and Reynolds, Ltd., for cables, transformer stations, and switchboards in connection with the scheme for the supply of electricity to the colliery.

Rapid progress is being made with the scheme for bringing a supply of electricity from H.M. FACTORY, QUEENSFERRY, to Chester. It will be remembered that negotiations between the Government and Chester Corporation were started in August, 1919, and early this year an agreement was come to. The work will involve an expenditure of £52 000, which is being capitalised by loans from the Electricity Commission, to be repaid on the transmission lines in twenty-five years, and on the machinery in ten years.

Mr. J. Smith, the electrical engineer, reported to a meeting of COLWYN BAY Council last week that the building which is being erected to accommodate the plant for "breaking down" the electricity to be delivered there by the North Wales Power and Traction Company, Ltd., in bulk at a very high voltage, is approaching completion, but there was no development to report in connection with the Power Company's portion of the work. A deputation was, therefore, appointed to interview the Power Company on the matter.

RUGBY Electricity Committee has received a letter from the Rugby Building Trades Employers' Association complaining of the activities of the department in competing with contractors for the installation of lighting systems and plant on private property, and questioning the legality of the Council carrying on this work. The committee has satisfied itself that the necessary powers have been conferred upon it by the Rugby Water and Improvement Act, 1901, and, after the matter was discussed at length by the Council, it was decided to proceed as hitherto.

At the meeting of the BRISTOL City Council last week the report of the Electrical Committee advising that they should be authorised to exercise their option to acquire the whole undertaking of the Keynsham Electric Light & Power Company, Ltd., as from the end of this year was adopted. The purchase price is £4 650, plus £1 500, which will have to be spent on completing certain alterations which were in progress, to enable the company to take a three-phase bulk supply from the committee. The total amount of capital involved, less the value of superseded plant, is £6 075.

The Government have intimated to the promoters of the GRAMPPIAN ELECTRIC SUPPLY SCHEME, who asked for a guarantee on the capital outlay of nearly 3 millions, that no promise under the £25 000 000 scheme can be made until the Bill authorising the project has passed through all its Parliamentary stages. In spite of the risk of no guarantee being granted—although all the conditions of the undertaking comply with the Government's system except that of an immediate start of operations—the promoters have decided, it is stated, to proceed with the drafting of the plans and the legal procedure for the enterprise of impounding the water resources of the Grampians.

A further effort is being made by ACCRINGTON Corporation to get the sanction of the Electricity Commissioners for the borrowing of a sum of £150 000 for extensions. Following an inquiry, the Commissioners withheld their sanction, and a deputation to London was unsuccessful in obtaining a more favourable decision. The Corporation were referred to Blackburn for terms for a supply in bulk or a stand-by service, but Accrington consider that their own scheme would be more economical. It is stated that an expenditure of £45 000 for cables, &c., would be incurred in linking up to Blackburn, and there would be a loss of from £10 000 to £11 000 a year. A second deputation is to interview the Commissioners.

WORCESTER City Council at their last meeting approved a report from the Electricity Committee on the question of the extension of the works, which recommended that the suggestion of the electrical engineer to purchase considerable plant from the Disposal and Liquidation Commission, who are disposing of Government factory power stations, be adopted. This plant is at Southampton, and the engineer estimated that by the purchase there would be effected a saving of £17 700 on his original estimate for buildings and plant extensions. If the purchase were made, the amended estimate for which sanction would be required would be £53 950, compared with £62 200. The Committee recommended that, subject to obtaining the consent of the Electricity Commission, and to a loan of £55 850 being obtained, the Council acquire the Southampton generating plant to instal at the Hylton-road Works.

The scheme for the reorganisation of electricity supply in North-East Lancashire has not been generally accepted. Mr. Chas. Furness, borough electrical engineer of Blackpool, is of opinion that the proposal to embrace Blackpool, Fleetwood and the other coast towns with the towns of NORTH-EAST LANCASHIRE, with a wide but sparsely populated agricultural area intervening, does not offer any advantages from an administrative, technical, or financial point of view. Therefore he suggests that a scheme for linking up the coast towns between the Wyre and the Ribbles, and the urban and rural authorities within a ten miles' radius of Blackpool, would best serve the interests of the community. The co-operation of three existing supply authorities, Blackpool, St. Annes and Fleetwood, would be necessary. East Lancashire authorities are equally sceptical of its advantages, and a local scheme has been arranged between the authorities of Accrington, Burnley, Colne, Darwen, Nelson, Rawtenstall and Brierfield as an alternative to the larger scheme. The idea of the East Lancashire authorities is that the electricity stations should be utilised to their full capacity before accepting responsibility for big and expensive schemes.

Electric Traction.

Application is to be made by HULL CORPORATION PARLIAMENTARY COMMITTEE for a Light Railways Order to extend the tramway lines from Hull to Hessle.

At a meeting of WATFORD DEARNE Urban Council a motion "not to proceed further with the Dearne Valley Light Railway scheme" was defeated by six votes to three.

During the three months ended Sept. 30 WALSLEY tramways and bus undertaking made a profit of £36. For the first three months of the year a loss of £5 000 was recorded. The frequency fare is to be retained.

The LIVERPOOL Tramways Committee has prepared a comprehensive scheme for the extension of the tramway system in eleven districts. The matter will come before the Liverpool City Council on Dec. 21.

A scheme of tramway extension, estimated to cost £265 000, has been prepared by the ABERDEEN Tramways Committees, and the Corporation are recommended to promote a Provisional Order to secure the necessary powers.

A scheme for the amalgamation of the LONDON & NORTH-WESTERN and the LANCASHIRE & YORKSHIRE RAILWAY COMPANIES has been submitted to the Minister of Transport for reference to the Railways Amalgamation Tribunal.

The Ministry of Transport has extended for one year, from July 31, 1922, the period limited for the completion of tramways Nos. 1 and 2 authorised by the READING CORPORATION ACT, 1914. An extension has also been granted of one year from Aug. 15, 1921, for the completion of tramways, and for the purchase of land authorised by the DERBY CORPORATION ACT, 1913.

The Ministry of Health has sanctioned the borrowing of £32 000 for relaying the track of the PLYMOUTH electric tramway undertaking in Wilton-street and Stuart-road, making the junctions at Derrig's Clock and Fore-street, and for new car bodies and equipment. The Ministry of Transport has approved of alterations to tramlines consequent on the proposed improvement at Pennycomequick.

At a meeting of George Heriot's Trust, in EDINBURGH, last week, a discussion took place in regard to the proposal of the Corporation Tramways Committee, in connection with the electrification of the tramways, to fix rosettes to the buildings in York-place, where the offices of the Trust are situated, and the resolution passed at the last meeting in favour of fixing the rosettes was rescinded by nine votes to six.

Mr. W. G. Grace has been re-elected chairman of the TEESIDE RAILLESS TRACTION BOARD. At the meeting it was reported that a new type of railless car, designed by Mr. J. B. Parker, manager of the Teeside system, was being made by Messrs. Cross & Straker. One of the new cars was stated to have been already delivered. It has been designed in the light of experience gained by the use of the two types owned by the Board.

The enquiry held recently into the TRAMCAR ACCIDENT AT BURTON-ON-TRENT on the 3rd inst., when a Corporation car travelling from Stapehill to the railway station fouled the points and overturned, injuring eighteen passengers, showed that the accident was caused by the axle breaking. On examination it was found to have a flaw about one-third of the way round and about $\frac{3}{8}$ in. deep. It was stated that eighteen axles had broken on Corporation cars during last year and thirteen during the ten months of the present year. In May last the English Electric Company agreed to renew the whole of the axles on the new cars, and this work was now being carried out. The Corporation are now trying a new type of axle on the old cars.

In view of the proposals for the improvement and extension of the tube railways, &c., the London County Council have issued, in pamphlet form, the statement on LONDON'S TRAFFIC PROBLEM made recently to the London members of Parliament by Mr. G. H. Hume. It points out that the L.C.C., as tramway authority, own 146 miles of tramway track, that they carry more passengers than the tube railways, omnibuses, or local railways, and at a much cheaper rate. Consequently they claim that when proposals are put forward to deal with the traffic problem their position and past services should receive consideration. "The problem of London traffic," it is contended, can certainly not be solved, and it is doubtful whether it can be even eased, by any attempt to deal with it piece-meal and leave out of account a transport system like the tramways.

GLASGOW Tramway Committee, at their meeting last week, considered the question of taking over the Airdrie and Coatbridge Tramways undertaking, and agreed to recommend to the Corporation the assumption of the Parliamentary powers of the trustees under the Airdrie and Coatbridge Order of 1921, and the working of the tramways in the two burghs as part of the Glasgow Corporation system, and that it be remitted back to the Sub-Committee on Extensions to make the necessary arrangements. The total length of the Airdrie and Coatbridge Tramways is 3.63 miles, of which 2.32 miles is single track and 1.31 mile double track. Under the Tramways Order referred to, the price to be paid to the company is fixed at £77 500, plus £4 750 for stores, making in all £82 250. The Corporation proposal is to extend their system from Baillieston to Langloan, and to link up the latter place with the Airdrie system. With regard to the proposal to acquire the Paisley Tramways undertaking, a special meeting is to be held this week.

Personal and Appointments.

Mr. J. W. COLLIN has been elected chairman of Birkenhead Electricity Committee.

Mr. HUGO STINNES, the German industrial magnate, is on a visit to London. The object of the visit has not been disclosed.

Ald. E. HUNTSMAN has been elected chairman and Major W. E. WALKER vice-chairman of Nottingham Electricity Committee.

Councillor A. J. WARD and Alderman STYRING have been elected chairman and deputy chairman of Sheffield Electric Supply Committee.

Dr. R. M. WALMSLEY has been elected chairman for 1921-22 of the Committees and Boards of Studies Revision Committee of London University.

Mr. W. HARTLEY, mains superintendent at the Rochdale Electricity Works, has resigned owing to ill-health. He has been connected with the department for twelve years.

Principal THOS. LOVEDAY, of the University College, Southampton, has accepted the invitation to become Vice-Chancellor of Bristol University in place of Sir I. Owen, who recently retired.

Mr. E. MOXON, on leaving South Shields to take up the position of borough electrical engineer at Southport, has been presented with a silver tea service and salver by his late staff and fellow employees.

MESSRS. G. B. BATTEN (Edinburgh), L. S. HIRSCH (Columbia), E. R. MORTON (Toronto), and C. W. S. SABERTON (Manchester), have been approved of for the diploma in medical radiology and electiology.

Mr. J. ROLAND GOTT, assistant under Mr. C. I. Baker, Blackpool tramways traffic superintendent, has secured an important appointment as general assistant to the traffic manager of Calcutta tramways. He sails for India early next month.

The College Committee of UNIVERSITY COLLEGE (UNIVERSITY OF LONDON) have awarded Goldsmid entrance engineering scholarships of the value of £20 each, tenable for three years, to Mr. H. J. Channon, Mr. P. Hall, and Mr. H. Kaufmann.

Hackney Borough Council have elected COUNCILLOR C. W. JACKSON chairman, and COUNCILLOR E. A. NETTLE, vice-chairman, of the Electricity Committee for the ensuing year. COUNCILLOR J. HILLMAN has been appointed to represent the committee on the Joint (Staffs) Committee.

Mr. A. F. HARRISON, secretary of the City of London Electric Lighting Company, has been elected a vice-president of the Chartered Institute of Secretaries for the ensuing year, and Mr. H. W. ALLEN, of Marconi's Wireless Telegraph Company, has been elected treasurer.

Mr. BRUCE LINDSAY has been elected chairman of EDINBURGH Electricity Committee. Mr. GOALEN was nominated for the chairmanship of the Tramways Committee. Mr. Goalen was for four years chairman of the Leith Corporation Tramways Committee, and two years chairman of the Electricity Committee.

Mr. JOHN HORNE is leaving the Metropolitan-Vickers Export Company at the end of the month to take up an important position on the London staff of the A.C.E.C. (Ateliers de Constructions Electriques de Charleroi). Mr. Horne has been associated with the British Westinghouse and Metropolitan-Vickers Companies for nearly fifteen years.

Business Items, &c.

BILHAM & KIDNEY have opened showrooms for electrical goods in Pound-street, Carshalton.

FRIEND, WINTLE & COMPANY, 8, Park-street, Cardiff, are opening a large electrical showroom in St. Mary-street, Cardiff, on Dec. 1.

We are informed that Tom Norton, Ltd., the Automobile Palace, Llandrindod Wells, have ceased to take their supply from the town mains, and are using a WILLYS LIGHTING SET.

HILL, UPTON & COMPANY, of George-street, Oxford, staged an exhibit of electric heating apparatus and artistic lighting effects, at the Oxford Trades Exhibition, which was held last week.

ELECTRICAL UTILITIES, LTD., announce that they have arranged an agreement with Electrical & Engineering Development, Ltd., whereby they acquire the whole capital, patents, business, goodwill, and other assets of the latter company. On the formal completion of the sale, Electrical & Engineering Development, Ltd., will enter into voluntary liquidation.

Obituary.

Mr. WILLIAM McHUGH, secretary of the Dublin United Tramways Company, died at his residence in Rathgar on Sunday.

The death took place on Tuesday, at the age of 72, of Mr. SEPTIMUS YOUNG, late of Head, Wrightson & Co., Ltd.

The death has occurred of Mr. WALTER MACFARLANE, until recently principal of the County Technical College at Wednesbury, formerly known as the Staffordshire Metallurgical College.

We regret to record the death of Mr. W. H. BOOTH, F.G.S., M.Am.Soc.C.E., consulting engineer. He was the author of several books on engineering, including working on fuel economy, liquid fuel, superheating, and water softening.

Institution Notes.

The Committee of the NORTH-WESTERN STUDENTS' CENTRE OF THE INSTITUTION OF ELECTRICAL ENGINEERS have arranged a visit to the Lancashire and Yorkshire Railway Signal School, Victoria Station, Manchester, to-morrow (Saturday).

An address on "The Centenary of the Continuous Current Machine" was given by Prof. David Robertson last week, who presided at the first dinner meeting of the current session of the BRISTOL ASSOCIATION OF ENGINEERS, held at the Royal Hotel.

Applications for the year 1922 for GOVERNMENT GRANTS FOR SCIENTIFIC INVESTIGATIONS must be received at the offices of the ROYAL SOCIETY not later than Jan. 1. Further particulars may be obtained from the Clerk to the Government Grant Committee, Royal Society, Burlington House, London, W. 1.

On the 9th inst., Mr. Rolling, of Glasgow, delivered the opening Paper of the session of the GREENOCK ASSOCIATION OF ELECTRICAL ENGINEERS before a large attendance of members. His subject, "Automatic Electric Control Devices, with Special Application to Shipyard Equipment," was well illustrated by lantern slides and blackboard diagrams. Mr. Rolling anticipated a very wide adoption of automatic control, owing to the prejudice against automatic "gadgets" having almost disappeared, and to the reduction of time and labour costs effected by their employment.

An interesting programme of Papers for discussion has been arranged by the recently-established INSTITUTION OF THE RUBBER INDUSTRY, whose headquarters are at Charing Cross House, Charing Cross-road, London, W.C. 2. The meetings will be held monthly in London, and in Manchester, Birmingham and Glasgow. The social side is not being forgotten, and a golf challenge cup has already been presented to the Institution, while dinners and other functions are being arranged. For the studios, a complete library of books relating to rubber industry will be available at the London headquarters.

At the invitation of Mr. A. E. Smith, District Superintendent of the Edison Swan Electric Company, Ltd., a party of seventy-two, consisting of the leading electrical engineers of Hull and their men, assembled at the company's showrooms recently to hear and discuss a lecture on the EDISON WIRING SYSTEM by Mr. F. C. Raphael. Many practical points were raised in the discussion, which was wound up by Mr. Herbert Bell, the City Electrical Engineer, who expressed the opinion that some form of surface-wiring system was essential in many cases to reduce the cost of electrical installations, and that the one described was the most suitable for the purpose he had seen.

Lecturing on the working of the modern telephone system before the NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS at Newcastle, Mr. C. Whillies mentioned that, although there were now in this country, as well as in America and elsewhere, a number of different types of automatic systems actually in operation, this method of intercommunication had not yet by any means passed the fluid state of development, and a great deal of experimental work was still required before it crystallised into anything like standard practice. Very rapid strides were being made, however, and in the near future even very small village exchanges would probably be worked on the automatic principle when the necessity for replacement arose. Telephonic conditions in this country were so complicated that the problems of design to meet all requirements of traffic were extremely difficult, and any attempt to lay down automatic plant in a haphazard and piecemeal manner would tend to produce chaotic results.

Telegraph and Telephone Notes.

It is proposed to lay a NEW SUBMARINE CABLE between Glasgow and Belfast.

WIRELESS APPARATUS has been installed at the R.I.C. BARRACKS, MIDLTOWN (MUNSTER), and at the Courthouse immediately adjoining.

Owing to the depreciation in the mark, the rates for TELEGRAMS to foreign countries from GERMANY have been increased by 170 per cent.

The General Post Office have given authority for the work of erecting the new telephone exchange at SHEFFIELD to be proceeded with.

Arrangements have been made for reopening the YAP-GUAM SUBMARINE CABLE during the Washington Conference. The agreement will be signed by the United States and Japan, and approved by Great Britain, France, and Italy.

Sub-committees of the Porto Rose Conference have reported in favour of improving the TELEGRAPHIC COMMUNICATIONS between VIENNA and BELGRADE and BUKAREST.

Mr. Justice Astbury, in the Chancery Division last week, confirmed a proposed alteration of objects of the BIRMINGHAM PRIVATE TELEPHONE (NEW SYSTEM) COMPANY, a subsidiary company of the Telephone Manufacturing Company.

The second annual wireless exhibition promoted by the BIRMINGHAM EXPERIMENTAL WIRELESS CLUB will be held at the Municipal Technical School from Jan. 18-22 next. Popular lectures will be given each evening by wireless experts.

A contract entered into between the Government of COSTA RICA and the ALL-AMERICA CABLES INCORPORATED COMPANY for the establishment, within a period of eighteen months, of a direct cable-

gram service between Costa Rica and foreign countries was finally approved on Oct. 9.

The wireless telephone on the BAR LIGHTSHIP, which was licensed by the Post Office early this year for communication with the Mersey Docks and Harbour Board at Liverpool, is now equipped with the new Marconi ringing-up device, which dispenses with the necessity for a continuous watch.

The new TELEPHONE EXCHANGE at CLERKENWELL, which is one of the six new public exchanges in course of construction, will be one of the largest in London. Extensions of the equipment are being fitted in eight other existing London exchanges. In the provinces twenty-seven new exchanges are under construction and twenty-four existing exchanges are being extended.

An Exchange message from Melbourne states that the Amalgamated Wireless Company is making arrangements to establish a DIRECT SERVICE BETWEEN AUSTRALIA AND ENGLAND conjointly with the Commonwealth Government, and is promising a 50 per cent. reduction on present cable charges for all classes of messages. A million capital is needed. The company has half a million, and proposes to invite the Federal Government to invest the other half.

Imperial Notes.

EVANDALE (Tasmania) Council desires to take electricity in bulk from Launceston Council, and it is probable that suitable terms will be arranged.

ECHUCA (Victoria) Council has accepted the offer of the State Savings Bank to lend the Council £16,000 at 7 per cent., and repayable in ten years, for carrying out their electric supply scheme.

It is announced that a revision of the SOUTH AFRICAN CUSTOMS TARIFF is contemplated by the Union Government, and certain preliminary investigations are to be undertaken by the Board of Trade and Industries.

The profit of the IPSWICH ELECTRIC SUPPLY COMPANY, LTD. (Ipswich, Queensland), for the year ended June 30 was £6,904, and a final dividend of 2½ per cent., making 4½ per cent. for the year, has been declared.

The N.S.W. Railway Commissioners have agreed to supply electricity in bulk to BANKSTOWN (N.S.W.) Council, who have appointed Mr. H. J. Hoggan consulting engineer for the transmission and distribution scheme.

The Australian General Electric Company has secured the option of purchasing a site in WILLIAMSTOWN (Victoria) for the erection of large engineering works. It is stated that 300 workmen skilled in the manufacture of electrical appliances will be brought from abroad.

JOHANNESBURG Town Council has been authorised by the Administrator to borrow £119,000 for the development of the lighting plant, and the Electricity Committee has been authorised to obtain terms from the Victoria Falls Power Company for a supplementary supply of electricity.

The accounts of WELLINGTON (N.Z.) tramways department for the year ended March 31 show revenue £347,695 (an increase of £70,608), and a credit balance, after providing for working and capital charges, of £6,483 (decrease £15,342). The revenue of the electric lighting department was £112,318 (increase £8,325), and the credit balance £3,596 (decrease £20,329).

In 1919 there were forty municipal bodies in the UNION OF SOUTH AFRICA who ran electric supply stations: fifteen in the Cape, seven in Natal, ten in the Transvaal, and eight in the Free State. The number of consumers, states our contemporary "South Africa," was 63,408; the units sold and used 91,674,331, and the working cost per unit ranged from 77d. at Aliwal North, to 958d. at Pietersburg.

The Secretary of State for the Colonies has appointed a Committee of eight members to investigate and report upon the present RUBBER SITUATION in BRITISH COLONIES and PROTECTORATES, and to advise what remedial measures should be taken to improve the existing situation. The chairman of the Committee is Sir James Stevenson, Bart. (Commercial Adviser to the Colonial Secretary), and Mr. S. H. Leake, O.B.E. (Colonial Office), will act as secretary.

DEVONPORT (Tasmania) Council have decided to join other towns in endeavouring to obtain from the Government hydro-electric department 2,000 H.P. of electric energy for use in the towns on the north-west coast. The maximum load on the Devonport Council's present station is about 223 H.P., and the cost is about £23 10s. per H.P. year, and it is believed that 1,000 H.P. can be obtained from the Government supply for the same total cost. At the station in ULVERSTONE, another town in the district, the cost of production is £40 per H.P. year. Before extending the Hydro-electric Department's mains to the coast towns, the Government wish to know the requirements of the district. The chairman of the meeting thought the coast councils could give a guarantee similar to that given by Launceston if the same terms could be obtained. Latrobe would take about 500 H.P., Devonport 1,000, Ulverstone 1,000. Penguin 300, Burnie 1,000, and Wynyard 500. A total of 5,000 H.P. was wanted at once. Closer estimates of the Councils' demands will be obtained, and then the Government will be asked for a quotation for bulk supply.

Correction.

We regret that a mistake occurred in the placing of the arrow heads in Fig. 4 of Mr. W. E. Swale's article on "Electricity and Tube Tyre and Wheel Mills" in our issue last week. In positions 1 and 3 the arrow should show the clockwise direction of rotation instead of counter clockwise, as indicated for the bottom rolls.

Miscellaneous.

During the month of October, BRITISH OIL AND POWER COMPANIES (other than oil) increased their nominal capital by £343,800, of which sum electricity companies accounted for £10,000.

A sum of £10,000 has been contributed in support of the UNIVERSITY OF BARCELONA, offered by the Imperial Tobacco Company, and £1,000 has been given by the National Provincial and Union Bank of England.

TWO NEW SUBMARINES UNDER CONSIDERATION FOR THE U.S. NAVY ARE to be equipped with electric engines developing 6,500 H.P., and designed to give a speed of 21 knots on the surface and of 10 knots submerged.

The following companies will be STRUCK OFF THE REGISTER OF JOINT STOCK COMPANIES unless cause to the contrary is shown before Feb. 18, 1922: E. B. Magnetos, Electro Leather Industries, Indian Railless Traction Company, Kable Electrical Company, Wallace Griffin Electrical Company.

The latest addition to the X-ray and ELECTRO-THERAPEUTIC DEPARTMENT of the CANCER HOSPITAL is a twin induction coil installation of British manufacture, designed to give an output on a high-tension current of from 250,000 to 300,000 V. The apparatus will be used to test the value of the new technique for the treatment of deep-seated cancer.

Mr. W. E. Hobbs, district manager, presided on Saturday at a "coming-of-age" dinner, held at the Royal Hotel, Cardiff, in connection with the local branch of the GENERAL ELECTRIC COMPANY, LTD. Mr. M. J. Railing, director and general manager, and Mr. H. N. Whitford, the branch representative at headquarters, were present, together with about seventy members of the local staff.

On Saturday, Nov. 12, a re-union dinner took place at the Holborn Restaurant of the members of the TILLY ANTI-AIRCRAFT SEARCHLIGHT SECTION, LONDON ELECTRICAL ENGINEERS. Among those present were Messrs. F. Childs, E. Moore, R. Collins, H. Verey, G. Keen, E. Collings, E. McCarthy, R. Bonnett, J. Palmer, S. Smith, H. Thomas, and H. Payn. It was not possible to obtain the addresses of several others, including two of the late commanding officers, and should this notice be seen by any members who were not present, it is hoped that they will send their present address to Mr. R. Collins, 43, Brick-street, Piccadilly, W. 1.

At the inquest regarding the death of C. W. JONES (33), a wireman, employed by the National Oil Refineries, Skewen, who was killed at this work while working on a supply cable, T. Hopkins, an electrician at the works, said Jones had his left hand outstretched to withdraw the vice he was using, and must have caught hold of the stay wire with his right hand. The voltage at this point was 250 alternating. The current should have been turned off before work was begun, and probably Jones did not know it was on. A. Abrahams, the foreman electrician, was closely questioned as to the responsibility for turning off the current, and admitted that it could only be turned off on his instructions. He was at the sub-station at the time in question, and was not told that anyone wanted the switches taken off, though he knew that Jones and others were at work on the cables. The jury returned a verdict that death was due to electric shock, and expressed the opinion that there was forgetfulness on the part of Foreman Abrahams in not seeing that the current was cut off prior to the men commencing work. They also suggested that boards should be exhibited warning the workmen to see that all switches were off before commencing work.

Exhibition Notes.

THE INTERNATIONAL ELECTRICAL EXHIBITION at AMSTERDAM opens to-day (Friday), and will remain open until Dec. 26.

Arrangements are being made to establish a special pavilion for for British exhibits at the International PEACE EXHIBITION, to be held at TOKYO next March. Exhibits should be dispatched not later than Dec. 31. Substantial rebates will be allowed on exhibits forwarded by certain Japanese steamers.

The German Minister of Justice has certified that the temporary protection provided by the Law of March, 1904, applies to the FRANKFURT SPRING FAIR, to be held from April 2-8, 1922. The Law of March, 1904, provides that the exhibition of an invention, design, model, or trade mark at a certified exhibition shall not prejudice the obtaining of a patent for the invention or the registration of the design, model, or trade mark, if the application for such patent or registration is made within six months from the date of the exhibition. Such applications receive priority over applications made after the date of the exhibition.

Substantial progress is being made with the raising of the guarantee fund for the BRITISH EMPIRE EXHIBITION, to be held at Wembley Park in 1923, and the amount now exceeds £755,000. Glasgow's contribution is more than £80,000; the Liverpool amount is £35,000, and Bradford, which is to obtain £35,000, has already a list guaranteeing £21,000. Excellent reports are to hand from other large cities. The Executive Committee of the exhibition has decided to institute five or more COMMERCIAL RESEARCH FELLOWSHIPS. These fellowships will be approximately of the value of £500, and will be identified with those towns whose Chambers of Commerce secure the highest aggregate of guarantees for the exhibition in proportion to their membership. The local chamber will have the right of selection. Dec. 15 is the closing date for entries.

Tenders Invited and Accepted.

UNITED KINGDOM.

SHEFFIELD HEALTH COMMITTEE. Nov. 26.—Plant and machinery for refuse-disposal works, including cranes and grabs, d.c. switchboard, feed pumps and feed-water heaters, steam-driven electrical plant and condensers, electric motors and starters (contracts Nos. 9, 10, 11, 14 and 15), &c. Specifications from Messrs. Mortimore, Lyon & Company, Mansfield-chambers, Manchester.

BURGH OF ARDROSSAN AND SALTCOATS. Nov. 28.—Electric wiring work in connection with reconstruction and extension of Springvale Joint Hospital. Schedules, &c., from Mr. Hugh Thomson, Architect, Saltcoats.

GLASGOW HEALTH DEPARTMENT. Nov. 28.—Electric wiring and fitting of doctors' and workmen's houses at Robroyston Hospital. Specifications, &c., can be obtained at the Office of Public Works, 64, Cochrane-street, Glasgow.

WEXFORD CORPORATION. Nov. 28.—Overhead low-pressure distribution mains, street lanterns, &c. Specification, &c., from Messrs. MacEntee, Lovell & Gregory, 22, Nassau-street, Dublin.

FULHAM (London) Borough Council. Nov. 29.—Supply of 11,000 yds. of 0.2 sq. in. h.t. (3,300 V) concentric paper insulated and lead-covered cable. Forms of tender from the Borough Electrical Engineer, Townmead-road, and tenders to the Town Clerk, Town Hall, Fulham, S.W. 6.

CHORLEY GUARDIANS. Nov. 30.—Storage battery (128 cells, 300 Ah) and booster for the Institution at Eaves-lane, Chorley.

GLASGOW GAS DEPARTMENT. Nov. 30.—Two electric locomotives, gauge 30 in., height 68 in., to haul 30 tons. Particulars from the Manager, 45, John-street, Glasgow.

WIMBLEDON CORPORATION. Nov. 30, noon.—Supply, delivery and erection of high-pressure sub-station switchboard at Raynes Park sub-station. Specification and tender form from Mr. H. Tomlinson-Lee, Chief Electrical Engineer, Electricity Works, Durnsford-road, Wimbledon, S.W. 19. Tenders to the Chairman of the Electricity Committee.

WHITEHAVEN CORPORATION. Dec. 1.—Two water-tube boilers, with superheaters, economisers, pipework, &c., for the Electric Supply Department. Specification, &c., from the Borough Electrical Engineer and Manager.

THE COMMISSIONERS OF H.M. WORKS. Dec. 6.—(1) Electrical and (2) mechanical engineering labour in day work in connection with the maintenance of installations in the Birmingham, Bristol and Liverpool districts. Forms of tender (separate for each district), &c., can be obtained at the Contracts Branch, H.M. Office of Works, London, S.W. 1.

WEST HAM GUARDIANS. Dec. 15.—Three months' supply of electric fittings, ironmongery, tools, &c. Forms of tender from the Clerk, Union-road, Leytonstone, E. 11.

WEST DERBY GUARDIANS. Dec. 23.—Electric light and power installation (including generating plant), electric lift service, and telephone installation at the Walton Institution. Specifications from Mr. E. B. Bailey, 37, Moorfields, Liverpool.

NEW ZEALAND.

LITTELTON. PUBLIC WORKS TENDERS BOARD OF NEW ZEALAND. Jan. 31.—Two complete sets of 3 phase automatic oil circuit breakers suitable for 6,600 V, 1,200 A capacity, four sets of disconnecting switches for isolating the oil switches, and one 6,600 V air break lever operated switch for main transformer switches at Lake Coleridge power house. Tenders to the Secretary, Public Works Tenders Board, Government Buildings, Wellington.

PUBLIC WORKS TENDERS BOARD, WAIKATO POWER SCHEME. March 6.—(Section 45) two 2,500 kW alternators, three-phase, 50 cycle, 5,000 V, at 160 rds. rev. per min., with a power factor of .8. Excitation at 220 V. (Section 46) two 3,100 H.P. water turbines of the double-runner Francis type to operate the generators mentioned in Section 45. (Section 47) two exciter sets, each consisting of one 200 kW d.c. generator, and one 350 H.P. asynchronous motor, together with a Tirrill regulator. The generator shall have an output of 220 V, with a full-load current of 7,000 A. The motor shall be of 350 H.P., with a power supply of 400 V, three-phase, 60 cycle. The synchronous speed of the sets shall be 750. (Section 48) four Stoney sluice gates for the pits, appertaining to the turbines mentioned in Section 46. Tenders to the Secretary, Public Works Tenders Board, Government Buildings, Wellington.

SOUTH AMERICA.

ARGENTINE NATIONAL BOARD OF SANITARY WORKS.—January 19, 1922.—* Plant and accessories for new generating station, including three 4-cycle 375 H.P. Diesel engines, to run on crude petroleum, and three 3-phase alternators, each of 250 kW, 2,200 V between phases, 50 cycles, power factor 0.8.

BULGARIA.

BULGARIAN DIRECTION OF POSTS, TELEGRAPHS AND TELEPHONES. Jan. 10, 1922.—Supply of sixty 50-line and fifteen 100-line telephone exchanges. Particulars and drawings may be obtained from the Bulgarian Legation, 3, Queensberry-place, S.W. 7.

YORK Corporation have accepted the tender of the Metropolitan-Vickers Electrical Company for a 60 H.P. motor, with starter, at £386 18s.

LONDON COUNTY COUNCIL have accepted the tender of Holt & Willets (the lowest tender received) for the supply and erection of
* Particulars from the Department of Overseas Trade.

an electric goods lift at the Stamford Hill stores depot, at £895. Fourteen tenders were received, the highest being £1 550.

BETHNAL GREEN (London) Borough Council have accepted the tender of the Metropolitan Vickers Electrical Company for switch gear and l.t. feeder panel at £978 5s.

The tender of the MOUNTBATH Electric Light Company has been accepted for supplying current for eighteen 200 c.p. and one 400 c.p. electric lamps in Mountrath, at £35 per annum.

DONCASTER Town Council has accepted the tender of the Enfield Edison Company, Ltd., for low and high tension cables in connection with the Arksey housing scheme at £1 181.

LEEDS Corporation have accepted the tender of S. H. Johnson & Company for two electrically-driven air compressors (£1 684) and motors, starters, &c. (£1 062), for the sewage works.

BURY Corporation have accepted the following tenders in connection with extensions at Chamber Hall station: Ferguson, Pailin, Ltd., switchboard; Clarke, Chapman & Company, electric capstan.

LEEK Lighting Committee recommend acceptance of the tenders of Crompton & Company for a 400 kW dynamo at £1 730; and Herbert Morris, Ltd., for a 3-ton travelling crab winch for crane, £85 19s.

Orders have been placed by the Electricity Commissioners of VICTORIA for the Morwell power scheme, as follows: John Thompson, Ltd., of Wolverhampton (boilers), about £280 000; with Redpath Brown & Company (power-house building), £114 750.

STREPEY BOROUGH COUNCIL have accepted the following tenders: W. Lucy & Company, Ltd., Oxford, for eight cast-iron feeder pillars, at £24 17s. 6d. each (three tenders were received, the highest of which was £37); Worthington-Simpson, Ltd., Kingsway, W.C., for feed-water heater for the new air ejector on the turbine, at £109 (the only other tender received was at £120).

SOUTH SHIELDS Corporation have accepted the following tenders:—British Insulated & Helsby Cables, e.h.t. feeders and pilot cables, £1 417; e.h.t. sub-feeders, £577 12s.; and underground distributing mains, house service switch control mains and services for public lamps, £1 412; A. Reyrolle & Company, e.h.t. switchgear, £1 387; English Electric Company, three tramcar bodies, £1 200.

LONDON County Council have received thirteen tenders (including one alternative tender), varying from £13 765 13s. 6d. to £22 305 10s., for high and low tension switchgear required in connection with the rearrangement of the plant at Holborn and Streatham sub-stations. The Highways Committee report that the lowest tender (that of the Sprecher and Schuh Company, of Aarau, Switzerland) is not according to specification, and they recommend that the tender of the British Thomson-Houston Company, £15 056 17s., be accepted. The British Thomson-Houston Company are also supplying the rotary converters for the sub-stations.

Catalogues, Price Lists, &c.

A revised price list of telephone apparatus for local and central battery service has been issued by JAMES McMILLAN & Co., Clon House, Surrey-street, Strand, London, W.C. 2.

We have received from W. F. DENNIS & COMPANY a leaflet descriptive of the telephone-telegraph submarine cable between East Prussia and Pomerania, details of which we gave in our issue of Sept. 16.

A list giving particulars of the new C.S. "Bull" Dynamo and Motor has just been issued by the makers, the A.G.E. ELECTRIC MOTORS, LTD., Stowmarket. The C.S. type has a larger capacity than the well-known M.S. "Bull," and extremely high efficiencies at all ratings are claimed.

A list of A. F. A. "DUROS" CELLS, types "A c" and "A d," are being distributed by Messrs. E. G. LIND & COMPANY, 48A, Buckingham Palace-road, S.W. 1. The Duros cell is supplied in a charged state. It is claimed to be very durable and reliable, with a high E.M.F. (22 V), and is suitable for telegraphy, telephony, signalling, &c.

A circular giving particulars of the VENTHETHA APPARATUS for supplying a constant flow of warm fresh air into the interior of a building is being distributed by the VENTHETHA (UNITED KINGDOM), LTD., 311-24, Old-street, E.C. 2. The apparatus is supplied in three forms, for electric heating, or for burning gas or oil, and specifications are given of the three models.

In a nicely illustrated pamphlet of 24 pages the PARK ROYAL ENGINEERING WORKS give a few typical examples of the latest designs of their switchgear and instruments. The company supply switchgear and switches for all systems, and for all purposes. Their manufactures are of a high-class character, and they comply fully with the Home Office and other departmental regulations.

THE SWEDISH GENERAL ELECTRIC, LTD., 5, Chancery-lane, London, W.C. 2, have issued new stock lists of generators and motors. The company are now able to quote for all types of a.c. or d.c. motors for the driving of printing presses, and they have developed a complete series of starting and regulating devices for hand operation and push-button control for starting and regulating the speed of such motors.

The recent trade literature of the EDISON SWAN ELECTRIC COMPANY, LTD., Ponders End, Middlesex, include a neat booklet on semi-indirect fixtures for home and office lighting, which gives particulars and prices of a large variety of fittings in a number of finishes and for various services. Some very artistic designs are included. Leaflets on Edison primary batteries and on Edison circuit breakers are also available.

Companies' Reports, &c.

The directors of BRUNNER, MOND & COMPANY announce an interim dividend of 2½ per cent., less tax.

THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY have declared a quarterly dividend of 2½ dollars.

The accounts of the NATIONAL TELEWRITER COMPANY, for the year ended June 30 last show a credit balance of £1 191.

THE EVER-READY COMPANY (GREAT BRITAIN) have declared a half-yearly dividend on the preference shares at the rate of 7 per cent. per annum.

The net revenue of the NORTH MELBOURNE ELECTRIC TRAMWAYS AND LIGHTING COMPANY for the year ended Sept. 30, 1920, was £13 232, against £11 228.

The directors of the BRITISH ELECTRIC TRACTION COMPANY have declared an interim dividend of 3 per cent. on the 6 per cent. cumulative participating preference stock.

The directors of the POWER GAS CORPORATION recommend a dividend at the rate of 6 per cent. for the year ended September last, against 8 per cent. in the previous year.

The directors of the ISLE OF THANET ELECTRIC TRAMWAYS AND LIGHTING COMPANY, have declared a dividend of 2½ per cent. (less tax) on the preference shares for the half-year ended July, 1908.

THE BRITISH THOMSON-HOUSTON COMPANY invited subscriptions this week for £1 500 000 7 per cent. mortgage debenture stock at 92½ per cent. The subscription list was closed on Monday, the day it opened.

The report of CALLENDER'S SHARE AND INVESTMENT TRUST for the year ended Aug. 31 shows a net profit of £10 864, plus £6 218 brought in. It is proposed to pay a dividend at the rate of 8 per cent., less tax, to place £500 to reserve, £700 to corporation tax, leaving £6 619 to be carried forward.

THE STOCK EXCHANGE COMMITTEE have granted official quotations to £250 000 £1, fully paid, ordinary shares of the Calcutta Electric Supply Corporation: £500 000 fully paid scrip certificates for ½ per cent. extension debenture stock, 1921, of the Metropolitan Electric Supply Company: £1 300 000 8 per cent. mortgage debenture stock of the Mond Nickel Company, and 108 000 £5 fully paid ordinary shares of the United River Plate Telephone Company, and have specially allowed dealings in £200 000 4 per cent. debenture stock of the London Electric Railway Company.

The directors of the WESTERN TELEGRAPH COMPANY, LTD., report that for the year ended June 30 last, the revenue amounted to £2 073 498, and the working expenses to £1 024 425. After providing £32 747 for debenture stock interest, and £306 536 for income tax, excess profits duty and corporation profits tax, there remains a balance of £709 790; to this is added £149 410 brought forward, making a total of £859 200. The directors have transferred £350 000 to general reserve, £50 000 to maintenance ships reserve fund, and £50 000 to land and buildings depreciation fund. Further expenses of issue of new capital amounted to £1 336. Four dividends of 2½ per cent. each have been paid, amounting to £259 905, making a distribution of 10 per cent. (tax free) for the year, and a dividend of 4s. per share (tax free) has been paid on 96 102 new shares, which amounted to £19 220, leaving a balance of £128 739 to be carried forward.

The gross revenue of the EASTERN EXTENSION, AUSTRALASIA AND CHINA TELEGRAPH COMPANY, LTD., for the year ended Dec. 31, 1920, amounted to £2 514 825, from which is deducted £744 934 for ordinary expenses, and £451 307 for maintenance of cables and special expenditure, leaving a balance of £1 318 584. After providing £666 138 for excess profits duty, corporation tax and income tax payable in England, £30 096 for interest on the mortgage debenture stock and £5 451 on account of expenses of issue of new capital, there remains a balance of £616 898, to which is added £232 440 brought forward, making a total available balance of £849 338. From this balance the directors have transferred £450 000 to the general reserve fund. Four dividends of 2½ per cent. each have been paid on the old shares, making a total distribution for the year of 10 per cent. (tax free), together with a dividend of 4s. per share (tax free) on the new shares, amounting together to £318 559. These appropriations absorb £768 559, and leave a balance of £80 780 to be carried forward.

The report of the INDIA RUBBER, GUTTA PERCHA AND TELEGRAPH WORKS COMPANY for the eleven months ended Aug. 31, 1921, shows, after making provision for doubtful debts and Excess Profits Duty refund, a net loss of £445 461. The sum of £142 418 was brought forward from last year, from which eleven-twelfths of the dividend on the preference shares (£11 458) was taken, leaving £130 960. To this sum £350 000 has been added from the reserve fund (leaving £215 722), making £480 960, and leaving £35 498 to be carried forward. Of the net loss a very large proportion, the directors state, is due to depreciation in the value of stock as at Aug. 31, 1921, compared with Sept. 30, 1920. The remainder is the result of the coal strike, the shorter hours of work, labour difficulties, the unsettled state of markets, and the great reduction of turnover due to the competition of dumped foreign goods and surplus stocks arising out of world-wide over-production; these together having reduced the turnover by about one-half. The board regret that the payment of a dividend on the ordinary shares is impossible, but with a return to more normal conditions they feel confident that the company will once more be put on a dividend-paying basis. The warrants for the half-yearly dividend on the preference shares will be payable on Jan. 2, 1922.

THE DIRECTORS OF THE EASTERN TELEGRAPH COMPANY, LTD., for the year ended Dec. 31, 1920, states that the revenue amounted to £4381 856, from which are deducted £1629 057 for interest, and £1359 726 for expenditure relating to maintenance of cables, income and war taxes payable abroad, share of contribution to the pension and superannuation funds towards depreciation of investments, payments to staff, and other expenses incidental to the war, special grant on formation of staff widows' fund, and sundry differences in exchange, leaving a balance of £1393 073. After providing for income tax, corporation profits tax, and excess profits duty payable in England, interest on mortgage debenture stock and dividends on the preference stock, which in all absorb £474 015, there remains £919 058, to which is added £416 083 from preceding account, making a total available balance of £1335 140.

The directors have placed £500 000 to general reserve and £100 000 to the maintenance ships fund. Three interim dividends of 2½ per cent. each, and a final dividend of 2½ per cent. have been paid on the ordinary stock, amounting together to £400 000, and making a total distribution of 10 per cent. (tax free) for the year 1920. There has also been paid a dividend (tax free) on the new ordinary shares amounting to £18 662. These appropriations absorb £1 018 662 and leave a balance of £316 479, which is carried forward. An expenditure of £1476 088 has been incurred during the year in respect of new cables, and in accordance with the purpose for which the new ordinary shares were issued the sum of £1 000 000 has been charged to capital expenditure, the balance of £476 088 being charged against the general reserve fund. This fund has also been debited with £301 022 for partial renewal of main line cables, &c., £57 650 for loss on sale of investments, and £250 000 as a further provision on account of investment fluctuations. The balance to the credit of the fund is now £221 931.

Electrical Imports and Exports.

IMPORTS.—The following are official values of electrical machinery, apparatus and material imported into this country (a) during October, 1921, and (b) the aggregate figures from Jan. 1 to Oct. 31, with increase or decrease compared with corresponding periods of 1920:—

Electrical machinery, (a) £27 887 (decrease £169 236), (b) £631 515 (decrease £414 208); telegraph and telephone cables, submarine (a) nil, (b) nil (decrease £50); other than submarine, (a) £4 308 (increase £1 812), (b) £72 703 (increase £61 711); telegraph and telephone apparatus, (a) £20 021 (decrease £14 120), (b) £279 524 (increase £121 864); other electrical wires and cables, rubber insulated, (a) £6 636 (increase £5 010), (b) £33 617 (increase £8 431); with other insulations, (a) £6 504 (decrease £11 012), (b) £92 046 (decrease £11 462); carbons (a) £3 737 (decrease £20 380), (b) £89 094 (decrease £30 963); glow lamps, (a) £16 722 (increase £6 242), (b) £217 681 (increase £167 129); arc lamps and electric searchlights, (a) nil, (b) £6 630 (increase £2 616); parts of arc lamps and searchlights (other than carbons), (a) £315 (decrease £844), (b) £14 231 (increase £2 844); batteries, (a) £5 153 (decrease £2 638), (b) £102 466 (increase £8 221); meters and measuring instruments, (a) £2 821 (decrease £6 196), (b) £130 576 (increase £60 809); switchboards, (a) £188 (decrease £238), (b) £15 937 (increase £14 376); electrical goods and apparatus unenumerated, (a) £37 619 (decrease £63 138), (b) £619 726 (decrease £31 961). Total of electrical machinery, apparatus and material, other than uninsulated wire, (a) £132 911 (decrease £299 528), (b) £2 305 746 (decrease £40 643).

EXPORTS.—The exports of electrical machinery, apparatus and material (a) during October, 1921, and (b) from Jan. 1 to Oct. 31, with increase or decrease compared with corresponding periods of 1920, were as follows:—

Electrical machinery, (a) £316 427 (increase £53 948), (b) £3 981 735 (increase £2 103 210); including railway and tramway motors, (a) £3 120 (increase £2 243), (b) £187 048 (increase £155 125); other generators and motors, (a) £178 301 (increase £2 155), (b) £2 230 711 (increase £1 113 211); and electrical machinery unenumerated, (a) £135 006 (increase £49 550), (b) £1 565 916 (increase £334 874); telegraph and telephone cables, submarine, (a) £9 373 (decrease £135 038), (b) £2 021 883 (increase £1 652 847); other than submarine, (a) £145 672 (increase £6 351), (b) £1 426 447 (increase £641 526); telegraph and telephone apparatus, (a) £204 782 (increase £90 203), (b) £1 677 464 (increase £710 823); other electrical wires and cables, rubber insulated, (a) £59 368 (decrease £90 124), (b) £1 129 058 (decrease £257 566); with other insulations, (a) £211 764 (increase £48 599), (b) £1 803 639 (increase £104 490); carbons, (a) £3 728 (decrease £23 184), (b) £60 323 (decrease £46 747); glow lamps, (a) £22 886 (decrease £17 350), (b) £391 154 (increase £157 316); arc lamps and searchlights, (a) £198 (decrease £224), (b) £12 294 (decrease £3 533); parts of arc lamps and searchlights (other than carbons), (a) £112 (decrease £1 177), (b) £5 590 (decrease £6 097); batteries, (a) £42 858 (decrease £29 046), (b) £601 134 (increase £530 039); meters and measuring instruments, (a) £36 511 (increase £5 109), (b) £243 502 (increase £98 028); switchboards, (a) £19 240 (increase £11 422), (b) £200 170 (increase £117 495); electrical goods and apparatus unenumerated, (a) £137 504 (decrease £88 118), (b) £1 771 111 (increase £179 142). Total of electrical machinery, material and apparatus, other than uninsulated wire, (a) £1 210 623 (decrease £110 629), (b) £15 505 504 (increase £4 580 973).

Arrangements for the Week.

FRIDAY, Nov. 25th (to-day).

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, London, S.W. Lecture, "Electro-Magnetic Instruments: Problems in Design and Construction," by Mr. G. H. Shotton.

ELECTRICAL POWER ENGINEERS' ASSOCIATION. (SOUTHERN DIVISION.)

7 p.m. At Central Hall, London, S.W. Lecture on "Some Notes on Boiler-house Plant," by Mr. W. A. Bennis.

EDINBURGH ELECTRICAL SOCIETY.

8 p.m. At the Philosophical Institute, 4, Queen-street, Edinburgh. Paper on "The Manufacture of the Modern Electric Lamp," by Mr. A. S. Black.

PHYSICAL SOCIETY.

5 p.m. At the Imperial College of Science, London, S.W. Discussion on "Hygrometry."

MONDAY, Nov. 28th.

INSTITUTION OF ELECTRICAL ENGINEERS (NORTH-EASTERN SECTION.)

7.15 p.m. At Armstrong College, Newcastle-on-Tyne. Lecture on "Single and Three-phase Commutator Motors, with Shunt and Series Characteristics," by Dr. S. P. Smith.

TUESDAY, Nov. 29th.

INSTITUTION OF ELECTRICAL ENGINEERS. (NORTH-WESTERN SECTION.)

7 p.m. At the Engineers' Club, Albert-square, Manchester. Paper on "Induction Type Synchronous Motors," by W. H. A. Carr.

WEDNESDAY, Nov. 30th.

INDUSTRIAL LEAGUE AND COUNCIL.

7.30 p.m. Caxton Hall, London, S.W. Lecture on "Some Causes of Industrial Unrest and a Remedy," by Mr. H. H. Elvin.

ROYAL INSTITUTE OF PUBLIC HEALTH.

4 p.m. At 37, Russell-square, London, W.C. Lecture on "Health and Welfare in the Coal Mining Industry," by Prof. E. L. Collis, M.A.

THURSDAY, Dec. 1st.

INSTITUTION OF ELECTRICAL ENGINEERS.

6 p.m. At Savoy-place, London, W.C. Paper on "The Cyc-Arc Process of Automatic Electric Welding," by Messrs. L. J. Steele and H. Martin.

FRIDAY, Dec. 2nd.

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, London, S.W. Lecture on "Notes on Maintenance of Electrical Accumulators," by Mr. B. L. Larkin.

INSTITUTION OF ELECTRICAL ENGINEERS. (STUDENT SECTION.)

7 p.m. Savoy-place, London, W.C. Paper on "Automatic and Semi-automatic Railway Signalling," by Mr. H. S. Petch.

Prices of Metals, Chemicals, &c.

		TUESDAY, NOV. 22.		
		Price.	Inc.	Dec.
<i>Copper</i> —	Best selected .. per ton	£67 5 0	—	15s.
	Electro Wirebars	£76 10 0	—	10s.
	H.C. wire, basis .. . per lb.	0s. 11½d.	—	½d.
	Sheet .. .	0s. 10½d.	—	—
<i>Phosphor Bronze Wire (Telephone)</i> —				
	Phosphor-bronze wire, basis	1s. 3½d.	—	½d.
<i>Brass</i> 60/40—	Rod, basis	0s. 7½d.	—	—
	Sheet, basis	0s. 10½d.	—	—
	Wire, basis	0s. 11½d.	—	—
<i>Pig Iron</i> —	Cleveland Warrants .. per ton	£5 15 0	—	—
	Galvanised steel wire, basis 8 SWG ..	£22 0 0	—	£1 0 0
<i>Lead Pig</i> —	English	£25 10 0	10s.	—
	Foreign or Colonial ..	£24 10 0	7s. 6d.	—
<i>Tin</i> —	Ingot	£160 15 0	£3 0 0	—
	Wire, basis per lb.	2s. 2½d.	½d.	—
<i>Sulphammoniac</i> .—Per cwt. 65s. 60s.		<i>Copper Sulphate</i> .—Per ton £28 15s.		
<i>Sulphur</i> (Flowers).—Ton £13.		<i>Boric Acid</i> (Crystals).—Per ton 26s.		
" (Roll-Brimstone).—Per ton £13.		<i>Sodium Bichromate</i> .—Per lb. 6½d.		
<i>Sulphuric Acid</i> (Pyrites, 168°).—Per ton, 20 17s. 6d.		<i>Sodium Chlorate</i> .—Per lb. 3½d.		
<i>Rubber</i> .—Para fine, 1s. 2½d.; plantation 1st latex, 10½d. to 11d. lb.				
The metal prices are supplied by British Insulated & Helsby Cables, Ltd.				

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Partnerships Dissolved.

BAKER, Thomas, and LOCK, Henry Alfred, under the style of T. Baker & Company, at 93, Upperton-road, Leicester, electrical engineers, as from Nov. 11, 1921. Debts received and paid by C. Howard Bolton, Chartered Accountant, 22, Millstone-lane, Leicester. T. Baker will continue the business alone at 93, Upperton-road, Leicester.

BALDWIN, William Townley, and WHITE, John Stanley, as The Sheffield Accumulator Company, at Broom-street, Sheffield, by mutual consent as from Nov. 5, 1921. Debts received and paid by W. T. Baldwin, who will continue the business.

JOLLEY, Sidney Thomas, and EYES, William David, manufacturing electricians, 83, Forest-street, Forest Gate, Essex, under the style of the Accumulator Service Company, by mutual consent, as from Nov. 14, 1921.

Bankruptcy Information.

RENNETT, William, Back Sitwell-street, Derby, electrical contractor. Receiving order, Nov. 18, debtor's petition.

OWEN, Joseph (trading as J. Owen & Sons), 186, Westcombe-hill, and 3, The Grove, Greenwich, electrical engineer. Receiving order, Nov. 7, debtor's petition. First meeting, Nov. 18, 11.30 a.m., 29, Russell-square, W.C. 1. Public examination, Dec. 20, 11 a.m., Court House, Greenwich.

WARING, Thomas Driffeld, 55, Walm-gate, York, previously 18, Waterloo-place, Coney-street, York, electrical engineer. Receiving order, Nov. 14, debtor's petition. First meeting, Nov. 29, 3 p.m., Official Receiver's Offices, Duncombe-place, York. Public examination, Dec. 16, 12.15 p.m., Law Courts, Clifford-street, York.

Notice of Intended Dividend.

WATKINSON, Matthew, WATKINSON, Harold, and WATKINSON, Arthur, trading as Watt & Company, 22 and 24, Palmer-road, Sheffield, electrical and mechanical engineers. Last day for receiving proofs, Dec. 8. Trustee, T. C. Parkin, jun., 36, Bank-street, Sheffield.

Order Made on Application for Discharge.

DOWNIE, Charles Philip Manners (trading as Philip Downie), 355A, Westborough-road, and 88, Ronald Park-avenue, Southend-on-Sea, Essex, electrical engineer and factor. Discharge suspended for two years, bankrupt to be discharged as from Oct. 17, 1923.

Liquidator's Notice.

STONECROFT ELECTRICAL WORKS, LTD. Particulars of claims should be sent by Dec. 28 to Ernest Chetter, Incorporated Accountant, of 26, North John-street, Liverpool, liquidator of the company.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

ARCHER, Bertram George Raine (trading as Argent Archer & Company), 89, Abbey-road, N.W. 8, electrical engineer. £21 12s. 2d. Oct. 5.

BANKS, Walter, 63, Clifton-street, Old Trafford, Manchester, electrician. £32 1s. Oct. 4.

BARNETT, B., 104, Whitechapel-road, electrical contractor. £32 19s. 3d. Oct. 5.

CLARKE, E. E., 23, Albert-road, Morecambe, electrical engineer. £11 6s. 4d. Sept. 28.

FOWLER, Mr. A. V., 85, High-street, Broadstairs, electrician. £40 19s. 4d. Oct. 12.

GLANFIELD, Edward, Thornhill House, Biscot-road, Luton, electrician. £11 5s. 9d. Oct. 13.

HAINÉ, Mr. W. E., 495, Fulham-road, S.W., electrician. £21 0s. 4d. Oct. 4.

HAINES, Mr. J. M., 122, St. John-street, E.C., electrical engineer. £16 2s. Oct. 3.

HIRONS, Hy. Louis, and HIRONS, Lilly (his wife), 52, Gopsal-street, Ashted, Birmingham, electrical instrument maker. £10 6s. Oct. 11.

LEWISHAM ELECTRIC WIRING COMPANY, 273, High-street, Lewisham, electrical contractors. £10 14s. Sept. 30.

MACAULAY, Mr. R. A., 48, Ashton New-road, Beswick, Manchester, electrical and mechanical engineer. £15 14s. 8. Oct. 11.

PRIMETT, Victor, Winbush-lane, Hitchin, electrical engineer. £18 12s. Oct. 10.

SEACOMBE, James, 98, Trevor-terrace, North Shields, electrician. Oct. 6. £18 18s. 2d.

USHER, Samuel Leonard, 141, Anglesey-road, Burton-on-Trent, electrician. £11 13s. 6. Sept. 30.

WELSH, Phillip A., 363, Upton-lane, Forest Gate, E. 7, electrical engineer. £12 4s. 1d. Sept. 29.

Bills of Sale.

[The undermentioned information is from the Official Registry. It includes Bills of Sale registered under the Act of 1882 and under the Act of 1878. Both kinds require registration every five years. Up to the date the information was obtained it was registered as given below; but payment may have been made in some of the cases, although no notice had been entered on the Register.]

BARON, John, 42, Newbold-street, Rochdale, electrical engineer. Nov. 12. £50.

GREEN, Horace Sidney, 35, Railway-terrace, Fitzwilliam, electrical engineer. Nov. 12. £30.

RAYBOULD, Wilfred Ernest, Ivy House, 15, Milton-street, Derby, electrical engineer. Nov. 12. £80.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

Satisfaction.

OSWESTRY ELECTRIC LIGHTING & POWER COMPANY, LTD.—Satisfactions registered Nov. 1. £1 000, registered Jan. 8, 1912, and £300, registered May 5, 1915.

Bankruptcy Proceedings.

JARVIS, William Edwin Charles, 3 King Edward-street, Darlaston, late trading as the Darlaston and District Electrical Engineering Company, 48, King-street, Darlaston, Staffordshire, electrical engineer. The first meeting of creditors was held on Nov. 16, at the Official Receiver's Office, 30, Litchfield-street, Wolverhampton. The liabilities were returned at £282 19s. 6d. against assets £18 10s. The matter was left in the hands of the Official Receiver as trustee.

OWEN, Joseph, trading as J. Owen & Sons, 186, Westcombe-hill, Greenwich, Kent, and 3, The Grove, Greenwich, electrical engineer. According to the statement of affairs disclosed at the first meeting of creditors, held last week, ranking liabilities amounted to £1 293, against net assets estimated to realise £289, a deficiency of £1 004. Debtor started business in December, 1916, as an electrical engineer, and was successful until December, 1920, when the business declined owing to trade depression, followed by the coal strike. The case was left with the Official Receiver as trustee of the estate.

WORMULL, Frederick Alfred Stanley, 273, High-street, Lewisham, trading as the Lewisham Electric Wiring Company, electrical engineer. The first meeting of the creditors of the above was held recently at 29, Russell-square, W.C. 1. Debtor stated the causes of his failure were heavy administrative expenses, lack of proper supervision of outdoor staff, losses incurred through inaccurate tendering for contracts carried out, together with the general trade depression. In January, 1919, with a capital of £200, he started business in the name of the Lewisham Electric Wiring Company, at 273, High-street, Lewisham, rental £50 a year, but from accounts prepared by an accountant the business was carried on at a loss of £707 to Dec. 31, 1920. The estimated trading loss since that date was £1 049. The first legal process issued against him was in February, 1921, and at the date of the receiving order five creditors for £103 had obtained judgment. The unsecured liabilities included £2 584 to the debtor's wife for cash advanced apparently for the purpose of the business, £34 to other cash creditors, and £145 to trade creditors. The statement of affairs showed gross liabilities of £2 834, of which £2 763 was expected to rank. The net assets were estimated to produce £260, thus showing a deficiency of £2 503. The case was left in the hands of the Official Receiver.

Receiverships.

GILLETT (S.) & COMPANY, LTD.—A. Dees, of 25, James-street, Newcastle-on-Tyne, appointed as receiver and manager, on Nov. 2, under powers contained in debenture dated July 17, 1921.

HEAD'S (ELECTRICAL), LTD.—A. E. Orbell, of 151 and 152, North-street, Brighton, appointed as receiver on Nov. 2, under powers contained in first mortgage debenture dated June 1, 1921.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been prepared by Messrs. Messers, LISTS & CO., Chartered Patent Agents, 25 Abchurch Lane, London, E.C. 4.

COMPLETE SPECIFICATIONS.

- 144 682 BELMONT-GOLDSMITH CORPORATION, INC. Sparking plugs. (9/6/19).
 145 401 GOSSETT, G. B. Automatic spark advance for magnetos. (20/9/19).
 145 385 NOLAN, W. Process and apparatus for electrically separating dust from gases and vapours. (27/8/19).
 145 774 LA PHOENIX, D. M. G. R. DE. Means for coupling wires to electric lamp holders and other terminals. (5/2/19).
 146 256 GARDIN, E. J. Process of manufacture of zinc cups intended for dry cells for pocket lamps and other purposes. (28/6/19).
 147 455 ALGEMEENE ELECTRICITEITS-GEN. Connecting clamp for electric wires. (11/5/18).
 149 632 WURSTENBERGER, F. VON. Process for protecting against electrostatic destruction of certain parts of apparatus which contain several liquid spaces. (2/8/19).
 150 971 LA PHOENIX, D. M. G. R. DE. Holder for electric incandescent lamps. (12/1/19) (Addition to 150 728).
 167 063 BOORNE, W. H. Electrode for use in depositing molten metal. (30/6/20).
 167 092 NORMAN, A. C. Electric motor attachments for bath chairs, tricycles, and the like. (10/8/20).
 167 097 WARNER, H. J. Electric direct current circuits. (18/8/20).
 167 197 CARNEY, H. A., & LACEY, H. M. Cooling of transformers or other electric apparatus. (22/4/20).
 167 204 BULL, M. P., FAIRBANK, & LAYNE, M. J. Electrical apparatus for transmitting indications to a distance. (19/2/20).
 167 222 IGRANIC ELECTRIC CO., LTD. (Cutler Hammer Manufacturing Co., Ltd.). Mercury vapour arc devices. (22/4/20).
 167 231 WINDYBANK, R. K. Electric switches and locking devices therefor. (27/4/20).
 167 232 CLAREMONT, E. A., & BEAVER, C. J. Impregnated paper and the like with insulating compounds and the like for electrical purposes. (2/4/20).
 167 242 HUNT, L. J. Dynamo electric machines adapted for synchronous work. (29/4/20).
 167 250 POUCHAIN, A. Method of preventing loss of zinc in an electric battery. (30/4/20).
 167 256 EDISON SWAN ELECTRIC CO., LTD., & TAGGART, J. SCOTT. Means for arranging electrodes in vacuum tubes. (3/5/20).
 167 277 EFANDEM CO., LTD., & WILLIAMS, A. H. Electric lanterns. (4/5/20).
 167 286 KOLBACH, S. W. M. Electric operated hammers. (4/5/20).
 167 291 BRITISH THOMSON-HOUSTON CO., LTD., & SODGEN, J. Slow motion devices, rheostats, and controllers. (5/5/20).
 167 305 EXACT ELECTRICITY, LTD., & MOORE, H. T. Dynamo-electric generator for lighting cycles and other road vehicles. (11/5/20).
 167 310 AUTOMATIC TELEPHONE MANUFACTURING CO., LTD., HARRISON, H., & SMITH, S. R. Telegraph printing systems. (13/5/20).
 167 316 CAMBERLIN, B. Electrical heater for use in perforating and other devices. (15/5/20).
 167 346 SYKES, G. H. Terminals for electrical conductors. (29/5/20).
 167 348 SCHNEIDER, J. P. Instantaneous electric water-heaters. (31/5/20).
 167 361 TIBBLES, H. J., & GUNN, LTD., T. Electric burglar and like alarms. (22/6/20).
 167 374 LAWRENCE, W. Trolleys for electric tramways of the overhead conductor system. (14/7/20).
 167 375 WALTERS, F. M. Electrically driven vehicles. (15/7/20).
 167 391 JOHNSON, J. Y. (United States Chain & Forging Co.). Electric welding machines. (4/8/20).
 167 393 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). Arc welding compositions. (20/8/20).

APPLICATIONS FOR PATENTS

June 14, 1921.

- 16 294 GREENHALGH & JENNISON. Device for testing h.t. magnetos, coils, &c.
 16 302 THYNE. Electric ovens.
 16 317 GHESTY. Device for preventing removal of lamps from holders.
 16 331 KRUPP (F.) AKT.-GES. Arrangement for operation from a distance of overload switch. (20/8/20, Germany).
 16 363 PERNOT. Electric signalling methods.
 16 389 LENAGHAN. Motor mechanism for automatic telephone systems, &c.
 16 371 LENAGHAN. Automatic telephone systems.
 16 372 BEE. Time switches.
 16 388 DROUOT & THOMAS. Telephone systems. (16/6/20, France).
 16 393 SIEMENS-SCHUCKERTWERKE. Automatic maximum current switches. (15/6/20, Germany).
 16 400 MERRY, BARBER & BURR. Electric light pendants.

June 15, 1921.

- 16 425 FROST. Resistances.
 16 429 FARGHER. Electrically operated diaphragm pump.
 16 431 MACINTOSH & BROWN. Variable accumulator boxes.
 16 473 METROPOLITAN-VICKERS ELECTRICAL CO. & BUTLER. Excitation of electric machines.
 16 481 Codd & MARTIN. Electric lamp holders and adaptors.
 16 482 MERRIS. Electric time alarms.
 16 491 VAREZ. Electric condensers. (11/4/21, France).
 16 504 SIEMENS-SCHUCKERTWERKE. Air removing apparatus for mercury vapour rectifiers, &c. (15/6/20, Germany).
 16 545 STERLING TELEPHONE & ELECTRIC CO., BELL & DAVEY. Electric heaters.
 16 520 WENTON. Electric furnaces.
 16 521 B. T. H. Co. (G. E. Co.). Electron discharge devices.
 16 532 BENT & THOMAS. Telephone systems. (17/6/20, France).

June 16, 1921.

- 16 550 ANGLID, TURNER, & RAILING. Automatic circuit breakers.
 16 551 SOC. FRANCAISE RADIO-ELECTRIQUE. Electro-magnetic wave transmitters. (16/10/19, France).
 16 558 HILL & MATHURONE. Electro-magnetic wave-signalling systems. (16/6/20, U.S.).
 16 595 BRUSH ELECTRIC & ENGINEERING CO., HUGGINS & BOYCE. Machinery for electric welding, &c.
 16 606 BERRY. Electric radiators.
 16 609 WILDERMAN. Electrolytic decomposition of alkali salts.
 16 642 METROPOLITAN-VICKERS ELECTRICAL CO. Electrical controllers. (15/7/20, U.S.).
 16 643 PRICE. Electric lighting for motor cycles, &c.

June 17, 1921.

- 16 646 TAYLOR. Electrical transmission.
 16 717 B. T. H. Co. & CLOUGH. Alternating current distribution systems.
 16 718 B. T. H. Co. (G. E. Co.). Electron discharge apparatus.
 16 724 COLEBROOK. Electric water heater.
 16 731 MARKS (Siemens-Schuckertwerke). Liquid resistances.
 16 736 GUGGENBUHL. Electric bed-warmer. (7/9/20, Switzerland).
 16 737 FORT. VENTOS, HENRI, HENRI, HENRI. Hengeloche Elek. en Mechan. Apparatenfabr. (Heemst). Protecting arrangements for switches, &c.
 16 738 KANDO. Rotary h.t. electrical machines in oil bath. (10/6/18, Hungary).
 16 782 SIEMENS, BOOT & FERREIRA. Relays.
 16 799 SIMPSON & YOUNG. Indicating period of and for controlling electrical oscillations.
 18 800 AKT.-GES. BROWN, BOYER ET CIE. Anodes for mercury vapour rectifiers. (18/6/20, Switzerland).
 18 806 SIEMENS & LE MARCHEL. Production of tungsten and tungsten filaments.
 18 807 SIEMENS & SILVERBERG. Method of producing tungsten.
 18 809 B. T. H. Co. (G. E. Co.). Electron discharge apparatus.
 18 811 SEAL & URBAIN. Magnetos. (18/6/20, France).

June 20, 1921.

- 18 833 SUTTON. Means of generating d.c. voltages.
 18 840 GREENWOOD. Loud-speaking devices for wireless receiving sets, &c.
 18 875 PHYSIKALISCHES INSTITUT DER UNIVERSITAT, JENA. Oscillation valves. (18/6/20, Germany).
 18 879 B. T. H. Co. (G. E. Co.). Signalling systems.
 18 882 SCHWETTER. Apparatus for working fragmentary materials by electric conductivity. (18/6/20, France).
 18 884 AUTOMATIC TELEPHONE MFG. CO. Telephone systems. (29/11/20, U.S.).
 18 888 MERZ-WERKE (GER. MERZ) & MOLLIK. Annular electrical contact for electric wires. (11/10/20, Germany).
 18 889 MERZ-WERKE (GER. MERZ) & MOLLIK. Incandescent lamp holders. (18/10/20, Germany).
 18 894 FLETCHER & HILL. Electric radiators.
 18 907 RELAY AUTOMATIC TELEPHONE CO. & JOHNSON. Automatic telephone exchanges.
 18 910 KESSLER. Electrically operated tools.
 18 914 SHANAHAN. Adjustable resonant circuits for radio-telegraphic apparatus, &c.

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- 18 929 BRESFORD. Secret wireless communication.
 18 931 HACKING. Electric water-heating apparatus.
 18 955 PERREM. Means for preventing oxidation and volatilisation of contacting parts in induction coils of internal combustion engines.
 18 966 SVENSKA AKKUMULATOR ARTIFABRIKAT JUNGNER. Batteries. (21/6/20, Sweden).
 18 968 B. S. T. ELECTRIC FITTINGS CO., SAUNDERS, THOMPSON & BARNETT. Electric lamp holders.
 17 014 SCINTILLA. Wire-clamping terminal for low voltage installations. (24/8/20, Switzerland).
 17 029 AM-O-METER CO. & SHERRILL. Short-circuit detectors.

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- 17 062 SMITH. Supply of electric current to factories, &c.
 17 073 TUDOR. Electric fireproof holders for half-watt lamps, &c.
 17 105 VANDERVELL & HETTINGER. Reception of electric signals.
 17 106 VANDERVELL & HETTINGER. Photographic recording of electric signals, &c.
 17 114 BREISIG. Determining cross-talk in multipair telephone cables, &c.
 17 115 FELTEN & GUILLEAUME CARLSWERK A.G. Self-induction coils for charging duplicable four-line telephone systems. (25/6/20, Germany).
 17 120 WESTERN ELECTRIC CO. Selectively operable devices for selective signalling.
 17 128 PATENT TREUHAND GES. FÜR ELEKTROISCHE GLÜHLAMPEN. Evacuation of electric lamp bulbs. (22/6/20, Germany).
 17 148 WEST & CO. & BREEZE. Switching devices for electric machines.

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- 17 163 WHISTON. Prevention of interference in wireless circuits.
 17 179 LEFLEUR. Electric controlling devices for prime movers. (5/7/20, Germany).
 17 183 HUMPHRY. Earth connection devices for cables, &c.
 17 200 WILKINSON. Electric transmitter microphones.
 17 224 EASTERN TELEGRAPH CO. & DAVIES. Electric signalling.
 17 236 GOLD. Radio telegraphy and telephony.
 17 246 IGRANIC ELECTRIC CO. (Cutler-Hammer Mfg. Co.). Pressure responsive circuit controllers.
 17 255 ELECTRO-MECHANICAL BRAKE CO. & PATTISON. Control of electric vehicles.
 17 258 PLAUSON. Motors of high frequency electro-magnetic current or electro-magnetic waves. (23/6/20, Germany).

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- 17 265 SHANAHAN. Electric cable connections.
 17 273 KEELAN & RAILING. Speed control of a.c. motors.
 17 297 BÉARD. Mounting electric motor for domestic uses. (26/6/20, France).
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Notes of the Week.

Life Saving at Sea.

AN interesting discussion on the use of life-saving appliances and radio-telegraph apparatus on ships took place at the final session of the International Shipping Conference, which was held in London last week. No one will deny the great importance of the subject or the desirability of adopting every practical and efficient precaution to save lives at sea. As will be remembered, the International Convention held in London in 1914, laid down a code of rules relating to wireless telegraph apparatus and other matters, but owing to the war its adoption was postponed, and some of the countries who have ratified the Convention have since introduced regulations which are in conflict with its principles. In fact, only Great Britain appears to have ratified the Convention without reservations.

Need of Uniform Rules.

It need scarcely be pointed out that any International Convention becomes practically valueless unless the contracting States apply uniform rules for all ships visiting their ports, and the first thing to be done is, therefore, to induce all nations to enforce a code of standard rules which shall be applicable all over the world. It is a hopeful sign that the associations of shipowners represented at the Conference have now undertaken to nominate representatives to serve on a committee which is to report upon the details of such modifications in the Convention of London relating to life-saving appliances and wireless telegraphy, as experience has shown to be necessary. It is also proposed to take the necessary steps to secure the International adoption and application of the suggested modifications by the Governments concerned. We sincerely hope that this committee will be successful in its task, and that such

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alterations will be made in the existing Convention as will make it acceptable to all parties.

Alteration of Wireless Rules Demanded.

THOUGH the problem of saving life at sea has been much simplified by the introduction of wireless telegraphy, it has been proved that the attempt to maintain constant communication by human agency cannot be made effective and, therefore, the International Conference think that an automatic alarm device should be approved and permitted to take the place of the watchers provided in Article 34 of the Convention. If necessary, the Code should also be altered in order that the alarm call can be taken by an automatic device. The legal obligation on ships which are compelled to carry wireless should also be limited to the efficient operation of wireless for life-saving, and a limited knowledge of wireless sufficient for these duties should be a qualification for a certificate to be held by a member of the ship's company, so that no idle men will have to be carried. On the whole, these seem to be reasonable demands, more particularly as there should be no practical difficulty in introducing an automatic device such as that suggested. More than one solution is, in fact, available. It will lead to economy in working, which is an important element in these days of acute International transport competition. Shipowners assert that there is no practical difficulty in maintaining wireless installations or in training personnel to use the Morse code.

Free Market in Wireless Apparatus.

THE shipowners also demand a free market in radio-telegraph installations so long as merchant vessels are compelled to carry wireless apparatus. It is much easier to make this demand than to achieve the desired end. Patents, International trading agreements and other things may interfere with the fulfilment of the claim. Subject, however, to efficiency and regular working, we think the

shipowners are justified in asking for complete freedom in this respect so as to be able to introduce any improvements or amplifications of wireless installations from time to time.

Radio-Telegraphy Only a Second Line of Defence.

WE agree that safety of life at sea depends primarily upon properly designed, well-built ships and upon the skill and experience of commanders. Anything which interferes with the stability and seaworthiness of ships should, therefore, be avoided. The provision of boats and other life-saving appliances should be adequate for all ordinary circumstances: but it is difficult to lay down hard and fast rules on this subject, and a certain amount of latitude should be allowed to naval architects and ship-builders. We think, therefore, that a good case has been made out for a revision of the London Convention.

Municipal Electric Services.

THE organisers of the Public Works, Roads and Transport Congress, which was held at the Agricultural Hall, London, last week, are to be congratulated on the wide range of subjects discussed and on the high character of the Papers presented as pegs on which these discussions were hung. Perhaps we may be forgiven for adding that the best of the Papers (the electrical ones) were given at the end. They comprised two, of both of which we give abstracts on other pages of this issue; one was by Mr. F. AYTON on "Electric Vehicles for Municipal Purposes," and the other by Mr. S. J. WATSON on "The Application of Electricity to Municipal Services." Both Papers gave rise to an interesting discussion, and showed that, though much has been done in these fields of electrical progress, much yet remains which could well be done for the good of both the supplier and the user of the electric service.

The Electric Vehicle versus the Horse.

THE latter of these conditions applies more particularly to the electric vehicle than does the former. The electric vehicle is an application of electricity to which much lip-service is given. It is generally agreed that for many classes of municipal work, such as refuse collection, it can be used with advantage, and experience confirms this view. But there the matter too often ends. For, as Mr. AYTON truly said, one of the greatest drawbacks to the successful use of electric vehicles is apathy—apathy which results in the supply department losing a valuable consumer and the Corporation (and, we might add, the public generally) the economy of the electric vehicle. This should certainly be altered. And, in spite of certain arguments to the contrary, we feel that it can best be altered by more enterprise in the granting of charging facilities by electricity supply authorities, and, next, by careful attention to design and production by the manufacturers. The first is a matter of propaganda, which, as was pointed out in the course of the discussion, might well be taken up by the Electric Vehicle Committee. The latter is a matter to which we have no doubt manufacturers are giving their close attention. Besides the usual directions, propaganda might also be turned to one specific point—the essential advantage of using the electric vehicle to replace the horse. The horse—unfortunate animal—is obsolete, expensive and inefficient. Moreover, it is not only inefficient in itself, but is a cause of inefficiency in others at a time when labour costs are high. To the humane, the continued employment of the horse in streets crowded with motor vehicles is a distressing anachronism unworthy of our

civilisation. And as the "electric" would do the work better and more cheaply, there is no reason why it should not be allowed the chance of doing so.

Cheap Power in Municipal Services.

MR. WATSON'S Paper throws an interesting light on a by-way of municipal electricity supply. How far can—and should—municipal departments go in taking in each other's washing? In other words, how far can the electricity department help the other municipal departments, such as the sewage, refuse disposal, and even the gas departments, by the supply of cheap power? The answer is that they can help a great deal, especially on long hour loads. It is an answer that is not unexpected, and, in fact, is the result of experience in industry generally. But though, as Mr. WATSON is able to show, electricity is being used to a large extent for all these purposes, there are still cases where it might well be applied with economical results. Departmental jealousy in these days of high labour costs and short hours should not be allowed to stand in the way of still further conversions. Incidentally, we are glad to see, by Mr. WATSON'S statistics, that good progress is being made with the employment of electricity in housing schemes, and to hear that there is a general determination, by means of attractive tariffs, to increase the use of current for domestic purposes.

Liability for Damage to Telephone Cables.

WE report in another column an important judgment on the question of the liability for damage caused to telephone cables by leakage from an electricity supply system. It appears that certain telephone cables were laid in Liverpool in 1903, when there were no electric light mains in the subway, but the Corporation claimed that in virtue of a clause in an agreement made in 1896 with the National Telephone Company, they were exonerated from liability to pay damages for nuisance causing loss to the Company or their successor in title, the Postmaster-General. The County Court judge held that the Postmaster-General was bound by the terms of the agreement in question, and that, as there was also negligence in laying the telephone cable, he must be held responsible for the consequences of that negligent act.

Damage Caused by Nuisance.

ON appeal, a Divisional Court has now held that the Postmaster-General is not bound by an agreement to which he was not a party, and which came to an end by the effluxion of time when the Company's licence ended on the transference of their property. Further, the Court was of opinion that the damage was caused by the nuisance committed by the Corporation in laying their electric light mains in close proximity to the telephone cables and, therefore, they were held liable for the agreed amount of the damage caused—a sum of about £40. There is a prospect of a further appeal as to who is to pay this small sum. The costs already incurred must be several times the amount involved, and we hope that the parties will settle the matter amicably, and so avoid the further expenditure of public money in discovering whether the liability is caused by the negligence of the one or the nuisance of the other.

Electric Traction in India.

THE rapid expansion of some of the leading cities in India has brought about such a congestion of traffic conditions that recourse is naturally being had to electric

traction on their suburban lines in order to obtain the desired relief. For instance, we learn from the "Railway Gazette" that, despite the quadrupling of the Great Indian Peninsula Railway Company's system between Bombay and Kalyan, a distance of thirty-two miles, it was found steam locomotive conditions would not permit of the desired increase in the number of trains running into and out of Bombay. It has, therefore, been decided to electrify the whole of the Company's Bombay suburban services. Though the electrification plans have had to be modified in view of the financial situation, they provide for the use of electric traction on the Bombay-Kalyan four-track main line and on the Harbour branch, and also for the construction of a new overhead railway from the Victoria terminus to Reay-road, with the remodelling of the Victoria terminal station. It is probable that the necessary electrical energy will be supplied by the Andra Valley Power Supply Company, an associate of the Tata Hydro-Electric Power Supply Company, which will shortly be in a position to supply about 250 000 h.p. in Bombay from its hydro-electric plant in the Western Ghats, about fifty-five miles away.

Scope of Proposals.

THE work of electrification, which is to be on the direct current system at 1 500 V, will be carried out in three stages, viz., the Victoria terminus-Kurla section, the line from Kurla to Thana, and, finally, the Thana to Kalyan section. On the opening of the Victoria terminus-Kurla line the total hourly maximum load is estimated at 6 650 kW, which will be divided between the Bombay and Kurla sub-stations. On the opening of the electrical working on the second section, from Kurla to Thana, the third sub-station will be brought into use, when the estimated annual consumption will increase from 16 900 000 to 29 000 000 kW. On the completion of the scheme, the total hourly demand will reach 11 600 kW, and the annual consumption 36 000 000 units. It is calculated that on the first electrified section a train mileage of 2 000 000 will have to be worked—a service as heavy as on any electric line in existence, and that within ten years of the change from steam to electric working the hourly maximum demand will be 25 000 kW. It will thus be seen that the Company has undertaken an important scheme of improvements which must have far-reaching results, including the electrification of other sections of the Company's system. Other suburban lines, such as those in Calcutta and Madras, will no doubt have to be similarly converted in order to relieve existing congestion.

The Collection of Water Power Data.

ONE point in the final Report of the Water Power Committee of the Conjoint Board of Scientific Societies, with which we deal on another page of this issue, that needs stressing, is the recommendation that whether we use the water power available in the Empire or not steps should be immediately taken to collect such data as records of river flow, flood discharge, minimum low-water conditions and rainfall over a considerable period. To do this the Committee suggest the formation of a Board on the lines of the Imperial Mineral Resources Bureau, which would make a thorough study of methods of securing and recording water-power data and ensure that this data is collated in a uniform manner. The information so obtained would be kept in London so that information on the water-power resources of all parts of the Empire would be available in a central position. This is a suggestion to which no

exception will be taken, and we hope that it will be converted into fact without delay.

The Complaint of the Telephone User.

THE "telephone shooting" season has commenced, but we fear the sport will not be so good as usual, though our daily contemporaries are doing their best. This time there are no lurid tales of wrong numbers and much-delayed trunk calls, but simply a long-drawn-out variation on the theme that the increased charges have caused the quarterly bills to swell. We are often told that financiers and hard-headed business men are extraordinarily simple in private life, and now we have an illustration of it. But surely Sir VANSITTART BOWATER and the other correspondents of the "Times" are carrying simplicity a little too far in expecting the result would be anything else. It has also been discovered by certain ingenious arithmeticians, who have been given publicity in our contemporaries, that the fewer calls that are made the greater the cost per call. But this peculiar state of affairs applies to any two rate tariff, and can only be remedied by making more calls.

Simple Arithmetic.

IT may be noted for their information that the sale of telephone service cannot be compared to the sale of, say, cigars. Certain facilities are provided for a certain rent, which is designed to cover certain expenses which are incurred, whether the telephone is used or not; so that, while it is quite permissible to lump the fixed and running charges together, divide the sum by the total number of calls made and produce the result as the cost per call, this does not tell the whole truth. For instance, it leaves out of consideration altogether the incoming calls, not to speak of the cost of facilities provided—a fact to which attention has been duly called by the Post Office authorities and upon which scorn has been duly poured by the "Times." This is all so elementary that we feel apologetic for criticising it. Yet the public are taken in by such arguments, and the only result is that the telephone service suffers rather than improves. We agree that the rates are high, and we hope it will not be long before it is found possible to reduce them, but the reduction can only be economically justified when the system is developed to the greatest possible extent. There are certain other criticisms of the Department of a character to which attention was called in our correspondence columns last week, which have more basis in reason and to which those concerned might well pay more attention. But, allowing for the fact that the Post Office, like every public body, suffers for not being obliged to make a profit, its trading operations are not so inefficient as are popularly supposed. At any rate, we suggest our contemporaries might criticise something else. What about the railway company that charged for a can of bait on the ground that it was not personal luggage?

Machinery for Floating Docks.

A PAPER read by Dr. E. H. SALMON before a recent meeting of the Institution of Mechanical Engineers contains some interesting data on machinery used in floating docks. This machinery includes pumps, control gear, auxiliary machinery and berthing gear. In a large dock some 60 000 tons of water may have to be removed from an area of 11 000 sq. ft.—an operation that calls for ten pumps of an aggregate of 200 h.p. Some of the devices adopted to enable a portion of the water to be run off without passing through the pumps are highly interesting, and as much as 20 to 25 per cent. of the whole may be

so treated. There is, however, the drawback that if less work is done in raising the dock a corresponding smaller amount of work is stored up for the subsequent sinking operation, and, in general, a dock with air chambers sinks more slowly. Electricity, when available, can be conveniently applied to pumping operations. With a modern centrifugal pump a constant speed motor is quite practicable, and the three-phase and shunt wound d.c. types of motor have been recently employed. In general, the current is generated on shore and led out by a suitable cable. But in some docks—for instance, in a Black Sea dock of 30 000 tons lifting power—the current is generated on board by two 310 kVA three-phase turbo-alternators. Yet another plan is to generate the power on a floating supply station, and carry it to the dock by cable. Auxiliary and berthing machinery may also be electrical. It is convenient to adopt electric lighting, and compact forms of electric capstans, forming the most important items in berthing gear, are also available. The usual arguments in favour of electric working are also applicable in this interesting case.

Two Policies—and Probable Results.

It is obvious, from the current issue of the "Journal" of the Society of Technical Engineers, that the policy of the Society, to which we referred some weeks ago, has had a "good Press." It will be remembered that the fundamental plank in this policy is the steering of a middle course between the aims of the Trades Unions on the one hand and the aims of the employers' organisations on the other. We may reiterate that, in our opinion, this is the only safe course for a society whose object is to represent the salaried classes to take, and that the more widely this example is followed the better. We are, therefore, sorry to see a tendency on the part of the Electrical Power Engineers' Association to move in another direction. The point has arisen on the question whether the E.P.E.A. should include industrial members within its ranks? These members are really the preserve of the Society of Technical Engineers, but (so we are given to understand from "The Electrical Power Engineer") the latter body has done little or nothing to help them and dissatisfaction is the result. Now, it may be agreed, that members of both bodies have suffered and are suffering from injustices. The E.P.E.A. has succeeded, to some extent, in redressing these injustices by the liberal use of the big stick, but it may be doubted whether in so doing it has added to its reputation. At any rate, it has alienated many from its ranks. The Society of Technical Engineers has, it is admitted, done little up to the present but establish its reputation. And in these days that is something worth doing.

Tramways and Buses—A Little Doubt.

The praiseworthy attempt of the London County Council to increase the revenue of their tramway undertaking by reducing the fares has been followed by a similar downward movement in the fares of the General Omnibus Company. This gives one furiously to think. Is this merely an example of imitative suicide, or have both tram and bus fares been too high in the past? The former can hardly be the true explanation, for, as is well known, the profits of the bus portion of the Traffic Combine have been helping to liquidate the losses on the tube railways, while the latter explanation, in the case of the tramways, at any rate, will hardly hold water. It is significant, moreover, that the reduction in bus fares has only taken place on

routes where there is tramway competition, and where, indeed, the fares have never been increased to the same extent as on the non-competitive routes. It really looks, after all, as if it is one of those cases where competition is of assistance in benefiting the public. Incidentally, there is every reason to believe it will benefit both the tramway and omnibus undertakings.

Reparation and Taxation.

The Federation of British Industries, in the person of their Special Committee on German Reparations, seem to have reached the second stage only in that cycle of emotions which, as we mentioned last week, is generated by Sir HENRY STRAKOSCH's proposals that Germany should pay her indemnity by supplying us with electrical and other goods free of charge. We hope that it will not be long before they pass to the third stage, and that these ill-conceived ideas, whatever their parentage, will be given a much-needed interment. That this interment should speedily take place is not only necessary for the ultimate good, and the present peace of mind, of the British electrical industry, but to save the Federation of British Industries, who already seem as a body more than a little doubtful about the proposals of their committee, from the charge of inconsistency which might otherwise be levelled against them.

The F.B.I.'s Attitude in 1918—

That this charge, if made, cannot altogether be denied is evident from a comparison of the attitude of the Federation on the reparations question in December, 1918, and at the present day. In 1918 the Federation's opinion, as enunciated by the President, Sir VINCENT CAILLARD, was that the cost of the war and of such post-war reforms as housing, increased wages and reduced hours of labour should be borne by "those nations solely responsible for the war." If, Sir VINCENT stated, the enemy Powers were unable to meet this debt by an immediate capital payment, its collection would have to extend over a considerable period, and it would then be necessary to safeguard such payments by placing specific revenues at the disposal of an inter-Allied Commission. Payment in kind, Sir VINCENT continued (and this is important), either by raw materials or in the form of replacement of property, should only be permitted under safeguards which would effectually prevent any possible injury to the development of industry and employment in the Allied countries. The [inter-Allied] Commission should be empowered to refuse any manufactured articles which could be supplied by Allied countries.

—And in 1921.

In 1921 the view of the Federation, as disclosed by the Reparations Committee and to some extent confirmed by the discussion which followed the annual general meeting last week, is that the reparation scheme in its present form is incapable of fulfilment. More, to attempt to fulfil it would lead to the collapse of Germany and end in our getting nothing. Some modification in the present system of payment is, therefore, necessary, and as payment cannot take place in cash, but must take place either in goods or service, it is of the highest importance that the character and amount of goods should be adjusted to ensure the development of the Allied industry. This adjustment, the Committee consider, can best be effected by making German industrial enterprises, real property-holders and such undertakings as railways

and canals, create special preference shares or first charges, which will be handed over to the Allied Governments for disposal among individuals. In this way not only would existing private debts be met, but the annual payment on the reparation account would be automatically adjusted according to the capacity to pay, a permanent obligation would be erected on good security and a measure of control over German industries would be obtained.

German Co-operation Demanded.

Further, the Committee recommend a stricter regulation of the classes of goods exported by Germany so as to avoid, as far as possible, injury to Allied industries. This, we agree, is most essential, but it is a little contradictory of their other proposals and of their benison on a scheme which has a distinct family likeness to that of Sir HENRY STRAKOSCH. Finally, they consider that an endeavour should be made to enlist the assistance of German financial and industrial interests in carrying out the scheme. This, we fear, is idealism unadulterated.

A Menace to Industry.

Now we might argue against these proposals on the sole ground of inconsistency. But we have no desire to do that, for these new recommendations are so wide and far-reaching that the data on which they are founded, and the results which are likely to arise from their adoption, deserve careful consideration for their own sakes and for the future good of British industry. In connection with Sir HENRY STRAKOSCH's proposals, we have already expressed our opinion on both these points, and the arguments of Sir PETER RYLANDS put forward at the meeting to which we have referred—arguments which, we are told, are his own alone, and not, we are glad to learn, either the Federation's or the Reparation Committee's, do not reconcile us any more closely to the scheme as it stands. The STRAKOSCH plan is a real danger to the electrical industry, and is in a greater or less degree a menace to the industries with which the electrical industry is more or less closely connected. So great a menace is it that we have thought its character would have been universally evident to British manufacturers, yet we find Sir PETER RYLANDS suggesting that Germany should build "super-power" stations for us because at present there is no chance of our being able to build them for ourselves on account of the cost. The argument, however, is of very much wider application, and it may well be asked, except as a set-off to the reparations debt, what the good of numerous German designed and erected super-power stations would be to Britain if we allow the German to supply us with products that we cannot for the moment obtain for ourselves? Our industries would, in fact, be so undermined that we should not require more than a very small quantity of electricity to keep them going. Our technical knowledge and the enterprise of our engineers would not be required; our skilled workmen would be reduced to labourers. We should become helots rather than brain workers at a time when it is necessary that all our skill should be developed. This would be the ultimate and speedy result of the RYLANDS-STRAKOSCH proposals. If super-power stations must be erected and railways electrified, they should be erected and electrified in Germany with German capital and the revenue from them handed over to us.

One Way Out.

It is perhaps no part of our duty to sail the troubled waters of high finance and suggest methods of obtaining reparations from Germany which shall not at the same time ruin our own industries. But a sentence in some

remarks made by Mr. GODFREY ISAACS, in the discussion on the proposals we have just outlined, do, we think, give an indication of one solution. The German people, Mr. ISAACS said, although they lost the war, were not paying for it . . . and only when every man in Germany was paying a proper share of taxation for the payment of indemnities and reparations would the exchange improve and conditions move towards normal. To require that Germany should increase her taxation seems to us to offer better chances of obtaining reparation and a greater chance of stabilising the exchange and preventing undercutting than payment in kind can ever do.

Reduction in Taxation Essential.

At the same time, British industry can in very great measure be assisted by a reduction in our own rate of taxation, and we are glad to see that this point was insisted upon by Sir PETER RYLANDS and in a statement made by the new President of the Federation, Colonel O. C. ARMSTRONG, to "The Times." Only last week we called attention in these columns to the drag on progress that our present imposts were causing. Since then we have had an opportunity of learning from many sources that the electrical industry is, in particular, suffering from this obstacle to development. The exploitation of foreign business particularly is prevented, but confidence in the extension of credit in future is also undermined, orders are reduced owing to financial stringency, reserves are depleted and remain unfed, and fresh capital for development is becoming increasingly difficult to obtain. It is no wonder, then, that the cost of raw materials and finished equipment remains high and that the price of electricity shows no signs of falling. It would be extraordinary were it otherwise, but this state of affairs will be more quickly relieved by reducing our own taxation than by allowing Germany to supply us with goods.

The Coat and the Cloth.

It has been represented to us that we must expect high taxation, as the war costs must be met in some fashion or other. We agree. But an appreciable proportion of the country's present revenue goes not in meeting war costs, but in maintaining inflated Government departments and in financing schemes of social amelioration which, however attractive they may be in theory, cannot be afforded in these days of stringency. It is that kind of expenditure which must be cut off, so that the cost of administering the country can be reduced to a minimum. This will only be done by increasing pressure, by watching and acting rather than by grumbling and paying. We are glad to learn that the Federation of British Industries have not yet approved the proposals of their Committee, and have not yet had an opportunity of discussing Sir P. RYLANDS' application of its principles to the electrical industry. We hope that further thought will lead to a reconsideration and the production of some scheme which, while extorting a just tribute from Germany, will not harm our own industries.

We note that Colonel ARMSTRONG, in his attempt to calm the storm which has arisen on the RYLANDS-STRAKOSCH proposals, ascribes the present condition of trade to a want of confidence in the future. Confidence, in the electrical industry, at any rate, is not likely to be restored while such ill-conceived plans as those which we have just been criticising continue to be put forward by our commercial magnates. We are told that in making these suggestions Sir PETER RYLANDS was only searching for striking examples to illustrate his meaning. He has certainly succeeded in doing that.

A RESEARCH ON INSULATING OILS.*

The Best Form of Spark Gap for Electric Strength (Breakdown Voltage) Tests.

By E. B. WEDMORF.

The problem of the best form of spark gap for breakdown voltage tests is one of those arising out of researches initiated by the Institution of Electrical Engineers which have been transferred to the Electrical Research Association, and, owing to the importance and immediate value of the results obtained, it has been decided to make some of these public in advance of other information.

These results lead to the conclusion that spherical electrodes should be employed, and it is recommended that they should be 0.5 in. in diameter and spaced 0.15 in. apart. Such electrodes prove to be very sensitive to the presence of contaminating particles of moisture and fibrous and other material. The use of spherical electrodes admits of an accurate calculation of the maximum stress to which the oil is subjected.

Two Facts of Importance.

The Association is indebted to Mr. A. R. Everest and the British Thomson-Houston Company, Ltd., for a valuable contribution to this subject, contained in a report summarised below, which establishes two facts of the first importance:

(1) That the different forms of electrodes show widely different

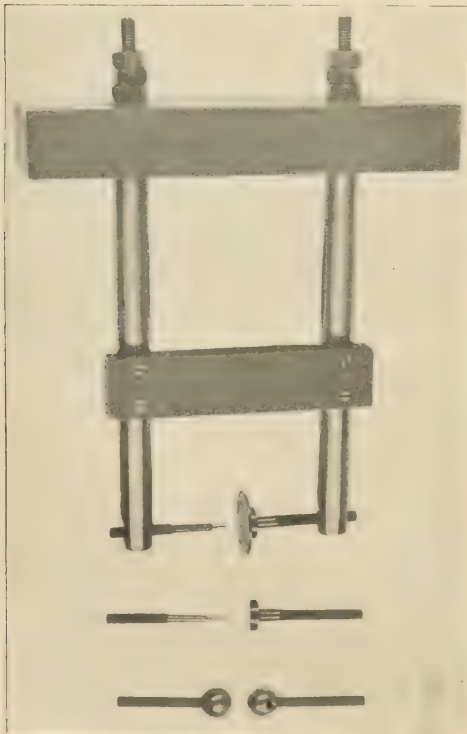


FIG. 1. ELECTRODES USED IN PRESENT INVESTIGATION.

degrees of sensitivity to the presence of contaminating matter. The uniformity of results obtained by the use of a needle-point electrode is proved to be due to want of sensitiveness of such an electrode to the presence of contaminating matter, and therefore indicates the unsuitability of this type of electrode for the purpose in question.

* Communicated by the British Electrical and Allied Research Association.

(2) That the relationship between the test results obtained with different kinds of electrodes cannot be expressed by fixed ratios, because the results are dependent upon the quality of oil tested, with special reference to the amount of contaminating matter it contains.

Spark Gaps for Testing the Electric Strength of Insulating Oils.

As regards the influence of the form and dimensions of spark gaps on the observed breakdown voltage in oils, various types and settings of spark gaps are in use for commercial testing. These are principally: $\frac{1}{2}$ in. discs

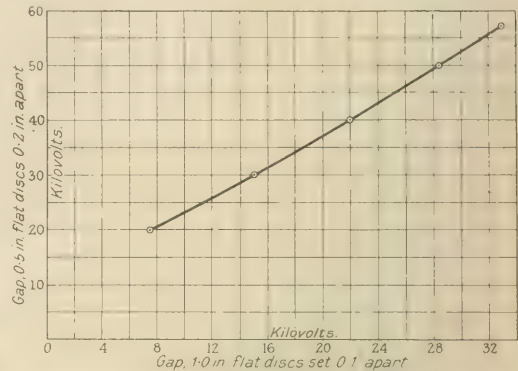


FIG. 2. CURVE PREPARED BY THE G.E.C. CO. (U.S.A.) SHOWING DIFFERENCE BETWEEN STANDARD OIL TESTING GAPS.

TWO $\frac{1}{2}$ IN. DISCS SET 0.2 IN. APART.

TWO 1 IN. DISCS SET 0.1 IN. APART FOR A GIVEN OIL.

spaced 0.2 in. apart, 1 in. discs spaced 0.1 in. apart, $\frac{1}{2}$ in. spheres spaced 0.15 in. apart, needle points and point and disc. It was desired to ascertain the relation between them and the relative merits of each type.

Examination of the Various Results.

Table I. shows the results obtained by various investigators (including the present investigation) with several different types of electrodes, and in each case with a gap setting 0.15 in. The tests, the results of which are given on the attached curves, are arranged in the order of goodness of the oils indicated by the sphere-gap tests.

Table I. R.M.S. Breakdown Values with a Common Gap Length 0.15 in.

Investigator.	$\frac{1}{2}$ -in. Spheres. Gap 0.15 in.	$\frac{1}{2}$ -in. Discs. Gap 0.15 in.	Needle Points. Gap 0.15 in.	Point & Plate. Gap 0.15 in.
Tubey, 1910 (1)	—	—	18 000	16 500
Digby & Mellis, 1910 (2)	11 500	—	17 500	11 000
Present Investigations	20 000	20 000	22 000	18 500
American National E. L. Assn. Transformer Standard (3)	40 000	29 000*	—	—
Peck (4) Specially dried and filtered oil	64 000	31 000†	22 000	—
Hirobe (5) Specially dried and filtered oil.	92 000	62 000	—	15 000

(1) A.I.E.E., Vol. XXIX., 1910.

(2) I.E.E., Vol. XLV., 1910.

(3) Report of the electrical Apparatus Committee, National Electric Light Association, June, 1917.

(4) G. E. Review, August, 1915, and elsewhere.

(5) Electrical Insulating Properties of Transformer Oil, Report No. 25 of the third section, Electrotechnical Laboratory, Tokio, Japan.

* The N.E.L.A. (Ref. 3) gives 40 000 V with $\frac{1}{2}$ in. spheres as equal to 22 000 V with 1 in. discs spaced 0.1 in. apart. Other determinations show that this corresponds to 29 000 V with $\frac{1}{2}$ in. discs spaced 0.15 in. apart.

† Peck states that the oil gave 41 000 V R.M.S. tested between $\frac{1}{2}$ in. discs spaced 0.2 in. apart.

By examination of the above figures it will be seen that the effect of thoroughly drying and filtering the oil shows up to the most marked extent in tests with sphere gaps, to a somewhat lesser extent with discs, whilst tests with

fibrous dust, the following precautions were taken to remove such dust left on the electrodes and the inside of the containing vessel after cleaning them with cotton cloths: A small quantity of oil was introduced into the

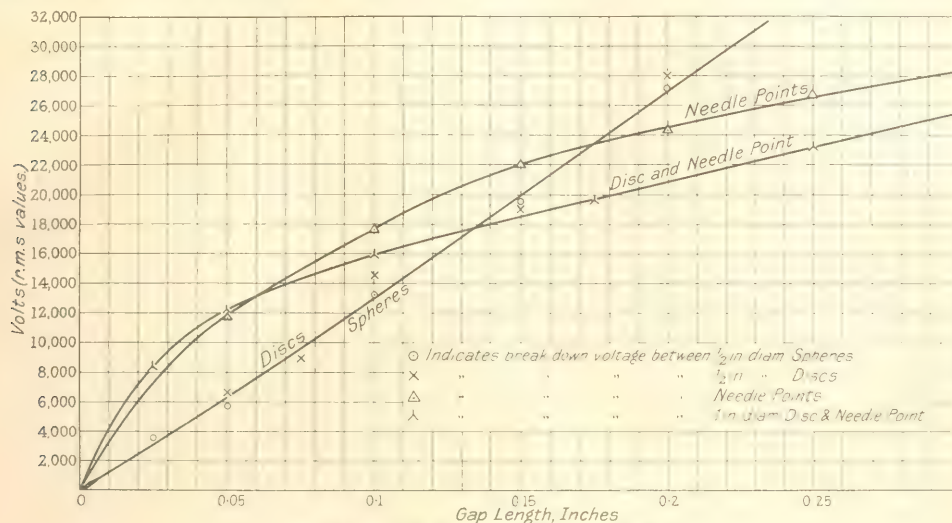


FIG. 3.—CURVES SHOWING OIL SPARK-GAP TEST.

needle points or point and plate do not indicate the quality of the oil as regards wetness or dirt.

The relative values of results obtained with different types of electrodes on a particular oil depend, therefore, upon the quality of the oil itself.

The Present Investigation.

The present investigation was initially undertaken to establish a basis which would permit the correlation of measurements taken with different types of spark gaps upon commercial oils.

The conditions were, therefore, arranged to secure the following features: (a) A good commercial grade of oil; (b) neither unduly dry nor unduly wet; (c) uniformity in quality throughout the tests; (d) precautions to avoid false results due to foreign matter on the spark gaps and testing vessels; and (e) tests with each type of spark gap to cover a working range up to about 30 000 V.

Oil Tested.—The oil used was the Vacuum Company's Gargoyle A.F. in the condition as received; it was brought to the laboratory in two 5-gallon steel drums, which had been properly cleaned, dried and filled from one large drum.

The Electrodes.—The electrodes used, as shown in Fig. 1, were two $\frac{1}{2}$ in. spheres, two $\frac{1}{2}$ in. discs, two needle points and a needle point with a 1 in. disc. The sphere and disc electrodes were of brass, mounted on brass rods tapped with a No. 2 B.A. thread. The needle point electrodes consisted of gramophone needles ("His Master's Voice") held in split brass tubes. These needles proved to have points with a radius of 0.0018 in. New needles were fitted after each breakdown, except in one or two tests with the 0.05 in. gap. In the case of the spheres, fresh points on the surfaces were brought opposite each other after half the total number of breakdowns had been made. The lengths of the gaps were adjusted to hardened-steel gap gauges. In all cases the common centre line of the electrode was horizontal.

The Containing Vessel.—The tests were made in a small rectangular glass cell, the oil being 1 in. above the electrodes.

Cleaning the Electrodes and Container.—The dielectric properties of oil being much affected by the presence of

containing vessel and the gap between the electrodes adjusted. The potential of one of the electrodes was then raised as high as possible without causing a breakdown in the oil in order to attract the dust particles to the electrodes

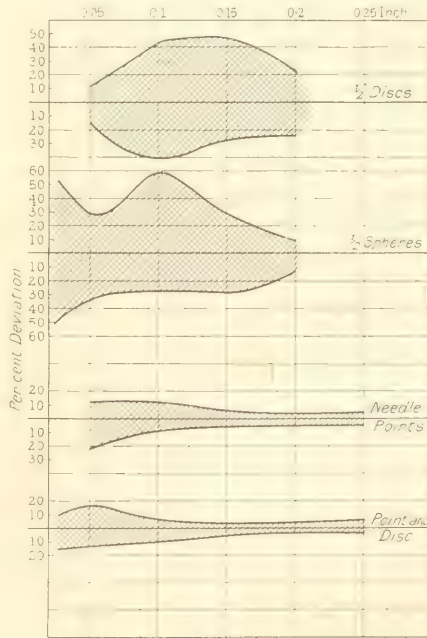


FIG. 4.—CURVES SHOWING PERCENTAGE DEVIATIONS OF INDIVIDUAL READINGS FROM THE MEAN.

and into the region between them by the electrostatic force. After about a quarter of a minute the electric potential was removed, the electrodes taken out and washed

by pouring fresh oil over them, and the oil in the containing vessel poured away.

This process of collecting and removing the dust particles was repeated two or three times after the cleaning of the electrodes with a cotton cloth, after which from 20 to 25 breakdown tests would be made before the electrodes were again cleaned.

Procedure of Test.

The R.M.S. value of the breakdown voltage was recorded for each oil sample, and only one breakdown was made with a sample. The mean of ten such readings with a particular gap length was taken as the breakdown voltage corresponding to that gap length. The voltage at which the first preliminary spark passed in each sample was also observed: with the two needles and needle disc electrodes

General Deductions.

Spheres and Discs.—Two $\frac{1}{2}$ in. discs and two $\frac{1}{2}$ in. spheres at the same spacing have practically equal values for oil not abnormally dry and clean and within the range of test values generally employed in commercially checking the quality of the oil.

As indicated in Table I., spheres give higher values than discs for oil which is extremely free from moisture and dirt.

Half-inch Discs and 1 in. Discs.—The relation between $\frac{1}{2}$ in. discs spaced 0.2 in. and 1 in. discs spaced 0.1 in. apart has been carefully determined by the General Electric Company, U.S.A., for oil in commercial condition, and is shown in curve Fig. 2.

Needle Points.—For small settings (below 0.18 in.) these

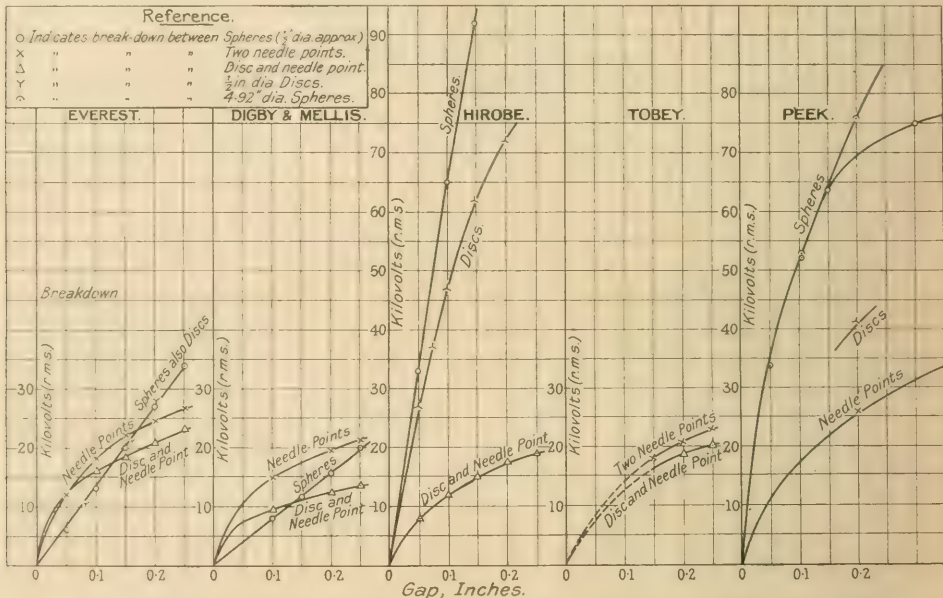


FIG. 5. COMPARATIVE CURVES SHOWING VARIATION OF BREAKDOWN VOLTS IN OIL WITH LENGTH OF GAP.

the sparking was violent and almost continuous at potentials just below the breakdown value.

Results of the Test.

The average breakdown values are shown on curves in Fig. 3, each point being the mean of ten readings. Both the breakdown and preliminary sparking values are shown in Table II.

Table II.—(Continued) Values Observed (R.M.S.).

Spacing.	B.D.—Breakdown		P.Sp.—Preliminary Sparking			
	$\frac{1}{2}$ -in. Spheres.	$\frac{1}{2}$ -in. Discs.	Needle Points	Point & Plate.	B.D.	P.Sp.
0.025 in.	3 570	2 940	—	—	8 430	7 075
0.05 "	5 712	4 354	6 510	4 680	11 950	8 140
0.075 "	—	—	8 950	6 220	—	8 256
0.100 "	13 185	7 583	14 500	7 380	17 760	13 500
0.15 "	19 530	11 140	19 060	11 070	22 090	16 300
0.175 "	—	—	—	—	19 660	14 680
0.200 "	27 100	15 340	27 900	22 080	24 100	18 750
0.250 "	—	—	—	—	26 730	20 390
					23 340	17 360

In order to determine the errors which might be introduced by burning of the needle points by spark or otherwise, a special test was made, from which it was found that the burning of the needle point by arcing does not sensibly affect the result so long as the spacing is maintained.

give higher values than discs or spheres at the same spacing. For spacings above 0.18 in. the results with needle points are seen to be lower. As indicated in Table I., tests with needle points do not indicate the quality of the oil as regards wetness or dirt.

Point and Plate.—For small spacings and with the plane of the plate vertical these give results very similar to needle points. Examination of numerous records shows that results in general depend largely upon the diameter of the plate (particularly with other than small spacings) and also upon the position of the plane of the plate, i.e., whether horizontal or vertical.

Irregularity of Readings.—Curves in Fig. 4 show the per cent. deviations of the individual readings from the mean of each set. It will be seen that with oils of the character tested the widest deviations occur when tested with spheres or with plates, while readings with needle points (or point and plate) are much more uniform. This is associated with the fact noted above, that tests with needle points do not indicate the presence of moisture or impurities.

Preliminary Sparking.—The observed values of the first preliminary sparking (P.Sp.) are shown in Table II. When testing between needle points, or between point and disc electrodes, the sparking was violent and almost continuous at potentials just below breakdown value.

The Use of Electric Vehicles for Municipal Purposes.*

B. F. AYTON.

In spite of the great progress made in the last seven years in convenient electric vehicle design, motor transport work in this country is still mainly served by vehicles driven by either steam or internal combustion engines. This may be due partly to the fact that the types mentioned were in possession of the field some time before the modern and highly efficient electric vehicle appeared, and partly to a conservative attitude. To local authorities, who are now faced with the insistent need for economy, the use of electric haulage services should specially appeal. In general, local authorities obtain, for the purchase of motor transport vehicles, loans from Government Departments which must be repaid within seven years. Accordingly anything purchased on such a basis should comply with the following requirements:

(a) Its assured useful life should be at least equal to the loan period, and obtained without abnormal cost for upkeep and repairs.

(b) There should be some degree of certainty that, apart from wages, the cost of working and efficiency will not greatly vary during the useful life.

Requirement (a) is met only in two types of vehicle, *i.e.* those driven by steam and electricity. The electric has an assured life, in ordinary usage, of at least ten years. There are in this country many electric vehicles still running efficiently which were put into service seven years ago, and the author quotes confirmatory experience in America. Thus Mr. La Schum, of the American Railway Express Company, reports a period of useful service of eleven years, and believes that modern vehicles could be operated economically for twenty years.

As regards condition (b) the electric vehicle draws its power from the public electricity supply system. Before the war charges for electrical energy for power showed a steady downward trend. The advance during the war has been much less than for many other commodities, and before long a diminution in cost should again become feasible. On the other hand, internal combustion engines depend on an imported commodity, petrol. There is reason to think that in the near future there may be a world-wide petrol famine and greatly increased prices. In any case, the cost is liable to great variation and the future is uncertain.

Cleanliness and Reliability.

Another advantage of the electric vehicle is that it is clean and odourless. In reliability it takes first place. In this connection favourable experiences in Wolverhampton and Willesden are quoted. Mr. La Schum reports that his company find it feasible to operate electric vehicles for 280 and even 300 days in the year. Moreover electric vehicles are much less affected by severe cold and weather conditions. Thus it was recorded in the "Buffalo Times" of Feb. 29, 1920, that, whereas 75 per cent. of petrol cars were left in the garages during severe weather, not one electric car in fifty was laid up during the winter.

Low Cost of Operation.

The most important advantage of the electric vehicles is low cost of operation. Thus Mr. W. E. Low, Council Engineer to Pontypridd, finds that the cost per ton of collecting refuse by electric 2-ton and Ford 1-ton vans was 6s. 5½d. and 8s. 3½d. respectively. The total expenses for petrol, repairs, renewals, cleaning, &c., was 18 per cent. higher in the case of the Ford car. It has been contended that for journeys up to three miles in length there is still an advantage in horse haulage; but for longer distance electric vehicles are undoubtedly cheaper. For house-to-house collection work the electric car cannot be approached by petrol vehicles. Electric cars have been very widely used for refuse collection. Here good road surfaces and proper use of the vehicle are important. On normal road surfaces a total mileage of 50 to 45 may be obtained. But if a vehicle has to travel across fields to get to the tip the total mileage per charge is naturally reduced, and an undue strain may be put upon the vehicle. In using a labour-saving vehicle it is also naturally important to arrange for a maximum number of working hours in the day, and the author, as an illustration, describes the "continuous" system used by Mr. J. Jackson, the superintendent of the Birmingham Salvage Department. Very favourable results are reported from Bootle and also Blackpool, where the use of electric vehicles for street-watering was stated in 1919 to affect a saving of £20 a week for each motor. Several municipal tramways departments use electric tower wagons, important advantages being the reliability of the vehicle in the event of an emergency call, and the ease with which an employee can be taught to drive it.

'Buses v. Trackless Trolley.

Electric omnibuses are in use at Derby, Lancaster, South Shields and York. While such vehicles have proved economical in working,

*Abstract of a Paper read before The Public Works, Roads and Transport Congress (1921).

they are, in the author's opinion, lacking in sufficient speed. However, in the near future it may be possible to put on the market electric (battery) buses much more speedy than those now running. In this connection one has also to bear in mind the advent of "railless" buses operating from overhead trolley-wires, examples of which are to be seen at Bradford, Leeds, York and elsewhere. While lacking the mobility of the petrol or electric (battery) vehicle, and confined to long stretches of roads equipped with trolley-wires, these buses have good prospects. With electricity at not more than 1½d. per unit, and a sufficient volume of traffic, they would doubtless prove financially successful.

At the present time municipalities own and operate a total of 413 electric vehicles, and, in an appendix to his Paper, the author gives particulars of types owned by various towns. A second appendix summarises favourable opinions received from a large number of city engineers, surveyors, &c., who were asked to reply to a circular inquiry on the subject.

In introducing the Paper, Mr. AYTON said that one of the greatest drawbacks to the successful use of electric vehicles was apathy. As a result, the electricity supply business was losing a valuable customer and the Corporation Departments were losing the economy of the electric vehicle.

Experiences at Sheffield.

Mr. J. A. PRIESTLEY (Cleansing Superintendent, Sheffield) said that Sheffield bought its first electric vehicle in 1915 and had been adding to them continually ever since. In addition to forty-five electric vehicles used entirely on refuse collection, they had an electric tower wagon for tramway purposes, and an electric vehicle for taking testing weights, for weights and measures, about the city. Last year they removed 59,000 tons of refuse by electric vehicles at a cost of 9s. 8d. per ton against 11s. 6d. when the work was done by horses. Last year the vehicles travelled 123,700 miles, and the consumption of electricity was about 1½ units per mile travelled. The charge was 1½d. per unit and these vehicles were consumers to the extent of 250,000 units, which represented £1,400—a by no means small revenue for the electrical department, especially considering that the charging could go on at a time when other demands were small. Therefore, it paid the electrical engineer to afford facilities for charging these vehicles. He had found the cost of removing refuse by electric vehicle cheaper than any other method—horses, petrol or steam—and he had tried them all. The radius of action of the electric vehicle depended entirely upon the local circumstances. In Sheffield he had found that if the radius of action was more than 3 miles, then the horse was a strong competitor, but within the 3 miles, then the electric was easily first. Noiselessness and cleanliness were two important points. He had had some vehicles working day and night for five or six years, and the reliability was all that could be desired. His figures were not quite as good as those quoted in the paper for Willesden, but in that case the vehicles were new, whereas his had been in use for some years. Nevertheless, he maintained the service at 90 per cent. efficiency, and the same could not be said of petrol vehicles which had been in use the same length of time.

Mr. A. J. MAKOWER (Mossay & Company) gave particulars of tests carried out by Capt. Cable of the Westminster City Council with an electric vehicle on refuse collection. Capt. Cable challenged the statement by Mr. Ayton that the electric vehicle had an assured life of ten years. On the figures in the Paper the life seemed to be about six and a half years. He agreed with the author that present conditions were such as to tell heavily in favour of electricity. At the same time, he had been quoted low terms for non-trust consignments of petrol. The thirty-seven expressions of opinion favourable to electric vehicles in the Paper were hardly conclusive in favour of electricity as against petrol, and he gave some figures to show that the advantage was on the side of the petrol vehicle. Mr. Makower added that it should be taken into account that the Westminster City Council was in the position of being able to get petrol at very low rates, and also the conditions were exceptional, because there were heavy loads and few stops. These figures could not, therefore, be applied to other districts where the conditions were different, as they mostly were. Moreover, current was charged at 2d. in this case, whereas in many districts it would be 1½d. per unit.

Electricity v the Horse

Mr. CURTIS thought the discussion was going in the wrong direction. There was too great a tendency to compare the electric with the petrol vehicle, whereas it was the horse they wished to eliminate and with which they should make their comparisons.

Mr. H. W. WIGFIELD (Cleansing Superintendent, Islington) thought it was time that electrical engineers and councillors took a deeper interest in this subject. In Islington they had spent £5,000

in building a garage and another £5,000 approximately for plant for charging eleven electric vehicles. The cost of this plant was 18s. 2d. per vehicle in wages alone, and as the Islington Electricity Department charged 23d. per unit, it was found that each of the vehicles were costing £12 per week without allowing for maintenance, tyres, insurance or drivers' wages. In other metropolitan boroughs the prices varied from 1d. to 23d.. With this apathy on the part of local authorities and electrical engineers it was impossible to compete with other forms of transport. He suggested that the first task of the Electric Vehicle Committee should be to see that every large borough and city provided means for charging vehicles at a uniform and economical rate and without undue difficulty before they asked the public to take up these vehicles. Then the electric vehicle would come into its own and prove its advantage over other forms of transport, and the propaganda of the Electric Vehicle Committee would be largely unnecessary.

Mr. H. G. WHYATT (Borough Engineer, Grimsby) said conditions in Grimsby suited the electric vehicle. The Superintendent of Cleansing told him that in two months he had collected 528 loads of refuse, running 1 848 miles, or 3 1/2 miles per load. Grimsby was slow in adopting mechanical haulage owing to the fact that it could get, before the war, cheap labour, cheap horses, and cheap food. Experience with electric vehicles showed that in two months they saved 1s. 10d. per ton in collection, which was equal to a 23d. rate. When the whole scheme got into working order he anticipated a saving of something like 2s. 6d. per ton, or a 3d. rate.

A Word of Warning.

Mr. A. W. BLAKE (Borough Electrical Engineer, Willesden) said it was essential for salesmen to exercise caution in approaching prospective users of electric vehicles and not to sell vehicles for work for which they were unsuited. They should remember that a 5 ton van cost no more for garage accommodation or to drive than a smaller one and the advantages of having the larger vehicles were enormous. He was running certain 5 ton vehicles, and a number of 15 cwt. vehicles, for house-refuse collection. Such a 15 cwt. vehicle collecting refuse took 1.25 units per mile, while a similar vehicle working in the electricity department, and making longer runs, used 0.98 unit per mile run, and certain 5 ton vehicles running, roughly, 20 miles per day, used 1 1/2 units per mile run, so that a 5 ton vehicle was an attractive proposition when they had a definite duty

for it to perform. The collection of house refuse in Willesden cost 8s. 1d. per ton, inclusive, with the exception of barging away. As regards efficiency, the loss of time with petrol vehicles was out of all proportion to that of the electric. It was essential to maintain skilled attention on electric vehicles. Some of his vehicles had been running two and a quarter years, and he was getting 90 per cent. of the original rated capacity of the batteries out of them to-day. His experience was that it paid to have a large battery capacity on the vehicles, but in selecting the size of battery attention must be paid to the circumstances in which it is to be used.

The First Cost Question.

Mr. T. P. WILMSHURST (Borough Electrical Engineer, Derby) remarked that very little had been said about the initial cost of the vehicles. This was far too high, and he asked battery makers and chassis makers to come together to see if they could not produce something which was far more competitive in price with the petrol vehicle. He saw no reason, too, why an electric 'bus should not be got out for short routes which would compete with the petrol 'bus. Then there was need in municipal service for a cheap runabout which would compete with the Ford car, for town work only.

Mr. L. L. ROBINSON (Borough Electrical Engineer, Hackney) said it was very difficult indeed, until they got some work to do, to make a charging station anything but an annual loss. One of the troubles was that the energy could not be poured into the vehicle like petrol was, and the charging station could not be a paying proposition until there were something like a hundred vehicles to deal with. To find the space for that number of vehicles to stand for six or eight hours was an expensive matter in London, and the manufacturers must try and get out a type of battery that could be charged alone and exchanged from vehicle to vehicle. The next point was the voltage. He believed 80 V was the standard for batteries on vehicles and he had no doubt the Electrical Vehicle Committee had settled on that with a view to getting uniformity throughout the country, so that vehicles could go from place to place and always be sure of getting a charge. It would be economical if vehicles, especially those for certain purposes, such as refuse collection, could be provided with suitable batteries and with motors suitably wound so that they could be charged off the standard pressure of the district, by means of resistances, and so avoid wasteful motor generators.

The Application of Electricity Supply to the Municipal Service.*

By S. J. WATSON.

With a view to obtaining statistical data an inquiry was addressed to the chief electrical engineers of 198 local authorities, the total population being 20 103 000. Replies were received from 168 authorities (population 12 530 000), and the information received is grouped under the headings of electric lighting, motive power used by public utilities undertakings and other municipal services, power other than electric used by other municipal services, electric and non-electric vehicles, electricity supply undertakings.

Street lighting is regarded as important as affording an optical demonstration of the value of electric lighting. The statistics relating to this and other forms of lighting are assembled in Table I. It is noteworthy in connection with housing schemes that, according to replies received from eighty-four towns, 41 663 houses are or will be electrically lighted, the average annual consumption being 104 units per house. It is questionable whether so low a consumption affords sufficient revenue to cover the cost, in view of the heavy expense incurred in providing underground mains and services.

Table I.—SUMMARY OF ELECTRIC LIGHTING.

Streets.		
Number of electric lamps or groups	.. ..	55 632
Miles of streets	.. ..	1 873
Units per annum	.. ..	22 601 000
Buildings.		
Public buildings	.. ..	1 640
Schools	.. ..	1 158
Housing schemes	.. ..	41 663
	Number.	Units per annum.
	.. ..	9 847 000
	.. ..	1 944 000
	.. ..	4 334 187

Gas Undertakings and Electric Power.

In regard to the use of motive power it is remarked that gas undertakings tend to make fuller use of electric motors. In thirty-three gas works owned by municipalities 296 motors are in use with an aggregate of 4 620 H.P. Many steam-driven pumping engines used by waterworks are excellent examples of slow-speed design, in view of the long period that has elapsed since their installation, but they are now costly to instal in comparison with modern plant

and occupy relatively large ground space, and in course of time should be replaced by electric pumping. Electric motors have been largely used in connection with sewage works, of which fifty-six use electric supply, having 289 motors of 5 851 H.P. consuming 4 522 422 units per annum. Streets and Refuse Departments, &c., account for 347 motors. Cold storage and public bakeries, also, use electric supply to a material extent. Amongst miscellaneous applications one enterprising authority uses a 15 H.P. motor or pneumatic drill for grave-digging!

The following summary is of interest:

Table II.—SUMMARY OF ELECTRIC MOTOR POWER.

	Number motors.	H.P.	Units used.
Gas department		296 ..	4 620 ..
Water department		72 ..	3 480 ..
Tramways department (car-sheds)		302 ..	3 130 ..
Sewage department		289 ..	5 851 ..
Ice-making, &c.		131 ..	2 870 ..
Bakeries		285 ..	1 667 ..
Town's yard, &c.		347 ..	4 365 ..
Other purposes		159 ..	797 ..
	1 881	26 780	20 638 160

Tramways are fully dealt with in "Garcke's Manual." In the year 1918-19 there were 1 705 miles owned by local authorities, 1 015 by companies, the total capital expenditure being £82 843 000. The total number of units used was returned as 568 100 000, the passengers carried 4 557 600 000, and the car-miles run 320 378 000.

A table is given of comparative amounts of power supplied by steam, gas and other power for miscellaneous services. The total H.P. amounts to 28 834 of which the greater part is steam (23 510).

Finally, a brief review is given of vehicles. Of a total of 1 468, 281 are electric, 254 steam, and 933 oil. The majority of these vehicles are used in connection with towns' yards, streets, &c., refuse removal, or by fire brigades.

Since writing the paper, Mr. WATSON said he had heard from the engineer of a large urban district council that, owing to the high value of refuse it was possible to generate between 4 and 4 1/2 million units per annum and sell them to a power company. In 1919 one unit

*Abstract of a Paper read before the Public Works, Roads and Transport Congress (1921).

of electricity was generated for 8 lb. of refuse. There were some undertakings in the country where it would be difficult with the plant available to generate one unit for 8 lb. of coal. The amount of refuse burned in the case mentioned was between 25 000 and 26 000 tons.

Pumping and Gasworks.

Mr. F. M. LONG (City Electrical Engineer, Norwich) said that an electric motor was being used now instead of gas-producers at the pumping station. It was the intention to use the motor during the night and on Sunday, and make it entirely automatic so as to save wages, but the automatic arrangements were not very successful on account of the motor being a long way from the generating station, $1\frac{1}{2}$ miles. It had, therefore, been decided to replace the d.c. motor with a three-phase motor which would be supplied from the 6 600 V supply, and there would be a saving of £1 162 over the present arrangement with current at 1d. per unit, a remunerative price considering the character of the load. A good deal of electric power had also been used at the gas works at Norwich for many years. This power had been generated by means of gas engines, but now that the works had been almost entirely rebuilt there was not much room to spare; the gas manager had asked the electricity department to give him a supply, partly to save capital expenditure and partly on account of lack of space. The consumption of the gas company was about 40 000 units a year. With regard to housing supplies, it was difficult to deal with them because the demand was so very small, being probably less than 100 units per annum in Norwich for small houses. The method adopted in Norwich was to collect 1s. per week with the rents, and the Corporation was doing that for the electricity department. That was just about sufficient to cover the ordinary use for lighting. There was a risk of it being abused if people had unlimited use and therefore he was putting in meters so that after 100 units per annum the consumer was charged at the rate of 1½d. per unit, and if the demand was less than 100, then a rebate was allowed.

Electric Housing at Bradford.

Mr. ALLSOPP (Sales Manager, Bradford) said that all the 600 houses in the housing scheme in Bradford were electrically lighted. The charge was on the basis of 25 per cent. of the rateable value, and 1d. per unit. At present, only lighting was in use, but they were gradually getting the tenants to use current for other purposes, and 1d. per unit was a paying proposition on both sides. The gas works took about 250 H.P. from the Corporation electricity works. There was also 200 H.P. of electric motors at the refuse destructor works, for concrete-making, and in connection with the disintegrators, &c. The sewage works also used a good deal of power, and in the driving of a tunnel 2 miles long for an extension of the sewage system small electric locomotives were used.

Mr. H. G. WHYATT (Borough Engineer, Grimsby) said that at Grimsby the present cost of pumping sewage by steam was £2 433 per annum, but a scheme had been submitted whereby it was hoped to do it electrically for £1 952. The price of electricity was £8 10s. per kW per annum and ½d. per unit, and the total charge for power last month came out to exactly 1½d. per unit. For the housing scheme, there was one service for four houses. The houses were designed with gas-coppers and gas-fires in two bedrooms, but the demand was regarded as likely to be so small that the gas company would not lay mains. Meters were installed in these houses, and a charge of 1s. per week was made in the summer and 1s. 9d. in the winter, but above a certain consumption the charge would be by meter, as mentioned by Mr. Long.

Progress at Watford.

Mr. A. W. BARRHAM (Borough Electrical Engineer, Watford) said that some years ago his council started a housing scheme with thirty or forty houses, and there was one service to all the houses, a current limiter to each house, and a charge of 3d. per week was made. Other people took advantage of the scheme and builders constructed houses which were sold. They were dealt with in the same way as regards the service and current limiter, but the new owners were putting on cookers and radiators, and a current limiter of 60 or 100 watts capacity was not much use in those circumstances, and the council had been compelled to lay services to each house, with a 5 A meter. He hoped in this way to increase the supply to these houses, but he thought it would be nearer 60 units than 100 units per annum.

Housing Services.

Mr. S. J. WATSON, replying to the discussion, said that at Sheffield there had been important developments in recent years in regard to sewage disposal which would increase the demand for power in that direction, in connection with the compressed air required in the activated sludge process of disposal. In an experimental plant at Sheffield, it was found that the load factor was over 70 per cent., and a scheme had been prepared in which two motors of a total of 1 000 H.P. would be used, the consumption of which was estimated

at between 5 and 6 million units per annum. At the Sheffield gas works there was 407 H.P. of d.c. and 54 H.P. of a.c. motors, and a further scheme involving the use of nineteen motors with a total of 242 H.P. was in progress. So far as the paper was concerned, continued Mr. Watson, it was not controversial. He agreed that the number of units per house, viz, about 100, was high, and from an additional twenty-four replies that had been received since the paper was written the average was 78. At Bury, the system of wiring was to lay the mains round the back of the houses, attached to the framework, under the eaves, so that no underground cables would be used so far as the exact locality of the houses was concerned. One service was run to every two houses as they were semi-detached, and that led to a great saving. The Housing Commissioner had suggested that either gas or electricity should be installed, but eventually they got their way. Considerable economy had been effected by putting in a fireplace in only one upstairs room. In the other two rooms, plugs were installed for electric radiators, and this had resulted in a saving of £30 per house, the plugs costing 22s. 6d. each. The Corporation had agreed to keep a stock of radiators for the tenants. A compound system of charging for these houses was essential and meters were absolutely essential in order to check wastage. Moreover, a meter would become necessary sooner or later as additional apparatus was installed.

The Future of Railway Electrification.

An address by Sir PHILIP DAWSON to the London Students' Section of the Institution of Electrical Engineers marked the official return of the junior portion of the Institution to its own building. The meeting was very well attended, more than 200 students being present. In his address Sir Philip Dawson first reviewed the growth of electric traction during the thirty odd years of its life, the outstanding points being the pioneer electrification of the City and South London line, and, in 1894, the introduction by Sprague of the first multiple unit system.

Continuing, he said, that the sole criterion of the practicability of electrification was its financial soundness. The selection of a suitable system should be made from an Imperial standpoint, due regard being paid to the conditions of service. For example, although a low tension direct current system required many more sub-stations than an alternating current system, this increased expenditure was justifiable where the traffic was such as to keep each sub-station operating at a good load factor.

Alternating v. Direct Current.

Comparisons were available on the subject of alternating *versus* direct current, the former figures being provided by the London, Brighton and South Coast Railway, while the latter were taken from a collection of figures from the various d.c. systems in operation in the country. It must be borne in mind, of course, that the service of the L.B. and S.C. was not so frequent as that of the London Tube railways, but the d.c. figures included railways such as the Manchester-Bury, the service of which was of the same nature as that of the Brighton Railway. The lowest cost of installing a low tension direct current system, including cables, sub-stations, bonding, signalling, &c., was about £10 000 per mile of single track. In the extension of the Brighton Railway the corresponding cost was only about £6 000. The cost of operating per car-mile for d.c. varied from 4½d. to 11½d., the a.c. cost being 9½d., the same figure being assumed per h.t. (generated) unit. The figures per ton-mile were from 0.14d. to 0.237d. and 0.224d. respectively. It was often stated that the a.c. equipment was much heavier than d.c. machinery developing the same power. The following figures showed that this was not the case:

Railway.	Wt. of El. Equipment as per cent. Total Weight.	No. of Cars per Train. (average).
Liverpool and Southport	20 per cent.	4.24
Manchester-Bury	27.3 per cent.	3.91
L. & N. W.	18 per cent.	5.2
L. & S. W.	19 per cent.	4.5
Metropolitan	23 per cent.	4.6
District	17.3 per cent.	4.87
L. B. & S. C. R.	21 per cent.	4.3

Electricity v. Steam.

The L.B. and S.C.R. had prepared from their records a comparison of the cost of working a system under steam and electric power. The figures were taken from experience, and were all agreed to by each department. The cost of running, inclusive of maintenance, staffing, &c., per train mile was as follows:

	Steam.	Electric.
Local Passenger	50.51d.	27.58d.
Local Goods	108.083d.	64.084d.
Through Passenger	41.769d.	26.714d.
Through Goods	66.054d.	52.028d.

Public versus Private Supply from a Colliery Standpoint.*

By ROBERT NELSON.

The Institution of Mining Electrical Engineers is primarily concerned with the production and use of electricity for colliery purposes: how, then, can it assist to provide cheap fuel and cheap and readily available motive power? Is it not possible that better use might be made of available material and available resources? The intention of this Paper is to support the view that full advantage is not always taken by colliery concerns of the opportunities they have of purchasing electricity instead of generating it, and this applies where the position is in no way complicated by the existence of waste energy in the form of coke-oven gas, or in any other form. A full consideration of the matter will lead to the wider adoption of electricity supply from a public source, and, this will ultimately prove to be no inconsiderable contribution to the economies of the coal industry and of industry in general.

Three Typical Cases.

It is assumed that there are three collieries A, B, and C, all possessed of a growing load and all so placed as to be within the network of cables of public electricity supply undertaking, but differing in this way: whereas A has spent no capital on electrical plant of its own and has steam plant approaching obsolescence, B has spent a considerable amount of capital on generating plant of its own, and this plant is used to supplement steam plant, which in itself, for steam plant, is efficient; and C is in very much the same position as B plus a considerable quantity of surplus coke-oven gas. What steps should be taken in each case?

No Room for Argument.

As regards colliery A there can be no room for argument. In such a case the great saving in first cost of power plant makes the purchase of current from outside in nearly every case by far the best solution. There are two basic reasons why A would be well advised to purchase current, one technical, the other commercial. The technical reason is summed up in the higher efficiency and lower cost per kW of turbo-generator units of large capacity. The commercial reason is that the supply authority are specialists in power production, whereas the colliery company are specialists in coal production, and what is of vital importance to one is only a secondary consideration to the other.

The Effect of the Winding Load.

It is only in cases like collieries B and C, which have moderately efficient power generating plants of their own, that difficulty arises. The load curve of a colliery is made up of the fairly uniform demand of the ventilating and pumping and (in part) the haulage load plus a very fluctuating load, mainly winding, but partly haulage, with high peaks. Due to the small capacity of the generators then in use this winding load, with its high peaks of short duration, was not in early days regarded favourably by the electricity supply undertakings. Attempts were made to relieve the power supply system of the winding-load peaks, but the first cost of the electrical equipment necessary for this purpose was heavy. This has led in all but relatively few cases to partial electrification; the haulages, pumps, and ventilation fans have been converted, but not the winding engines. At many collieries this has meant only a moderate degree of success, because the heavy fluctuating load—mainly the winding load—is the element of the total load which chiefly contributes to the normal inefficiency of the steam plant at a colliery. For this reason the conversion of only the steady load to electric drive has in some cases had little better result than to add the cost of electric power to very nearly the former cost of steam working; or at any rate it has often left a disappointingly small nett saving in the total cost of power. It is abundantly clear that the full benefit from electrification is not realised unless the whole of the colliery boiler plant is shut down.

Advantages of Interconnection.

In more recent days the supply authorities have come to appreciate that with a large colliery load the peaks of the individual collieries so arrange themselves as to give a reasonable load factor to the supply system, and this enables them to allow the use of induction motors for winding supplied direct from the mains without provision for equalisation of the peaks, and, what is even more important, to offer more favourable terms to the collieries.

The old argument in favour of colliery generating its own power, that only such coal as is otherwise unsaleable is burnt under the colliery boilers is challenged. Coal cleaning processes are now available which separate out at small cost all the coal from any mixture of coal and dirt with a wastage of coal which in the best

process is quite negligible. Investigation will prove it to be economically sound in most cases to clean and wash everything sent out of the pit which purports to be coal, rather than to burn it inefficiently in boiler furnaces.

Indirect Advantages of Public Supply.

It is a matter for regret that the indirect advantages of a supply of power from an outside source cannot be readily measured for, in the aggregate, they are often more considerable than the directly measurable advantages. Amongst them is the facility with which additional motors can be installed when developments, whether of mining or machinery, become possible. It sometimes happens that further development is postponed because it necessitates additional capital outlay on boilers and engines, and considerable delay is often involved in obtaining this last mentioned machinery. If, on the other hand, all that is necessary is the purchase from stock of new machinery which is directly productive, the contemplated development can be proceeded with at once. There is also the enormous convenience of having the electric current as it were "on tap" so that power and light are available at week-ends, and, in fact, at any hour of the day or night for exploration, tests, or repairs, without the need to employ at odd hours more than the minimum of labour for the work in hand. Again, there is less likelihood of interruption of pumping and ventilating services in the event of unskilled labour trouble. All these are tangible, but not directly measurable advantages which must be credited to the purchase of current from a public source.

In the case of colliery C which has surplus coke-oven gas, the advantages of association with a public supply authority are emphasised. Where a supply authority meeting a large and varied demand from a neighbouring industrial area exists it is of considerable advantage to a colliery with surplus heat to co-operate with such an authority rather than to run its own generating station on independent lines.

Co-operation of Power Users Necessary.

Electrification of collieries has made a great deal of progress during the last fifteen years, and a moment when the output of coal is greater than industry and the export trade can bear may seem an inappropriate one to choose for recommending further extension in the use of electricity. But there remains a great deal of lee-way to be made up due to stagnation as a result of the period of control of the coal trade by the Government, and further it must always be remembered that a period of dull trade offers the best opportunity to make alterations and new arrangements. Attention has therefore been directed to the opportunities that exist for the substitution of electricity for steam for colliery winding; a substitution which almost of necessity involves the supply of current to collieries from public supply authorities in possession of large power generating units. It is important to remember that the building up of an efficient public supply involves the active co-operation of power users, and therefore the first step necessary to give effect to the anticipated economy arising from complete electrification is for collieries to insist upon a cheap supply of power for all colliery purposes, including electric winding. That demand, if made, will be met by the electricity supply undertakings. In my opinion that is one way in which it is possible to "make better use of our available resources."

An Animated Discussion.

In the course of discussion, Mr. HARBOTTLE said that the average steam consumption per H.P. hour for a colliery running on steam was something like 70 lb., whilst the electrical kW hour, which was greater than the H.P. hour, was produced by a large undertaking at from 13 to 14 lb. of steam.

Mr. HAIN said that in the Lofthouse district the Power Supply Company did not offer facilities such as would enable a bulk supply to be taken. Their demands both as to charges and restrictions were often exorbitant. He himself had found that where exhaust steam turbines were in operation, it was more economical to install further turbine plant than to take a supply from the Power Company. Considerable difficulties had been experienced both as regards the reliability of the supply and also as regards the putting right of troubles. He thought that power supply companies in that district took little interest in their clients, and that he himself had found that a private installation gave as great an economy as could be expected. He did not agree with Mr. Nelson that conversion to electric drive gave a disappointingly small nett saving unless it included the winders. In an installation with which he had been concerned before electrification had been used, twelve Lancashire boilers were required. By electrifying everything except the winders and fans and installing a mixed pressure steam

* Abstract of a Paper read before the Institution of Mining Electrical Engineers.

turbine, it was found possible to do away with six boilers, and thus to burn less coal and also save on labour and maintenance.

Reliability the Main Point.

Mr. WILLIAMS said that, in his opinion, far beyond any question of economy was the question of reliability. It was no use obtaining a saving of a few per cent. on costs if this was to be obtained at the expense of reliability. He had found that bulk supply in that district was not reliable. A plant was shut down whilst the power supply company made alterations, and there was considerable voltage variation. There was less likelihood of interruption of vital services if a colliery was running its own plant, or if these services were run with steam plant.

Mr. WADESON said that each case had to be settled on its merits. In the case of a single colliery, totally electrified, including the winders, a cheap, efficient, and reliable public supply would undoubtedly be the best, but where a group of collieries were situated favourably in respect to one another, power for all could be generated at one quite as cheaply and efficiently as any supply company could give it. But even in cases where collieries generated their own electricity a good case could still be made out for taking a bulk supply for such loads as night and week-end, the colliery thus working its own plant most efficiently. Moreover a night and week-end load ought to be such a load as a public supply company could give on exceptionally favourable terms.

Mechanical Construction of a 60 000 kVA Turbo-Generator.*

By A. ZEHRUNG.

In 1916, the Siemens-Schuckert Works received an order from the Rhine Westphalian Electricity Works for a 3-phase turbo-generator to give 60 000 kVA at 1 000 revs. per min. and 6 600/7 000 V. For the Goldenberg Station, where this set was to be installed, units of 21 500 kVA at 1 000 revs. per min. had been supplied in 1914 by

Special Steel Employed.

The mechanical construction is shown in Fig. 1. A through shaft, having a maximum diameter of 1 100 mm, a total length of 8 700 mm, and weighing 36 000 kg, carries twenty-six plates 2·3 m in diameter and 120 mm thick in the widest place. The weight of all the plates, ignoring turnings, &c., was 60 000 kg. As nickel steel was unobtainable, a high-quality special steel had to be used. The plates were first forged radially on a mandril, like tyres, and then gradually forged axially to the proper diameter. After being rough-turned, they were oil-treated. Test rings were taken from both outside and inside edges of each ring. The shaft was held in a vertical position while the gas-heated plates were shrunk on.

Rotor Construction.

There are forty-eight slots for the rotor copper, which weighs about 11 000 kg, and the slots are closed by metal wedges. The coils are insulated with mica, and the coil ends are secured by nickel-chrome steel end-bells, each bell weighing 2 500 kg. The caps are centred on the shaft and registered on the teeth. Air is drawn through the rotor by the fan action of the revolving coils. The air enters along grooves cut in the shaft and passes into the radial ducts between successive plates. Axial holes are also drilled through the rotor teeth to receive air entering near the coil ends. The wedges are also arranged to allow air to pass along axially.

At each end of the rotor there is a steel slip ring to carry the exciting current of 1 000 A at 220 V. The completed rotor weighs 104 000 kg, so that each bearing carries 52 000 kg. The peripheral speed in the bearing is 31·4 meters per sec. The critical speed of the rotor is above the running speed. The shaft is rigidly coupled to the turbine. There is a hollow of 300 mm diameter through the shaft to reduce weight. The flywheel effect of the rotor is 330 000 kg/m². It required 25 min. for the rotor to reach the speed of 1 000 revs. per min. when the applied power was 8·0 kW.

Stator Laminations.

The stator laminations are of alloy steel and weigh 63 500 kg. The outside diameter is 3·5 m, and the core length is 3 m. The cast-iron stator frame weighs 45 000 kg. The stator was made and wound completely in four parts for transport purposes. The stator requires 45 cub. m. of cooling air per sec. Axial ventilation is employed—the air entering at each end through 400 holes and passing into radial ducts in the middle of the core. Leaving these ducts, the air passes along the back of the core to the outlet at the bottom. There are channels at the back of the slots for cooling the conductors.

An external fan is used which can supply 60 cub. m. of air per sec. under

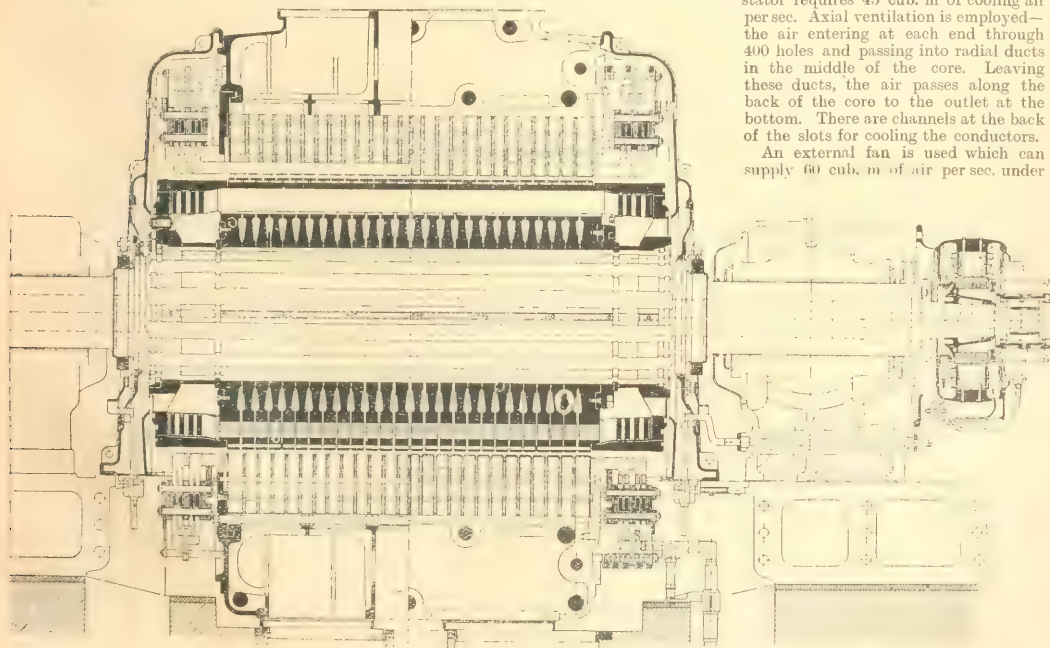


FIG. 1.—LONGITUDINAL CROSS SECTION OF 60 000 kVA GENERATOR

the same firm. The complete generator had to be interchangeable mechanically and electrically with that of another firm. Further, it was desired that the design should be suitable for an overspeed of 1·5 times the normal speed. The dimensions of the parts reached the maximum permissible on the railways.

* From "Siemens-Zeitschrift."

a head of 250 mm of water. There would be no difficulty in providing rotor fans for this purpose. The complete stator weighs 145 000 kg, of which 10 000 kg are copper. The stator winding is a simple bar winding with laminated conductors and solid end connectors. Micanite insulation is used. When short-circuit tests under full pressure were taken in 1918, no movement of the winding was observable.

Correspondence.

ELECTRIC STEEL FURNACES.

To the Editor of THE ELECTRICIAN.

SIR: In order to avoid misinforming your readers, may we call attention to three important slips occurring in your special Iron and Steel issue of the 18th inst.?

In your editorial you say that no new electric furnaces have been installed in this country during the past year. We have installed three new Stobie furnaces during that period, one being in England and two in Scotland. Each of these furnaces is of three tons capacity. There are further Stobie furnaces of still greater total capacity at present installing which will also be switched in this year.

Your editorial also suggests that the power factor of electric furnaces seldom averages 50 per cent. We are not cognisant of what some furnaces give by way of power factor, but we have not at any time known a Stobie furnace give less than 80 per cent. during normal operation over any period up to one year. We can, *per contra*, give you chapter and verse showing that the average power factor for a modern furnace need never average less than 85 per cent., and can at times, under quite ordinary practice, equal 93 per cent.

The third point is in the article you publish on "Electric Steel Furnaces," by Mr. Kershaw. It is stated therein that the two most favoured furnaces in this country are the Heroult and the Electro-Metals. If your contributor has up-to-date records, he will find that the total capacity of Stobie furnaces built in this country does not confirm such a conclusion. We are, &c.,

THE STOBIE METALLURGICAL CONSTRUCTION COMPANY,
VICTOR STOBIE.

Dunston-on-Tyne, Nov. 25, 1921.

POWER FACTOR OF ELECTRIC FURNACES.

To the Editor of THE ELECTRICIAN.

SIR: I have read the leading article on "Electricity and Iron and Steel" in your issue of Nov. 18 with great interest, but there is one statement which is probably an error in printing to which I should like to call your attention.

You state that: "From this point of view it is unfortunate that the electric furnace is not a good load. Its power factor seldom averages 50 per cent., and may be much lower."

No power company could be expected to consent to a large electric furnace if this were the case, but, fortunately, the actual power factor is much higher. Steel furnaces of almost all types work regularly with a power factor of 0.85 to 0.92. This could be even higher, but it is usual to design the transformers with a fairly high reactance so as to avoid rushes of current when two or more electrodes come in contact with the scrap.

There is, of course, a limit to the size of induction furnaces which can be designed with a good power factor, but furnaces of this type for brass melting are now being erected in Birmingham of 60 kW, 600 lb. capacity, which are expected to have a power factor of 0.8 or better. I am, &c.,

W. S. GIFFORD.

London, Nov. 26.

GRAMPIAN ELECTRICITY SUPPLY SCHEME.

To the Editor of THE ELECTRICIAN.

SIR: I notice in your issue of Nov. 25 you state: "The Government have intimated to the promoters of the Grampian Electric Supply Scheme, who asked for a guarantee on the capital outlay of nearly three million, that no promise under the £25 000 000 scheme can be made until the Bill authorising the project has passed through all its Parliamentary stages." I beg to inform you that we have received no such intimation.

No legal obstacle exists to prevent the construction of the works being initiated immediately, provided that the landowners concerned give their consent. Sir Robert

Kindersley's Committee is considering our application for a guarantee under the £25 000 000 scheme, and we still hope an arrangement may be arrived at by which, with the landowners' consent, employment may be given immediately to 1 000 men and arrangements made for the employment of many thousands more by the spring. Of course, your statement may turn out to be right, and in any case the Bill will be proceeded with. But we have not abandoned hope that Sir Robert Kindersley's Committee will enable us to initiate construction straight away. I am, &c.,

J. S. BARNES,

Secretary, Hydro-Electric Development Company.
London, Nov. 28.

Home Life Economy Exhibition.

THE HOUSING AND HOME LIFE ECONOMY EXHIBITION now being held in St. George's Drill Hall, NEWCASTLE, is proving a very popular attraction. The exhibition is well organised and very pleasing, although rather more room would have been advantageous. It is gratifying to note that the manufacturers of domestic electrical apparatus have, in this instance, taken good advantage of the opportunity to bring their wares to the notice of the public, the number of the electrical exhibitors far exceeding the number of gas exhibitors. The exhibits of electrical apparatus are, in general, in excellent taste, calculated to leave a favourable impression upon the minds of observers and potential users, although the range in some cases extends to articles of which it is difficult to see any useful application in home life.

One cannot fail to be impressed by the extensive embodiment of "safety first" features in the American domestic apparatus, and our manufacturers might well take a leaf out of their book. This exhibition shows, however, that the purveyors of electrical apparatus are beginning to realise the enormous field which does exist for the use of domestic apparatus, and the importance of bringing the apparatus available to the notice of prospective users.

An outstanding feature of the exhibition is the "Electric House" stand of the NEWCASTLE-UPON-TYNE ELECTRIC SUPPLY COMPANY, which comprises a model dining room and bedroom tastefully furnished and decorated and completely equipped with all electrical conveniences such as fires, kettles, toasters, fans, reading lamps, bed warmers, &c., all wiring being carried out on the "Stannos" system. In a model kitchen adjoining are demonstrated electric cooking and washing appliances of all descriptions, which give an excellent illustration of the cleanliness and convenience of electric service.

An exceptionally large display of domestic apparatus is to be seen at the stand of ELECTRICAL DEVICES, LTD., who exhibit numerous "Universal" appliances, amongst which many notable and outstanding features are to be found, such, for instance, as the renewable fuse in the coffee percolator, which, in the event of the percolator boiling dry, simply blows and prevents any further injury. One outstanding item is a portable 3 lb. iron, which, by means of an adaptor and voltage adjustment, can be fitted to any lighting circuit; this iron can also be utilised for heating and warming a glass of milk or water, &c., and has a further use in that ordinary hair curlers may be inserted and heated up. Altogether a most useful piece of apparatus to a lady tourist.

Mention should also be made of the exhibit of RAWPLUGS, the utility of which for fixing all types of apparatus in hitherto impossible materials is amply demonstrated.

Refreshments may be obtained in the exhibition at an electric restaurant and café, in which all the work is carried out by means of electrical apparatus, whilst a most excellent musical programme is rendered by the band of H.M. Royal Marines.

Other electrical exhibitors include: The Northern Steel and Hardware Company, Ltd., Manchester; Robson & Coleman, Newcastle; Siemens Bros. & Company, Ltd., Woolwich; and Gray Bros. & Company, Newcastle.

The exhibition is open until to-morrow.

Noise as an Energy Waster.

WE have recently heard a great deal about the waste of human and material energy and the methods by which such waste may be avoided. But although the subject has from time to time been treated more or less humorously, very little has been seriously written on the reduction in human and material efficiency caused by noise.

From this point of view the lecture, delivered on Tuesday at Blackburn by Prof. H. J. SPOONER, a member of the International Committee on Industrial Fatigue, is worthy of attention. The subject, he said, was of peculiar interest to boiler makers, workers in which trade often become more or less deaf before they reach forty. He proceeded to classify the primary kinds of noise, and discuss the expedients which had been and can be employed to eliminate or prevent them. He explained the use of vibrometers for the protection from vibrations in high-speed machinery, and dwelt on the great value of rubber in solving many noise problems, as well as with the law relating to noise and nuisance. He stated that in the United States the proceedings on the Annual Fatigue Day, on Dec. 5, would deal largely with the question of "avoidable noise."

The Collection of Water Power Data.

The final report of the WATER POWER COMMITTEE OF THE JOINT BOARD OF SCIENTIFIC SOCIETIES, which was appointed in November, 1917, "to report on what is being done to ascertain the amount and distribution of water power in the British Empire" has now been issued. A preliminary report was presented in July, 1918, and a second report in March, 1919. The contents of these two reports were summarised in THE ELECTRICIAN for August 6, 1918, and May 23, 1919 respectively. The present report is dated January, 1921.

Water Power of the Empire

About half of the report is taken up with bringing up-to-date the figures which were given in the two previous reports of the water power available and generated in the various countries of the world. The countries specifically dealt with include Great Britain, India, Ceylon, the Kenya Colony and Protectorate of British East Africa, British Guiana, British Honduras, and Australia. It appears that in Great Britain, India, Canada, New Zealand, Tasmania, and some portions of Australia more or less adequate steps have been taken by the various Governments to investigate the water power available and that definite preliminary steps have been taken in the Union of South Africa and British East Africa, in Ceylon, in British Guiana and in India. In the remaining countries of the Empire nothing definite is being done or appears to be projected, although the potential water power in New Guinea, Burma, and West Africa is known to be very large. Where investigations have been initiated with the exception of Great Britain, Canada, New Zealand, and possibly India, the scope of the work does not appear to be in any way commensurate with the importance of the subject.

Taking the Empire as a whole in fact, no attempts—the Committee state—are being made to ascertain the total resources, to secure any uniformity in methods of investigation and the recording of data; to encourage such investigations as are being made; or to collect the information as it becomes available at a central bureau. At present not even an approximately complete inventory exists much less the commercial information which would assist the development of this important national resource.

Water Power Used and Available.

Turning to development in other countries—it is pointed out that the Empire's position in water power development at the present time compares unfavourably with that of its commercial competitors. In Europe about 47 300 000 hydraulic horse power is available, of which 8 450 000 or 18 per cent. has been developed. In the United States about 32 000 000 hydraulic horse power is available, of which 6 500 000 or 20·3 per cent. has been developed, while in the British Empire 60 000 000 hydraulic horse power is available, of which 3 000 000 or 5 per cent. has been developed. Of the total developed water power in the British Empire about 72 per cent. is in Canada. It is pointed out that to be of reliable value the records of river flow, of flood discharge, and minimum low water conditions and of rainfall, more particularly in reference to storage must be available over a considerable period.

Proposed Imperial Water-Power Board.

In their first report, the Committee recommended the formation of an Imperial Water-Power Board on the lines of the Imperial Mineral Resources Bureau, to include a representative of each of the Dominions and Dependencies, and briefly outlined its functions. They now add suggestions as to the principal objects that the proposed Board should endeavour to carry out.

(a) It should get into touch with every Dominion and Dependency, with a view to ensuring comprehensive investigation on a uniform method and system, and to secure the initiation of investigations where these are not already in hand.

(b) It should endeavour to make co-operative arrangements for carrying out investigations in such Dependencies as are not in a position to undertake them unaided, on some such basis as is arranged under similar circumstances by the United States.

(c) Arrangements should be made with all Overseas Authorities for complete copies of all data secured and reports issued, to be on file at an Imperial headquarters in London.

(d) From these the Board should compile and publish an annual report and detailed annual records of investigations throughout the Empire in a uniform form, as is done by the United States in its "Water Supply Papers," and by the Dominion of Canada in its "Water Resources Papers."

(e) The Board should keep a complete and up-to-date file at its headquarters in London of all information obtained on water-power resources in all parts of the Empire, in such a form that the information available to any river or district could be immediately produced and summarised. It should, in fact, be a central clearing house of information on this subject for the whole Empire.

(f) The information on record should include such particulars as are known of allied natural resources available for manufacturing purposes, transportation facilities, etc.

(g) It should be possible for any capitalist or company needing cheap

power in large quantities to ascertain at the offices of the Board, from information immediately available, all the water-powers in certain districts, with the state of investigation for each, in such a form that it could be decided which locality and which power appeared sufficiently promising to justify further detailed investigation.

(h) For such purposes, whenever possible, investigations of rivers should be carried out with sufficient thoroughness to allow of reasonably close estimates of costs being obtained. These estimates should be made by the engineers of the Government concerned.

(i) To carry out these functions the Board would require a permanent staff consisting of administrative officers, technical experts and clerical assistants. A permanent staff dealing with the resources of all parts of the Empire would be necessary to secure continuity of policy and absolute impartiality.

Conclusions.

The Committee submit that the Conjoint Board of Scientific Societies should urge upon the Government—

- (a) That in view of the immense water-power resources known to exist in the Empire, and of their commercial value, it is of urgent importance that adequate measures should be taken to promote the development of these resources.
- (b) That in many parts of the Empire it is most desirable that records of river-flow should be instituted and maintained if they are to constitute a safe commercial basis for power development.
- (c) That the creation of an Imperial Water-Power Board, with extensive powers to carry out a comprehensive policy for stimulating, co-ordinating and, where necessary, assisting such development throughout the Empire, is needed.
- (d) That a great impetus would be given to the investigation of water resources in the Dominions and Dependencies, by the creation of such a Central Board to assist and to record such information for the assistance of commercial investors.
- (e) That the greater uniformity of methods of investigation and recording to be secured by such a Board would much increase the commercial value of the information.
- (f) That an Imperial Water-Power Conference be convened in London, if feasible, at an early date. The Committee understand that a proposal has been made to hold such a Conference and that this has been cordially received by the representatives of those of the outlying portions of the Empire, which are most directly concerned. Such a Conference would offer the opportunity of discussing matters of policy, administration, uniformity of investigation and record, in connection with water-power development, and could not fail to have a useful effect on such development.

The report is signed by Sir Dugald Clerk, chairman, and Professor A. H. Gibson, secretary. It is hoped to publish shortly a combined edition of the three reports, which has been prepared by the secretary of the Water-Power Committee.

A Central Authority for Greater London.

It is well known that the number and the over-lapping interests of the various authorities concerned with the local government of London are a cause of inefficiency and a clog upon progress. A Royal Commission has been appointed to report upon this important matter, and the London County Council's reform proposals will be considered next week, when Mr. R. C. Norman will give evidence in support.

In the opinion of the Local Government Committee of the County Council nearly all the most important services which are now centralised should be transferred to a new central authority, directly elected, but it might also include a limited co-opted element. The central authority should undertake all the duties which should be centralised, and it should not materially exceed the size of the London County Council. It would be a great advantage if, in determining the new administrative area, regard were had to the existing limits of the water supply and police areas, and to the area of the London and Home Counties electricity district provisionally settled by the Electricity Commissioners, so that, if possible, one single Greater London should be delimited for all local government purposes.

Powers and Duties of New Authority.

It is suggested that the other new local authorities in the area might have independence within their several spheres, subject, perhaps, in certain cases, to the exercise by the central authority of some co-ordinating or supervisory powers, or of powers to act in default, and to a scheme for the equalisation of rates. They might also exercise certain delegated powers which are now completely centralised. Roads should be allocated between the central authority and the local authorities, following probably the classification of the Ministry of Transport. The central authority should be the traffic authority for the whole area, although the question whether or not it should also be an operating authority would have to be considered. In the case of electricity, the central authority should, if the areas were co-terminus, take the place in the joint electricity authority designated in the Council's scheme for the London County Council itself, and for those outside local authorities which do not own or operate municipal electric supply undertakings.

Germany Seven Years After.

By C. H. HUGHLAND.

There was a time when Germany was the best customer this country had. She used to buy from us you by you about sixty million pounds worth of goods. That is the main reason why the condition of Central Europe can never be without a definite interest for the commercial community of Great Britain. We have been told during the past twelve months by one publicist that Germany is working hard, by another that she has nothing to do. Some observers endeavour to impress us with the wealth of the country, others with its poverty, but from personal observations during a recent extended tour in which I had exceptional opportunities of coming into direct contact with many phases of industrial and agricultural life, my impressions, summed up in half-a-dozen words, I think might be best conveyed by the phrase that "Germany is down but not out." There is no doubt that Germany is working hard, but that involves nothing very new. The industry of Germans is proverbial. But there is another motive which actuates them at present. It is far more apparent to them than it is to some of the other nations that they must either work or perish. What have they but work to offer to the world? It is necessary that they should labour diligently with their hands if they are in course of time to regain the prosperity which they threw away when they made an unsuccessful bid for the hegemony of the whole world.

The Downfall of the Mark.

The mark at 1200 to the pound sterling: is that really the world's estimate of the credit of a country peopled with many millions of industrious, scientific folk, or is it an artificial position created by printing presses set in motion by men determined that they will not pay the reparations demanded by the Allies? Industrial magnates, speaking as individuals, all express themselves in much the same way, saying, "We have lost the war, we realise that we must pay up, but how are we to do so if the Allies take the most productive coal and iron bearing districts and leave us largely without the means of manufacturing and making money?"

The unemployment problem in England and America occupied a large amount of attention in German newspapers, and it was freely said that this unemployment was largely due to the fact that Germany could flood the world with cheap goods owing to the state of the exchange. Time after time, in conversations with men of business, the impossible character of the wild demands of the Allies was emphasised. One man, controlling an enterprise employing nearly 10,000 men, said to me: "We thought Napoleon was bad enough, but these reparations surpass anything he did or would have done in the circumstances." I then asked him what, in his view, would have happened if the tables had been turned and Germany had won the war? His reply was so characteristic that I give it word for word for what it is worth. "Germany," he said, "would at least have so arranged matters that she got the money: if the Allies persist in their present policy it will be impossible for them to get it."

The mark fluctuated between 450 to 740 to the pound during my stay in Germany. When it reached 50 and 700 it was said on all hands that the whole world did not contain sufficient money to pay the indemnities at such a rate of exchange.

The downfall of the mark means that at present Germany can under-sell the world, more especially in those commodities the raw materials of which she produces herself. That is the way in which the unprecedented state of the exchanges affects manufacturers and merchants in Great Britain, America, and Japan; but this landslide in the currency plays some queer tricks inside Germany itself. Her people find that it is a good deal easier to sell than to buy. Therefore, if you have a taste for Havana cigars you will be wise to take them with you, or your search for them in Germany will be extended, and the price that you will be called upon to pay for them will give you food for reflection as to what happens in a country whose credit has gone to pieces.

Day by day Germany has to search inside her own borders for materials to work up into manufactured products. She is, with her scientific mind, thinking more especially of articles containing the minimum of material and the maximum of work to make that material valuable. An instance of this was a new slide rule which I saw being made by the largest engineering concern on the Rhine. It consisted solely of a strip of steel, but the precision work put upon it made it an article of considerable value. The conclusion that one inevitably draws is that the present state of affairs is as unprecedented as was that when credit came to a standstill soon after the declaration of war, when special measures were taken to relieve the situation. The Allies must make up their minds quickly whether Germany is simply playing a colossal game of bluff, and, if so, what steps they must take to put a stop to that game.

The Labouring and Business Classes.

Visitors to Germany in the old days were aware of the existence of three distinct classes. The lower or labouring class; the middle or business class; and the upper or ruling class. All classes underwent military training, but only the upper class liked it. The members of it learned and loved soldiering from their boyhood, and they developed the love of it through their student days with their sabre duels, which contests, akin in some measure to our football and cricket matches, were the only athletic sports of these young men. "Show me a nation's sportsmen and I will tell you what she is playing at." The soldier spirit went with them in their manhood, when they passed naturally as officers into the army. It was this military class above any of the others that wanted war.

But all the while the power, the wealth, the real strength of Germany was clothed, not in the pale blue uniforms of her soldiers, but in the black coats of her merchants. It was the merchants whom Bismarck saw as the justification of his visions. The army was a means to the end.

There are only two classes in Germany to-day; the military class has disappeared. Of the two remaining classes, that of labour is taking a more prominent place, but the German workman has always been a worker, and he is so still. He thinks socialism may possibly improve his lot, but he knows that work is the only philosopher's stone. In the merchant class the brains still live, and what they have done before they will do again, and they will do it the better for being unhampered by a huge and expensive army. Germany is down, but she is not out. She is, moreover, still writing her history in the buildings she is erecting. In Berlin there are many big sites cleared for new premises, or with new ones in course of erection. Large portions of the principal streets are "up" for extension of the tube railway, which is there very near the surface, and a matter of "cut and cover" instead of deep excavation as it is with us. Stuttgart is scrapping one enormous railway station for a fresh one on scientific lines. In the same town a technical college, which would have been the pride and glory of an English town of the same size, has been pulled down, and supplanted by another far bigger and better equipped. In Leipzig they are erecting two huge halls for the use of exhibitors at the annual fairs, and it is realised, long before they are ready, that they will not be nearly large enough. At Munich—but the point need not be further elaborated.

Jackson Cookers for Glasgow.

As we recently announced, the Glasgow Corporation have decided to hire the JACKSON ELECTRIC STOVE COMPANY'S No. 20 cooker. In this cooker the whole outfit is heavily constructed of cast-iron and steel. The oven has an actual cooking space (not total size of oven, which is often given and is misleading) of 14½ in. high by 12½ in. wide by 15 in. deep. It is loaded to 1600 W, with three-heat regulation. The oven is double cased and lagged on all sides, including the door. The switch is fitted in a convenient position, and is arranged for three-heat regulation. The hob, which is mounted above the oven, contains two open-type boiling plates, each with three-heat regulation, and a grill loaded to 1500 W, single heat.

It may also be mentioned that there is no mica of any description employed in this type of cooker. There are also no loose leads, beaded wires, asbestos covered wires; all connections are of the solid rod type mounted on porcelain insulators—in fact, the connections resemble the back of an ordinary switchboard. There is, therefore, it is claimed with justice, no further attention needed to



JACKSON COOKERS EN ROUTE FOR GLASGOW.

the leads once they are built in position; the only adjustment that may be occasionally necessary is the elements will require replacement, and this is easily done, for the hob lifts without screws or bolts having to be removed, and elements can then be inserted even by an unskilled person.

The boiling plates consist of three elements; these are connected as follows: On full heat each element is in parallel, on medium heat the two outside elements are in parallel, while on low heat the centre element is in series with the two others.

Large quantities of liquid can be deliberately thrown over these elements when glowing at full heat, without fracture or damage, though this is not recommended as a daily practice, and the cookers can be subjected to a flash test of 2000 V to earth.

It is of interest to learn that during the last two weeks in October, 173 No. 20 cookers were dispatched for use in connection with various hiring and housing schemes in this country, and over forty of the No. 21 type. The Jackson Stove Company can, therefore, claim that they are supplying at least some of the cookers that various authorities are installing for hiring, or in their housing schemes.

The Latest in Ironclad Switchgear.

There comes a time in the development of electrical equipment when a certain stage of success is reached. It is then sufficient to say "this is the latest in ironclad switchgear." All readers of THE ELECTRICIAN know what that means, but to assist them we publish, herewith, a photograph of an example of the latest patterns of this gear, which has recently been supplied by the firm for use in Holland.



BACK VIEW OF 11,000 V., 3-PHASE, 300 A., REYNOLDS IRONCLAD SWITCHGEAR, FOR SUPPLYING NEAR MAASTRICHT, TO THE ORDER OF STROOMVERKOOPMAATSCHAPPIJ

This eleven-panel switchgear is arranged for use on a 11,000 V. three-phase system. The switches being designed for direct operation. A feature of the back view as, as is evident, the neat and compact arrangement of the secondary wiring, which is run in conduit, and the indicating lamp wiring carried in flexible metallic armoured tubing.

The switchboard embodies all the standard features of the Reyrolle gear, such as the total enclosure of live parts, which are embodied in compound, with the exception of such parts as the switch contacts and potential transformer coils which are immersed in oil. The well-known plug-in feature, in which connections between incoming cables and busbars are made through the oil switch by means of plug contacts on a carriage type of switch fitting into plug sockets upon the busbar chamber and instrument transformer chamber is also used, thus dispensing with air-break insulating switches, with their accompanying danger due to careless operations. Complete fool-proof protection against accidental contact is obtained, firstly through the careful enclosure of the gear, and secondly, through a very thorough system of inter-locking.

refer to that equipment either by its maker's name or by some nickname for its various details to be immediately visualised. This name has been reached by A. REYNOLDS & COMPANY'S IRONCLAD

Attention may also be drawn to the provision of duplicate busbars, and to the fact that selection of the busbars is made in perfect safety by a simple adjustment of the oil switch.

Association of Consulting Engineers.

The annual dinner of the Association of Consulting Engineers, which was held on the 24th ult., was one of the most pleasant gatherings it has been our lot to attend. The chair was occupied by Mr. W. VAUX-GRAHAM, the chairman of the committee, and the numerous speeches were in humorous vein, in keeping with the occasion. A number of distinguished guests were present, including Lord Meston, Sir John Snell, Sir E. E. Pearson, Mr. Justice McCaigie, Mr. Justice Shearman, Mr. C. A. McCurdy and representatives of the Parliamentary Bar.

In proposing the toast of the Association, Lord MESTON referred to some Indian problems (such as destruction by erosion) which were of the highest importance to the country, and which could doubtless be solved by engineers if only the Government would take expert advice. There were, of course, competent engineers already in India, but they were concerned with their own difficulties, and were not in a position to deal with these larger problems.

After a brief response by the chairman, the toast of the Legal Profession was proposed in humorous fashion by Mr. S. R. Lowcock and replied to by Mr. Justice SHEARMAN, who made a defence of the profession.

In responding to the toast of the Engineering Institutions, Sir ALEXANDER KENNEDY said he looked forward to the adoption of a broader policy by the Institution of Civil Engineers, and Mr. J. S. HIGHFIELD dwelt on the difficulty of adopting standard lines in engineering when the outside inventor kept rushing in with new inventions.

The toast of British Industry was proposed by Mr. A. H. DYKES and responded to by Sir EDWARD PEARSON, who said he would not attempt to lay the blame for the present depression on any particular section of the community. Our past prosperity had been largely due to the pluck of the manufacturer. Wages would certainly have to come down, but they must come down slowly. Our exports were improving. It was necessary, however, to stabilise the foreign exchanges, and this would never be done until the inordinate printing of paper money ceased. It was essential that manufacturers should maintain their standards of quality and their deliveries. He felt certain that if labour were properly handled they would play the game, and that we should soon relieve our position.

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Exhibition of Fuel-Saving Appliances at Cardiff.

An interesting and highly-successful exhibition of apparatus, models, diagrams, &c., dealing with everything pertaining to the ECONOMIC GENERATION OF STEAM was held last week at the South Wales Institute of Engineers, Cardiff.

The exhibition was formally opened by Mr. W. Foster Brown, President of the Institute, on Thursday, Nov. 17, and remained open until Nov. 19. Over fifty firms were represented, and the exhibits covering all branches of boiler-house equipment, and the latest devices for facilitating scientific control. The show resembled, and in certain respects surpassed, that held in the Institution of Mechanical Engineers last June. The extraordinary interest taken in the exhibition by colliery engineers and officials afforded eloquent testimony of the degree to which the importance of economy in the use of fuel is now realised, even by those who burn coal at the pit's mouth.

Wireless for Life-Saving.

At the final session of the INTERNATIONAL SHIPPING CONFERENCE, held in London last week, Sir Owen Phillips, who presided, initiated a discussion on life-saving appliances and radio-telegraphy at sea. In a resolution submitted by Sir Alan Anderson, it was pointed out, with reference to wireless telegraphy, that it was essential that the free market in installations should be maintained. The legal obligation to install wireless on merchant ships was justified, only by the desire to save life, the shipowners should be left complete freedom to deal with improvement or amplification of wireless installations. As it had already been proved that the attempt to maintain constant communication by human agency could not be made effective, an automatic alarm device should, as soon as practicable, be approved and permitted to take the place of the human watchers, as provided in Article 34 of the Convention of 1914. The legal obligation on ships compelled to carry wireless should be limited to the efficient operation of wireless for life-saving emergency; and a limited knowledge of wireless, sufficient for these life-saving duties, should be a qualification for a certificate to be held by a member of such ship's company, so that no idle men would have to be carried to fulfil this exceptional duty.

Diesel Engine Users Association.

At the last meeting of the Diesel Engine Users' Association, held at the Institution of Electrical Engineers, Mr. Oswald Watts read a Paper on "SOME RECENT DEVELOPMENTS IN MECHANICAL INJECTION DIESEL ENGINES USING HEAVY OILS." The author dealt with various aspects of so-called "Semi-Diesel" engines, and described some of the outstanding developments of two and four cycle mechanical injection engines which had been instrumental in rendering these prime movers efficient and reliable power agents.

On the question of fuels, the author referred to the range of suitable petroleum fuels as being wide, but that viscosity had an important bearing upon the advisability of using some of the heavier grades. He also referred to his experience in the use of tar oil as fuel. In this case a second pump was usually employed to inject the pilot oil just before the main charge, and the pilot oil was usually about 6 per cent. of the total fuel used at the working load, its quantity remaining constant at all loads.

The further development of the oil engine, whether of the in-cylinder or open-type, was largely dependent upon the materials at the disposal of the designer, and the production of metals having greater heat-resisting properties demanded the close and continued co-operation of the engineer and the metallurgist. There was also still a wide field for research in connection with the atomisation of the charge.

The reading of the Paper was followed by a discussion.

C.A.V. at the Motor Cycle Show.

At Stand No. 124 at the Motor Cycle Show at Olympia C. A. VANDERVELL & COMPANY are exhibiting the long-awaited C.A.V. dynamo lighting sets for motor cycles, both on "solo" and "combination" machines. The dynamo for these installations is only 3 1/2 in. diameter, but it is built on identical lines with the standard C.A.V. car-lighting models. The output is 5 A at about 1 000 revs. per min., an ample charging rate to cover all ordinary lighting requirements, which may include a dashlamp, spotlight, &c. The battery, a special "C.A.V.-Willard," renowned for the "threaded rubber insulation," with the consequent freedom from trouble, has an actual capacity of 3 A for ten hours. This should be registered

at an official "C.A.V.-Willard" service station, the nearest of which will be indicated on application, as it is eligible for exactly the same free service benefits as its larger brothers are for car lighting and starting.

Electricity in Switzerland.

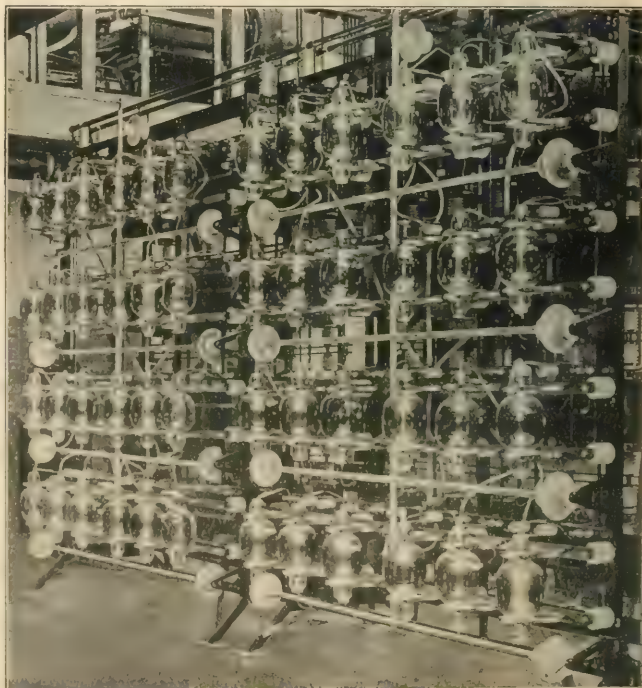
The report for 1920 of the Committee of the Swiss Commercial and Industrial Association contains some interesting information on the extensive use of ELECTRICITY IN SWITZERLAND. In 1914 it was calculated that the country's potential production of electric power amounted to about 4 000 000 H.P. The actual capacity at the beginning of 1914 was about 500 000 H.P., but various new stations, completed between that date and Dec. 31, 1920, increased the possible output by about 301 000 H.P., so that about 3 200 000 H.P., or 80 per cent. of the total possible production, remains undeveloped. At the beginning of 1914 there were 6 860 water-power installations, using 3 710 turbines and 4 903 water wheels. Of these 6 860 installations 6 025 had an average net power of 39 000 H.P. and a minimum constant power of less than 20 H.P. each, while the remaining 835 had a net power of 487 000 H.P. and a minimum constant power of 20 H.P. and over. On Jan. 1, 1914, there were six stations with a minimum constant power of 10 000 H.P. and over. Between the beginning of 1914 and the end of 1920 eleven important new works were started, the biggest being that at Olting-Goesgen, with a maximum net horse-power of 80 000 and a minimum of 17 000, and that at Ritom, with a maximum of 78 000 H.P. At Dec. 31, 1920, there were five important new stations under construction, including the Amsteg and Barberine stations for the Federal Railways, with a maximum horse-power of 80 000 and 60 000 respectively, and the Brox station (24 000 H.P.), Chancy-Pougny (43 000 H.P.), and Klosters-Kublis (45 000 H.P.). At present there is no village in Switzerland which is not provided with electricity supply; in 1916 the total units used were 1 534 000 000, and in 1919 over 1 846 000 000 units. These figures do not include the output of the undertakings which produce their own power, e.g., the Federal Railways and the principal electro-chemical works. Though in some parts the increased use of electricity was due to the high price of coal, it was mainly due to the cleanliness, convenience, and other advantages that the electric service has become so popular.

Direct Wireless to Australia.

Wireless test messages, prepared by an independent expert and transmitted in his presence, were sent direct to Australia last week from the MARCONI STATION AT CARNARVON. Cablegrams since received announce the reception of the messages, complete on the first transmission, both at Sydney and Melbourne. The valve transmitter used on this occasion, of which we give an illustration herewith, consists of forty-eight Marconi MT⁴ type transmitting valves. The anode voltage is 10 000 V, current being supplied by four d.c. generators in series. The earth screen which has recently been installed has reduced the aerial resistance to less than 1 Ω. An aerial current of 350 A is obtained when using this transmitter. The advantages of the valve for moderate ranges are well known, but hitherto for long distances the high-frequency alternator or the arc have been considered essential. As is well known, for some years past there have been wireless plants capable of sending messages to any part of the world. The German station at Nauen in 1918, having worked up in the course of ten or twelve years from a range of 3 600 kilometres, with a 100 metre mast and 10 kW in the aerial erected a mast system, the loftiest mast in which is 200 metres high, and with 400 kW in the aerial, found no difficulty in reaching the uttermost parts of the earth. A still more powerful station has recently been opened on Long Island, United States; and Bordeaux, which, with its 1 000 kW arcs, communicates easily with Indo-China, is only a little way behind that of Long Island.

The significance of the Carnarvon experiment, therefore, lies, not so much in the distance covered, but in the fact that it should have been possible to "wireless" through so many thousands of miles of ether with only 160 kW.

In his lecture last week at the Royal Society of Arts, Dr. Fleming stated that with the valve transmitter, not only is the capital outlay much less than is required for the equivalent high-frequency alternator or arc plant, but there is no necessity for complete duplication to secure reliability, as it is most unlikely that all the valves would fail at once.



THE BANK OF VALVES USED IN THE CARNARVON-AUSTRALIA WIRELESS EXPERIMENTS.

Legal Intelligence.

THE CLAIM AGAINST SIEMENS & HALSKE.

The Anglo-German Arbitral Tribunal has given judgment on the claim of Mr. Alex. Siemens against Siemens & Halske. Claimant undertook to transfer to respondent company 10 133 shares of £5 each in Siemens Brothers & Company, Ltd. On December 1, 1914, of shares in Siemens & Halske, a company established according to German law. Claimant had received until the outbreak of war the dividends declared by the German company and might have voted, although he did not as a fact do so, at general meetings of the company. The contract contained in the correspondence between the parties was duly performed by claimant and also by respondents, save as to the delivery of the share documents and the introduction of the shares on the Stock Exchange, but as claimant had never called upon them to do these things there was no breach of contract in those respects. Therefore the claim failed, and respondents were given £75 as costs.

TELEPHONE POLE AGREEMENTS.

At Birmingham Police Court on the 24th ult., Lord Ilkerton heard an application by the Postmaster-General to determine agreements for consents given for placing telephone poles on private property and the appropriate annual amount which should be paid by the Post Office for the facility. In 1910 Mrs. H. Hector, of Edgbaston, allowed the National Telephone Company to maintain a pole, underground pipe, and stays in the rear of property owned by her for an annual payment of £1 5s. In June last the Post Office engineers renewed the pole on account of deterioration, and without approaching Mrs. Hector. It was alleged that some damage had been caused to the property, and under the terms of the agreement notice was given for the removal of the pole, and the case was taken up by the Postmaster-General under the extended powers granted to him by the Telegraph (Construction) Act, 1916. Evidence was given that no complaints of damage or inconvenience had been received from the occupiers of the premises, and that the 25s. previously paid had been agreed to by the National Telephone Company, who had no statutory powers. The Postmaster-General was advised that any amount paid in respect of wayleave should bear direct relation to the loss or inconvenience caused by the presence of his fixtures, which in the present case was assessed by him at 2s. 6d. per annum.

Lord Ilkerton made an award consenting to the maintenance of the fixtures, subject to a payment of 2s. 6d. per annum, and directed that the costs (five guineas) should be paid by Mrs. Hector.

POSTMASTER-GENERAL v. LIVERPOOL CORPORATION.

On Friday a Divisional Court (Shearman and Salter, JJ.) allowed the appeal of the Postmaster-General from a decision of Judge Thomas, of the Liverpool County Court, who dismissed the claim of the appellant for the recovery of the agreed cost (£40 8s. 7d.) of repairing certain damage done to telephone plant caused by an explosion in one of the electric light mains belonging to the respondents. The grounds of appeal were that the judge had misdirected himself, and was wrong in law, in holding that the plaintiff was bound by the terms of an agreement (dated June 17, 1896) between the defendants and the National Telephone Company, and that the defendants had not waived or abandoned their rights under such agreement. A clause of the agreement exonerated defendants from liability to pay damages for nuisance occasioning loss to plaintiffs, and also from paying the expenses of making good the injury to plaintiff's telephone line under the provisions of the Telegraph Act, 1878. It was further submitted that the judge was wrong in law in holding that a letter dated Jan. 24, 1912, was not a sufficient notice under the Telegraph Act, 1892; that the laying of the telephone plant by the company in contact, or practically in contact, with defendants' electric light main amounted to negligence, and that plaintiff was responsible in law for such last-mentioned acts and for damage to plaintiff's telephone plant.

After hearing legal arguments, Mr. Justice Shearman said they agreed with the finding of the County Court judge that there was proof of nuisance, but that was subject to the evidence. It might have been dangerous in itself. As to the agreement between the National Company and the Corporation, it was shown that while the Postmaster-General held a monopoly of the telegraph and telephone business for the State, he was authorised to issue licences, which was done in that case to the company. That licence expired in 1911. The agreement was subject to certain conditions, one of which indemnified the Corporation against injury or damage which might be done by their electric light plant. The agreement was entered into before the licence of the Postmaster-General was obtained, and the court agreed with the contention of the Postmaster-General that he could not be bound by the agreement with the Corporation to which he was not a party, and which came to an end by the effluxion of time when the licence to the National Telephone Company ended on the transference of their property. The court held that there was a proper claim under Sec. 8 of the Telegraphs Act, 1892, and, on the ground of nuisance, the appeal was allowed, with costs.

On the application of Mr. Maughan, K.C. (for respondents), the court gave leave to appeal.

The executive of the Amalgamated Engineering Union estimate that a reduction of £50 000 000 will be made in the annual wages cost as a result of the recent decision of the members of the engineering and shipbuilding unions to accept the withdrawal by instalments of the 1½ per cent. and 7½ per cent. Ministry of Munitions bonus. The union has 87 768 unemployed, or nearly 25 per cent. of the total.

The I.E.E. Contract Conditions.

THE NEW EDITION of the Model Form of General Conditions of the Institution of Electrical Engineers indicates that a good deal of revision has taken place. The Committee engaged on the work included a number of representatives of other associations within, or closely connected with, the electrical industry, and the changes made should make the new issue more generally useful and of wider application as model general conditions for engineering contracts. It is of great advantage to have uniformity of conditions in contracts, and the new code is intended to cover the main conditions for the supply of plant and materials and the execution of work connected therewith. It will now be found to cover the majority of cases. Of course, there will always be particular contracts which require separate treatment, but even in these instances the model conditions can be amended to meet the situation.

Provision for Emergencies.

Many of the changes made are intended to make provision for emergencies or extraordinary situations, such as the cost of alterations necessitated by inaccurate information supplied by the engineer, the cost of obtaining new tenders, and of additional copies of drawings, &c. The clauses relating to the assignment and subletting of contracts, the variation or omission of work, the liability for negligence, and the death or bankruptcy of the contractor, have been strengthened, and the various conditions more clearly defined. A new clause dealing with underground works, such as foundations or cable trenches, has been added, and it is laid down, in the clauses on inspection and testing, that where the contract provides for tests at the premises of the contractor, the latter shall, unless otherwise agreed, provide, free of charge, such labour, materials, electricity, fuel, stores, and instruments as the engineer may consider requisite. The portions dealing with the supervisory powers of the engineer, the liability for accidents and damage, the terms and conditions of payment, the tests on completion, and the rejection of defective work, have also undergone considerable modification. Model forms of the agreement and guarantee, and of the conditions to be observed in tendering, are given in an appendix, and the new conditions are issued in a form which can be used as the actual contract by filling in the blank spaces.

Obituary.

The death is announced of Dr. F. W. PASSMORE, the well-known consulting and analytical chemist. He appeared as an expert witness in several electric lamp patent cases.

The death occurred, on Nov. 21, of Mr. FRANCIS GEORGE HART, who was for many years associated with the firm of Peto & Radford, of Victoria-street, London. He was sixty-three years of age, and resided at Epping, where he was a Founder and Past Master of the Bodicea Lodge of Freemasons.

The death took place, on Monday, after only a fortnight's illness, of AID. JOHN STRINGS HINCHLIFFE, a prominent member of the Leeds City Council and a partner in the firm of the Hinchcliffe Green Manufacturing Company, engineers. Mr. Hinchcliffe received his engineering training at Leeds and at the engineering works of the Lancashire & Yorkshire Railway Company. Later he spent four years on the Continent, where he gave particular attention to electrical engineering. His special knowledge proved of great advantage to the city, not only when, in his earlier years on the City Council, he, together with the chairman and manager of the tramways, undertook a personal investigation of Continental electrical tramway systems, but in later years when he filled the office of chairman of the Tramways Traffic Management and Highways Sub-Committee. He also served on the Corporation Gas and Electricity Committees.

Educational.

The recently-erected inorganic and physical chemistry laboratories at UNIVERSITY COLLEGE, London, are to be named after the late Sir William Ramsey.

Applications for grants from the ANDREW CARNEGIE RESEARCH FUND in aid of research work on the metallurgy of iron and steel should be sent in to the Council of the Iron and Steel Institute before the end of February next. Application forms may be obtained from the secretary.

In the course of a speech last week at the second annual dinner of the IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, over which Lord Creve presided, Sir Robert Blair said that there were 432 students at the Imperial College of Science and Technology, 204 at the Royal School of Mines, and 481 at the City and Guilds Engineering College, a total of 1 117 students. The post-graduate students numbered 218.

We are not surprised that the proposal of the Treasury to reduce the ANNUAL GRANT IN AID OF UNIVERSITY EDUCATION by £300 000 has been strongly criticised by teachers and education authorities. Much as we desire to see the curtailment of public expenditure, we regret that such a serious reduction is proposed in the University grants. As it is the annual grant to the Universities is absurdly small, being about one-fifth of the total annual grant for education. Already, owing to the large demands for specialised teaching and research the Universities are in a state of great financial embarrassment, and the reduction will cause serious injury, not only to pure learning and science, but to progress and development in industrial and commercial life.

Electricity Supply.

WILKES, a Lichfield Council, proposes to extend electricity supply to the schools, at a cost of £2 006.

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St. MARYLEBONE Borough Council proposes to apply for sanction to borrow £63 700 for electricity works extensions.

At the invitation of Mr. C. G. Morley New, city electrical engineer, members of the Cardiff Technical College Economics Society, a party of 10, visited the Cardiff Electric Supply Station.

A new electric plant has been installed by the Ocean Coal Company at their Dare Colliery, Cwmparc, and within a few weeks all the dwelling houses and public buildings in Cwmparc will be lit by electricity.

St. HELIER (Jersey) Town Council have decided to replace the present gas lighting of the town by electricity. A scheme to utilise tidal power is being prepared by French engineers resident in the island.

ACCRINGTON Corporation is sending another deputation to London to interview the Electricity Commissioners with a view to pressing the petition for borrowing powers for the extension of the town's electricity plant.

TRURO Town Council, after considering an electric lighting scheme by which it is proposed to take a bulk supply from the Cornwall Electric Power Company, has asked the company to revise their sliding scale of prices.

HERTFORDSHIRE County Council have consented to the North Metropolitan Electrical Power Distribution Company erecting overhead lines from Welwyn Garden City to St. Albans, via Hatfield, for the supply of electricity.

The Kent County Council has decided to expend £1 300 on an electricity supply scheme at BARMING HEATH MENTAL HOSPITAL, MAIDSTONE, by which it is estimated there will be an annual saving of £1 500 on fuel and gas.

LEEK Town Council are notifying consumers that, pending the installation of the new generating set, it will not be possible for the Council to consider any further applications for a supply of current for power purposes.

The Ministry of Transport have consented to the application of NEWTON ABBOT Urban Council for extension to the end of August, 1922, of the period over which the Council has an option to purchase the Newton electricity undertaking.

The Association of Municipal Electric Supply Companies have decided to apply to the Special Order-making Committee for the revision of the maximum prices authorised under the Orders of 1895 and 1903, and for other purposes.

FARNBOROUGH Urban Council have passed a resolution protesting against the increase in the charge for electricity for power from 4d. to 6d. per unit by the local Gas, Water, and District Lighting Company, and the Aldershot Chamber of Commerce have been asked to support the protest.

The Minister of Transport has extended for one year from July 8, 1921, the period of two years and eighteen months respectively allowed by the YEovil ELECTRIC LIGHTING ORDER, 1914, for laying mains, &c., in streets specified in the Order and in the remainder of area of supply.

A public inquiry has been held into the proposal to EXTEND THE AREA OF THE WOLVERHAMPTON borough, so as to include Heath Town, Wednesfield, Bushbury, and other adjoining areas. The electricity supply and tramway powers of the Corporation would be extended to the new areas.

The annual report of the Borough Electrical Engineer of SOUTHAMPTON (Mr. W. G. Turner) states that, though a deficit of over £2 300 was anticipated, the actual deficit for the year ended March 31 last was only £795 (against £4 500 in 1920). The gross profit amounted to £32 500.

The new super-power station at RUNCORN was officially opened last week. The plant, which has been erected for the Mersey Power Company, is capable of extension up to 100 000 kW. The total installed capacity is 50 000 h.p., compared with 5 000 when operating at maximum.

HAWARDEN Rural Council, at their meeting last week, passed a resolution protesting against the action of Chester Corporation in seeking to obtain a Special Order to supply electricity in the area of Hawarden Council, and pledging themselves to use all the means in their power to oppose the application.

We are asked to point out that the switchgear at the Jubilee-street Generating Station, BLACKBURN, a description of which was given in our issue of Oct. 28, was supplied by the Metropolitan-Vickers Electrical Company, as an extension of that originally supplied by the British Westinghouse Company.

The DARLINGTON Electricity Committee recommend a reduction from Jan. 1 of 4d. per unit in the charge for electricity for lighting purposes, and of 10 per cent. for power. This will make the charge for lighting 4d. per unit, as compared with 3d. pre-war, and will leave the power rate about 10 per cent. higher than pre-war.

The Electricity Commissioners have submitted to the Ministry of Transport for confirmation a Special Order granted to HEREFORD

Town Council extending the area of supply to the Urban districts of Bromyard and Kington, and the Rural Districts of Bredwardine, Bromyard, Dore, Hereford, Kington, Leominster, Ross, Weobley, &c.

At the invitation of the directors of the United Alkali Company, members of WIDNES Corporation paid a visit of inspection last week to the new electric power plant which the company has erected at West Bank Dock. When fully equipped the plant will have a capacity of 26 000 kW.

BRISTOL Corporation proposes to purchase about 15 acres of land, for £24 000, adjoining the Feeder-road works for extensions and other purposes. It is estimated that £2 425 will be spent on alterations to mains, &c., in connection with the purchase by the Corporation of the undertaking of the Keynsham Electric Light & Power Company.

During the past year, the LONDON MUNICIPAL ELECTRICITY UNDERTAKINGS obtained authority to borrow forty-two loans, representing £1 365 949, compared with eighteen loans, amounting to £478 959, in 1919-20. The total amount borrowed for electricity supply purposes is £8 929 644, but this sum does not include the expenditure of the supply companies.

LEATHERHEAD AND DISTRICT ELECTRICITY COMPANY has applied to the Commissioners for permission to make the standard voltage of supply for future consumers within their area 220 V between either phase and the neutral, and at their option to alter the supply to any existing consumers within the area from 110 to 220 V. The cost of replacements or alteration of any apparatus on consumers' premises necessitated by the change will be borne by the company.

BIRMINGHAM Chamber of Commerce, on Monday, considered a report of the Imperial and Local Finance Committee with reference to the increase of 50 per cent. in electricity and gas, and decided that a letter should be sent to each of the departments expressing the opinion that, in view of the fact that reductions had been made in the prices of materials and in wages, &c., it was only reasonable for traders to anticipate an early reduction in the existing charges.

At their meeting last week BRADFORD Electricity Committee authorised twenty-four extensions of mains, involving the laying of new cables in about two and a half miles of streets. In addition, the question of furnishing a supply of electricity in the Thornton district was considered as a special matter, and the committee recommended the City Council to proceed with this work, providing that sanction to the raising of a loan covering the cost can be obtained from the Electricity Commissioners.

The Mersey Power Company is applying for power to distribute electricity in that part of the CHESTER Rural District Council's area which lies in the Mersey and West Lancashire district. The Rural Council has decided that no objection be raised to the application, but that the clerk write to the Electricity Commissioners, pointing out very strongly that, in the opinion of the Rural Council, a reasonable limit ought to be fixed within which the Mersey Power Company would give a supply of current on a reasonable demand being shown.

Alderman Hamilton, chairman of PRESTON Corporation Electricity Committee, informed the Council last week that Preston and Blackburn Corporations are in consultation as to the possibility of a working agreement for the supply of electricity. It was quite possible that within a short time proposals would be submitted entailing a large sum of money for the erection of a power station much larger than would be necessary for Preston's immediate requirements. Until further progress had been made however, it would be impossible to give more information.

Trouble has been experienced in sinking the third of the sea shafts in connection with the Portobello electric power station of EDINBURGH Corporation. Mr. Bruce Lindsey, Convener of the Electric Lighting Committee, has stated that in sinking the third shaft they came across very bad seams of water-bearing sand, which had made the sinking of the shaft a troublesome affair, and had made the work of joining up the shaft and tunnel exceedingly difficult. The expenditure on that last small section of the work would be out of all proportion to what had been the cost of the previous work, and would probably amount to £4 000 or £5 000 more than the original estimate.

At a recent meeting of ERITH Electricity and Tramways Committee, Mr. J. C. Williams, the engineer and tramways manager, reported that he and Mr. Keats, Borough Electrical Engineer of Woolwich, had closely investigated the methods adopted for the protection of extra high tension circuits by those undertakings operating under conditions most closely corresponding to Erith and Woolwich, including the Corporations of Manchester, Rotherham, and Sheffield, and the works of Reyrolle & Company, of Hebburn-on-Tyne, and that they had agreed to recommend their respective committees to adopt the Beard-Hunter combination type, as manufactured by Reyrolle & Company. In view of the fact that Erith's 2 000 kW set was almost fully loaded, coupled with the difficulties they were experiencing in obtaining a sufficient supply of water for condensing purposes, their position would remain one of continued anxiety until such time as the supply from Woolwich became actually available. In the circumstances he had felt justified in asking Mr. Keats immediately to place on order the whole of the protective equipment required for both ends of the main cable. The total approximate price of this contract would amount roughly to £300. As Woolwich would bear half the cost Erith's share would be £150. The recommendation was adopted by the Committee.

Electric Traction.

There will be no toll levied at Preston or Clitheroe Docks. For the six months ended Sept. 30, EARTH tramways show a profit of £880.

BELFAST Corporation has decided to put wire netting on tramcars as a safeguard against bomb outrages.

Four double-decked tramcars, ordered nearly a year ago, have been delivered to the NEWPORT Corporation.

The revenue from BEXLEY and DARTFORD joint tramway undertakings is now about £300 less than at the corresponding period last year.

In the STOCKTON-ON-TEES Borough Fund rate, just over 1d. has been included for prospective loss on the tramway and omnibus undertaking.

WALLASEY Tramways Committee have appointed a special committee to consider the possibility of introducing a 1d. fare for shortened stages.

A scheme has been prepared by the London County Council for electrifying the horse tramways from Southwark Park-road to Rotherhithe, at a cost of £500,000.

HALIFAX Tramways Committee have decided to abolish the fare transfer system, and to establish 1d. stages, each of which will be half the length of the present 2d. stage.

There is a national DEADLOCK in the TRAMWAYS INDUSTRY upon the employers' proposal for a revision of the agreement which guarantees to the workers a forty-eight hour working week.

At a meeting last week of the LEEDS Chamber of Trade a resolution was passed, viewing with alarm the serious losses of the Tramway Department, and calling for a committee of inquiry to investigate the working of the service.

NEWCASTLE Transport and Electricity Committee have decided to invite the Municipal Tramways Association, of which Alderman Mayne, chairman of the Committee, is president, to hold their annual meeting in Newcastle next September.

EDINBURGH Tramway Committee recommend the Town Council to investigate the working of the conduit system, particularly as worked in Brussels, and it is proposed to send a deputation to report on the subject. The Committee have also decided that no alteration should be made on the fares in force at present until a period of three months has expired.

In order to provide work under the Trade Facilities Act, 1921, a proposal has been made to construct a new HIGHWAY RAILWAY FROM HEYWOOD TO SOUTH MANCHESTER and SIVAT. It is estimated that the cost of the 25½ miles of line would be £1,500,000. There would be twenty-four stations, and the line would make a circuit of about two-thirds of the city.

On the recommendation of its Highways Committee, Middlesex County Council have agreed to enter into negotiations with the METROPOLITAN ELECTRIC TRAMWAYS, LTD., in connection with the company's request for an EXTENSION OF THE LEASE for a further period of twenty years, to enable the company to raise money to deal with a number of necessary improvements and renewals. The existing agreement expires in 1930.

GLASGOW Corporation has decided to erect a new bridge over the Clyde at Oswald-street, to relieve tramway congestion. The estimated cost is nearly £500,000. The Tramways Committee recommend the Corporation to offer £200,000 for the undertaking owned and worked by the Paisley and District Tramway Company. The Paisley tramway system is 18½ miles in extent, and consists of 14-41 miles double lines of rails, and 3-84 miles single tracks.

THE STATISTICAL RETURNS of the RAILWAY COMPANIES of the United Kingdom for 1920 gives the total route mileage over which electric trains were run during the year as 477 miles, compared with 471 miles in 1919. The total train mileage worked by electricity was 32,494,596, or an increase of 2,796,523 miles over 1919. The total quantity of electricity used for traction and other purposes connected with electrical working was 390,991,589 units, an additional 22,032,171 units over 1919.

The deficit on the first nine months' working of the six motor-buses used in conjunction with the CARDIFF Corporation tramway service was £2,746, taking into account capital charges of £1,508. The tramways manager, Mr. R. L. Horsfield, thinks the omnibus services in the city are purely experimental. Their future success will depend upon working outside the city. The Chairman of the Tramways Committee, Coun. S. Jenkins, agrees, and states that a tentative arrangement had been come to with Newport Corporation which would have enabled the buses to travel to and into Newport, but the Monmouthshire County Council had vetoed the scheme. Further experiments are to be made.

For the thirty-three days ended Nov. 2, LEEDS Corporation Tramways Department shows an average daily deficit of £212. During the corresponding period last year there was an average profit of £96 per day. The income for the period under review was £89,472, the expenditure being £96,477. The total of 12,189,341 passengers carried shows a decrease of 282,189 on the corresponding period for the previous year. Since April 1, the beginning of the present financial year, the average deficit per day has been £208, a total of £44,890, whereas the corresponding returns for last year showed a profit of £7,351. Much of the discrepancy between these figures is accounted for by the decrease of over 6,000,000 passengers carried, while the maintenance expenses have increased considerably.

Municipal Accounts.

The accounts of HOVE ELECTRICITY DEPARTMENT, which were approved by the Council recently, show gross profit £13,939 for the past year, and after paying instalment of loan (£4,000), interest (£6,313), &c., the net profit was £2,959. In view of this profit and agreed reductions of wages of employees, the Lighting Committee expect to bring forward shortly proposals for reducing charges for current.

Mr. Chas. Furness, the BLACKPOOL tramways manager, reports that from July 22 to Sept. 15 the passengers carried were 8,795,373, compared with 10,150,384 for the corresponding period last year. Total traffic receipts were £85,780, against £93,302. The receipts per car mile, however, show a slight increase, amounting to 3s. 2½d. per mile. From April 1 to date the passengers are slightly under 18 millions, a decrease of over 5½ millions compared with last year, whilst the receipts of £164,605 are £24,604 below last year.

The income of the SALFORD TRAMWAYS DEPARTMENT for the year ended March 31 was £542,747, compared with £495,025 in previous year, the gross profit £108,797 (£119,528), and net profit £16,813 (£37,610), out of which £6,813 (£20,000) has been contributed to relief of rates and £10,000 (£11,610) to depreciation and renewals fund. Total revenue per car mile was 21.482d. and working expenses (including power) were 16.868d. Passengers carried were 78,142,501 and car-miles run 6,019,067.

The annual report and balance-sheet of LOWESTOFT ELECTRICITY DEPARTMENT for the past year shows total revenue to be £39,802, against £29,600 in the previous year, an increase of £10,201, and total working expenses (including cost of maintaining public lamps) £37,584 (£23,393), an increase of £14,190. Interest accounted for £4,832, against £5,850. The large increase in expenditure was mainly under the headings of generation and distribution, the former showing an increased cost of over £10,000, and the latter £2,300. Coal, which came under the heading of generation, showed the alarming increase of nearly £9,000. The distribution expenses increase was due to renewal of several sections of the distributing mains. In spite of the disastrous year through which they had passed, with its record loss, Mr. H. H. Saunders, the general manager, is of opinion that a comparatively quick recovery will be made, and that the end of the next financial year will show greatly improved results, provided that no further strikes take place in the mining industry.

Telegraph and Telephone Notes.

Sir Charles Bright asks us to point out that the statement regarding his father, which appears on line 78 of the second column of page 604 in our issue of Nov. 11, may give rise to a misapprehension. While it is true that the late Sir Charles Tilston Bright was engineer of the unsuccessful 1858 ATLANTIC CABLE, he was also the engineer who laid the successful cable. He was not responsible for the electrical failure of the earlier line. Among the early pioneers of 1861, Sir Charles Bright was, indeed, pre-eminent, as Lord Kelvin and Sir Henry Mance both pointed out in their Presidential Addresses to the Institution of Electrical Engineers.

According to "Tidens Tegn," proposals have been submitted to the NORWEGIAN BOARD OF TELEGRAPHS for two new cables for telephonic connection between Norway and Denmark and Germany. The first proposal is for a cable either from Arendal to Hirtshals, or from Fredrikstvern to Hirtshals, to cost about 1½ million kroner. The cable between Arendal and Germany would be laid over practically the same route as the existing telegraph line between Arendal and Sylt. The length of the cable would be 440 kilometres, and the total cost about 5 million kroner. On this cable three telephonic and one telegraphic connections could be made. In addition to the connection with Germany, it would be possible to telephone to countries with which Germany is, or may be, connected, such as Holland, Belgium, France, Switzerland, Italy, &c. It is stated that a further proposal may be submitted to the Board of Telegraphs for a cable between West Norway (Stavanger) and England, calculated to cost about 6 to 7 million kroner.

Wireless Notes.

The Air Ministry have recently obtained the temporary use of the WIRELESS STATION at LERWICK for the purposes of a meteorological observatory; its continuance as a permanent institution will be considered after a three years' trial of its usefulness in this capacity.

Notification No. 6081, issued by the Government of India on Oct. 22, prohibits the IMPORTATION INTO BRITISH INDIA of any APPARATUS FOR WIRELESS TELEGRAPHY, except under licence from the Director-General of Posts and Telegraphs, unless such apparatus is imported by a person licensed under the Indian Telegraph Act, 1885, to establish, maintain, and work a wireless telegraph in India.

Mr. Hughes, the Australian Premier, last week submitted to the House of Representatives details of the proposed DIRECT WIRELESS SCHEME BETWEEN AUSTRALIA and the UNITED KINGDOM, which he had previously foreshadowed. The Commonwealth and the Amalgamated Wireless Company will become jointly responsible for financing the scheme, the Commonwealth being allotted 500,001 £1 shares of the capital of £1,000,000, thus securing the controlling interest. The scheme is alternative to the link scheme submitted to the Imperial Conference. The proposed agreement is subject to the approval of the Imperial Conference. Wireless Estimates.

Personal and Appointments.

Mr. W. S. Smith has been appointed manager of the electrical department of the W. & A. Co., Ltd., Newcastle.

Mr. E. G. Gorman and Mr. H. G. Brown have been appointed members of the Mining Department Research Board.

Mr. F. W. S. Taylor, district manager of telephones in Birmingham, and Mr. P. F. C. R. R. L. the Brighton district manager, have exchanged posts.

Mr. R. J. Wensley, engineer of the Westinghouse Electric and Manufacturing Company, Ltd., has been appointed to an extended trip through England to study electrical conditions.

Newcastle Transport and Electricity Committee have re-elected Mr. R. J. Wensley as vice-chairman for the ensuing twelve months.

At a meeting at Loughborough, on Monday, of the Electricity Supply Industry (District Council No. 7, East Midland Area), ALDERMAN E. HUNTSMAN was unanimously re-appointed chairman.

Mr. H. A. H. Steward, chairman of the Light Railway Commission, has been elected to the position of Chairman of the Tribunal. The offices will be at 1, Horse Guards Avenue, Whitehall.

Viscount Chetwynd and Sir J. D. Rees have been elected to the Board of the Telephone Manufacturing Company in place of Messrs. H. G. Gorman and H. G. Brown. Lord Chetwynd has accepted the position of chairman.

Mr. F. Newey, Borough Electrical Engineer to Swindon Corporation Electricity and Tramways Department, has been appointed electrical engineer of the Long Eaton electricity works. There were 134 applications for the post.

A presentation of an inlaid Sheraton writing bureau from the staff and employees of York Electricity and Tramways Department was made last week to Mr. J. W. Hame, the late manager of the department, at a farewell smoking concert given in his honour at the City Arms.

Preston Town Council have appointed ALDERMAN PARKINSON chairman, and ALDERMAN ORMSBURY vice-chairman, of the local Tramways Committee. ALDERMAN HAMILTON and ALDERMAN PARKINSON have been appointed chairman and vice-chairman respectively of the Electricity Committee.

Mr. H. G. Gorman, who has resigned his position with the Birmingham Electric Supply Department in order to take up an appointment with the Calcutta Electric Supply Corporation, as station engineer, has been presented with a silver cigarette case by the members of the generating staff.

Mr. C. S. Atkinson has resigned his position on the staff of the Newcastle-on-Tyne Electric Supply Company to enter into partnership with Mr. P. Nutter (who was also on the staff of this company for many years) in the business of P. Nutter & Son, 41, Side, Newcastle-on-Tyne, engineers and merchants.

On Thursday, Nov. 24, Mr. FRANK A. RAWLINGS, of the Finance Branch of the Electricity Commission, was the recipient of a large canteen of cutlery, presented to him by the Commissioners and their staff, on the occasion of his marriage. Sir John Snell, chairman of the Commissioners, made the presentation.

Commissioned Telegraphist H. BLANDIN has been appointed to the Columbine for Port Edgar base. Commissioned Telegraphists A. BONIFACE and A. H. WARBURTON have been appointed to H.M.S. "Victory," Portsmouth, for Signal School. Lieutenant R. A. STORR joins H.M.S. "Malabar," depot ship at Bermuda, for charge of the wireless station on that island. Lieutenant H. F. THOMAS has been posted to H.M.S. "Columbine," Gibraltar, for services with the wireless station on the Rock.

On completing forty years' service with the Edison Swan Electric Company, Mr. J. M. MOFFAT was last week presented with a solid silver cigar box and a cheque from the directors and staff of the company. On Nov. 18, a presentation of a canteen of silver was made to Mr. J. S. CHILD, joint sales manager at the Ponders End works of the company, on his leaving after thirty years' service. In making the presentation, Mr. J. W. Elliot, lamp sales manager, referred to Mr. Child's forthcoming marriage, and said that the present was something in the nature of a dual one. An excellent presentation was made by Mr. A. P. R. R. L. to Mr. J. W. Elliot.

Business Items, &c.

The T. & A. T. B. Brothers & Company, Ltd., have removed their iron and steel works to Trafford Park, Manchester.

All communications to the general secretary of the Electricity Supply Association should be addressed to the secretary, 227, Well Hall-road, Eltham, S.E. 9.

We are informed that the DUBLINER CONDENSER COMPANY, Ltd., of Shepherd's Bush, is being wound-up voluntarily for the purpose of reconstruction. These proceedings are purely formal, and all creditors will be paid in full. The new company, which is in process of formation, will take over the old company as a going concern.

WILLYS OVERLAND CROSSLEY, LTD., announce that, owing to the reduced cost of manufacture, they are able to put the WILLYS light set, with the large capacity battery, capable of taking care of 100 20 W lamps, on the market at a greatly reduced price from Nov. 1.

The success of this model, due to the satisfactory working of the air-cooled Knight Sleeve engine, has made it possible to manufacture on a large scale.

We are informed that the fire which broke out on Thursday, Nov. 24, in a store-room in 2, Norfolk-street, Strand, a building occupied by a number of firms, including the Westinghouse Electric International Company, the Tudor Accumulator Company, did not originate in the Tudor Company's offices as stated in the Press. Naturally the fire tended to dislocate the company's business, but no matters were delayed for more than twenty-four hours.

W. H. ALLEN, SONS & COMPANY have secured from Harland & Wolff, Ltd., a licence for the manufacture of Diesel engines under Burmeister & Wain's patents. The engines will be made to jigs, tools, and fixtures under a system of detailed inspection to secure accuracy, interchangeability, and rapid production, and this work will be carried out in special fitting and erecting shops. These are fully equipped, and also have the latest appliances, so that the engines may be tested as nearly as possible under actual working conditions. The engines will be made in sizes to conform with present-day requirements, and the firm are specialising particularly in the supply of Diesel electric generating sets for auxiliary and emergency purposes on board ship. The firm hope shortly to be in a position to supply auxiliary air compressors under the same licence, and they are, at the same time, laying themselves out to provide the other auxiliaries which go to form the complete equipment of a ship's Diesel engine room. The machinery the firm are about to construct will comprise the following: Diesel auxiliary engines, Diesel engine-driven generators, auxiliary air compressors, motors for driving compressors, motors for sanitary, ballast, bilge, and cooling purposes, motors required in connection with refrigerating machinery, steering gear, hoists, and all descriptions of winches and centrifugal pumps for all purposes.

Institution Notes.

A Paper, entitled "Electrical Faults and Their Location," was read by Mr. Sichel, of Glasgow, before the GREENOCK ASSOCIATION OF ELECTRICAL ENGINEERS on Nov. 23.

Dr. H. S. Hele-Shaw, vice-president of the Institution of Mechanical Engineers, delivered the Thomas Hawksley Lecture on "POWER TRANSMISSION BY OIL" last week to local members of the Institution in Glasgow.

The LONDON STUDENTS' SECTION of the INSTITUTION OF ELECTRICAL ENGINEERS will hold a smoking concert on Friday, Dec. 9, at 7 p.m., at the Ship Restaurant, 45, Charing Cross-road, London, S.W. Tickets (price 3s. 6d.) can be obtained from Mr. L. B. Firnberg, 158, Adelaide-road, London, N.W. 3.

There was a large attendance at the annual dinner of members of the SOUTH COAST SECTION of the ELECTRICAL POWER ENGINEERS' ASSOCIATION, held at the Old Ship Hotel, Brighton, on Nov. 23, under the presidency of Mr. W. J. Oswald, of Wimbledon, who was supported by Mr. J. Christie, the engineer and manager of the Brighton Corporation electricity undertaking.

The twenty-fourth annual dinner of the KING'S COLLEGE ENGINEERING SOCIETY was held at the Holborn Restaurant, London, on Friday, Nov. 25. The chair was occupied by Mr. J. S. Highfield, President of the Institution of Electrical Engineers, the guest of the evening being Mr. W. B. Worthington, President of the Institution of Civil Engineers. The presence of the Principal of King's College, Dr. Barker; the Dean, Rev. Matthews; the Dean of the Faculty of Engineering, Prof. Wilson, and a muster of past and present members, made the gathering thoroughly representative of the society and its associations.

In an address on "Some Notes on the Economics of Power Transmission and Distribution" to the members of the NOTTINGHAM SOCIETY OF ENGINEERS last week, Mr. A. Phillips said that the electricity supply industry promised to become one of the large and important industries of the country. In its development, and to maintain its progress, large capital sums would be involved and continually required. In order to obtain these sums cheaply, and to ensure that further moneys would be forthcoming as required, it was necessary that the industry should be built up from the beginning on a sound financial basis. When very long distances were involved, it was necessary to keep down charges under the head of cost of transmission to a minimum, consistent with safety and the continuity of the supply. It was only when this was achieved that super-power stations would really come into their own. The lecture was illustrated by lantern slides.

A Paper on "Boiler-House Management," by Mr. David Brownlie, was discussed at a crowded meeting of the SOUTH WALES INSTITUTE OF ENGINEERS, held at Cardiff, last week. Mr. Brownlie's Paper was written and discussed under the following headings: (1) Types of boilers; (2) Mechanical stoking; (3) Economisers and Feed-heaters; (4) Superheaters; (5) Mechanical draught; (6) Auxiliary machinery. Those who know the author's vigorous style will not be surprised to hear that the discussion was animated. It was also well sustained, for the proceedings started at 2.30 p.m., and, with only a short break for tea, there was still a full house and many argumentative speakers when, at 8.30 p.m., the president called on Mr. Brownlie to do his best to reply in half-an-hour to all the questions and accusations which had been hurled at his head. As usual, Mr. Brownlie was as adamant, and refused to yield or be bullied by any of the attacks to which his outspoken views had been subjected.

Miscellaneous.

AN INTERNATIONAL CONFERENCE OF ELECTRICAL ENGINEERS was opened in Paris last week, under the auspices of the International Electro-Technical Commission.

Mr. C. S. Buyers, of Crompton & Company, electrical engineers and contractors, of Chelmsford, is stating the case for electricity in a discussion arranged by the CHICHESTER ENGINEERING SOCIETY on "Gas v. Electricity for Industrial and Domestic Purposes."

THE MINES DEPARTMENT OF THE BOARD OF TRADE are drafting regulations providing for the constitution of pit and district committees, and area and national boards, in accordance with the terms of Part II. of the Mining Industry Act.

OVER 200 schemes for public utility work have been sent by local authorities to the UNEMPLOYMENT GRANTS COMMITTEE. It approved they will involve a total expenditure of £7 000 000. A manifesto has been sent to the Prime Minister by the 345 Labour councillors in Scotland asking the Government to accept full financial responsibility for all relief work schemes and to allow the payment of standard rates of wages.

The issue for Nov. 15 of the "BULLETIN" of the FEDERATION OF BRITISH INDUSTRIES contains a transport supplement, which it is proposed to issue from time to time. This particular supplement deals in detail with the Railways Act and the position of the trader under its provisions, while statements on behalf of road transport, sea-carriage interests, and rolling-stock manufacturers are also included. The information given is clearly and interestingly set out, and the supplement itself worthy of wide distribution.

In order to deal with questions of wages, hours, conditions of service, and other matters affecting the staff employed on the Underground Railways, we understand that a scheme has been agreed on which provides for the establishment of sectional committees, departmental councils, and an UNDERGROUND RAILWAY COUNCIL. There is also to be a negotiating committee, consisting of representatives of the companies and of the trade unions concerned, which will deal with every alteration or variation of any agreement between the companies and the unions governing employment.

The Board of Trade have referred to a Special Committee a complaint by the British Flint Glass Manufacturers' Association and the National Flint Glass-makers' Society, that articles of domestic glassware, ILLUMINATING GLASSWARE, and mounting glassware, manufactured in Germany and Czechoslovakia, are being offered for sale in the United Kingdom at prices which, by reason of depreciation in the value in relation to sterling of the currency of the above-named countries, are below the prices at which similar goods can be profitably manufactured in the United Kingdom. The Committee will take evidence on Dec. 12, at the Hotel Windsor, Victoria-street, S.W. 1. The secretary is Mr. W. G. Fergusson, Board of Trade.

THE ASSOCIATION FOR THE ADVANCEMENT OF EDUCATION IN INDUSTRY AND COMMERCE has recently appointed two committees of enquiry to prepare reports on "Education for Foremanship" and "Education for Executive Positions in Industry and Commerce." The committee will welcome any information from firms that have already instituted some system of staff training for management, or from educational bodies—universities, technical schools, &c.—that specialise in these directions. Mr. R. W. Ferguson, of Cadbury Brothers, Bourneville (secretary of the Foremanship Committee), or Mr. W. Shovelton, of Christopher, Thomas, and Bros., Bristol (secretary of the Executive Positions Committee), will supply any further particulars or receive information on behalf of their respective committees.

The Export Credits Department has issued statements and regulations governing the EXTENDED FACILITIES FOR BRITISH EXPORTERS under the Trade Facilities Act. Applications for general credits, i.e., for specified amounts in respect of specified countries and for a specified period, must be submitted through the exporter's bankers. The Export Credits Department and its advisory council will decide the amount of general credit which it will be prepared to guarantee. The exporter under a general credit will be able to enter into transactions abroad up to the full amount fixed by the Department without further reference to it. In the case of credits for specific transactions, the Department may guarantee up to 100 per cent. of the amount of a bill drawn against a shipment if the credit does not exceed twelve months, and not exceeding 85 per cent. if the credit exceeds twelve months. The Department will not require bills to be accepted before guaranteeing them.

The following case, the British Chemical Trade Association states, is typical of the delay and chaos caused by the policy adopted by Customs with regard to the Safeguarding of Industries Act: A firm desiring to import SAL-AMMONIAC inquired of the authorities if this product, of a quality used FOR CHARGING BATTERIES, was liable to the key duty. They were told it was free, and imported about 100 casks, which arrived at a London dock on Nov. 1. About half was cleared without any trouble. Then Customs seized the remainder and held it until Nov. 16, when the importers were informed that it could be removed. The time for the delivery of the goods to the buyer had in the meantime expired, and the order had been cancelled. The result is that the goods have had to be put in store, and until the importers can find a buyer they will have to pay storage charges. It is probable the goods will have to be sold at a loss owing to a depreciated market, and this, together with the storage and cartage charges, will mean a fairly heavy financial loss over a transaction that should have shown a profit.

Tenders Invited and Accepted.

UNITED KINGDOM.

THE COMMISSIONERS OF H.M. WORKS. Dec. 6.—(1) Electrical and (2) mechanical engineering labour in day work in connection with the maintenance of installations in the Birmingham, Bristol and Liverpool districts. Forms of tender (separate for each district), &c., can be obtained at the Contracts Branch, H.M. Office of Works, London, S.W. 1.

DUBLIN GUARDIANS. Dec. 7.—Three months' supply of electric fittings, ironmongery, oils and colours, &c.

MANCHESTER CORPORATION. Dec. 9.—Self-sustaining electric hoist for Barton power station. Specification (B. 26) from Mr. F. E. Hughes, Town Hall, Manchester.

LEEDS HEALTH COMMITTEE. Dec. 10.—Installation of telephones at the Old Killingbeck Sanatorium. Particulars from the Superintendent.

DUBLIN UNITED TRAMWAYS COMPANY (1896), LTD. Dec. 12.—Electrical supplies for six months. Particulars from the General Manager's Office, 9, Upper Sackville-street, Dublin.

MANCHESTER TRAMWAYS COMMITTEE. Dec. 13.—(a) Motors and (b) controllers for trams. Forms and tender, &c., from the General Manager, Corporation Tramways, 55, Piccadilly, Manchester.

MANCHESTER GAS COMMITTEE. Dec. 14.—Two electrically-driven capstans and three dummy capstans on the site of the Bradford-gasworks, Manchester. Specifications, &c., from the Secretary, Gas Department, Town Hall, Manchester.

COMMISSIONERS OF HIS MAJESTY'S WORKS, &c. Dec. 14.—Electrical and mechanical labour in day work in connection with the maintenance of installations in the Glasgow and Edinburgh districts during three years. Forms of tender, &c., can be obtained at the Contracts Branch, H.M. Office of Works, London, S.W. 1.

WEST HAM GUARDIANS. Dec. 15.—Three months' supply of electric fittings, ironmongery, tools, &c. Forms of tender from the Clerk, Union-road, Leytonstone, E. 11.

WEST DERBY GUARDIANS. Dec. 28.—Electric light and power installation (including generating plant), electric lift service, and telephone installation at the Walton Institution. Specifications from Mr. E. B. Bailey, 37, Moorfields, Liverpool.

LONDON COUNTY COUNCIL invite applications from firms, and particularly manufacturers, to be placed on the lists of persons or firms from whom the Council from time to time invite tenders for the supply of electrical and mechanical equipment and spares, &c., required for the Council's tramways. Applications for inclusion in the first lists of goods required must be sent in not later than Dec. 31.

BIRMINGHAM SALVAGE AND STABLES COMMITTEE. Jan. 2, 1922.—Contract No. 1 (a) eight-cell destructor in two units; Contract No. 2, electric garage. Particulars from Mr. J. Jackson, Superintendent, Salvage Department, Council House, Birmingham.

AUSTRALIA.

VICTORIAN GOVERNMENT RAILWAYS. Jan. 25, 1922.—* Supply and delivery of ten coasting recorders, or, alternatively, ten coasting and service recorders, for electric trains. (Contract No. 34 736.)

COMMONWEALTH OF AUSTRALIA. Jan. 4 and 17, 1922.—Telegraph instruments and telephone apparatus and material (schedules 1 718 and 604), returnable in Australia by Jan. 4 and 17, 1922, respectively. Particulars from Supply Officer, Australia House, Strand, London, W.C. 2.

DEPUTY POSTMASTER-GENERAL, ADELAIDE.—Jan. 4, 1922.—*Supply and delivery of telephone apparatus and material, including cords, hand sets, supervisory lamps, plugs, jacks, &c. (Schedule No. 604.) Local representation is essential.

VICTORIAN GOVERNMENT RAILWAY COMMISSIONERS. JANUARY 4, 1922.—* 60 tons galvanised telegraph wires (contract No. 34 706): 25 steam meters and accessories for Newport power house (No. 34 611); and 150 electric train stops for power signalling (No. 35 546). Tenders must be accompanied by a preliminary deposit of half per cent. of total amount of tender, and local representation is essential.

NEW ZEALAND.

BOROUGH COUNCIL OF PALMERSTON NORTH. Original closing date Sept. 24. Extended date not yet decided.—*Service meters: (a) Single-phase, 230 V, 400 5 A, 150 10 A, 50 15 A; three-phase, balanced load, 400 V, 100 10 A, 30 25 A, 15 50 A, 10 75 A, 5 100 A. (b) 19 50 kVA single-phase transformers, with oil, complete; 1 complete winding h. and l. tension, for one leg; spare parts and accessories.

TORQUAY TOWN COUNCIL has accepted the tender of Mr. W. H. Lee for wiring St. Marychurch Town Hall.

DORCHESTER CORPORATION have accepted the tender of the Hart Accumulator Company for a 693 Ah battery at £1 262.

ST. HELENS CORPORATION have accepted the tender of E. Green & Son for economiser sections, at £1 350, and that of Ferranti, Ltd., for electricity meters.

EDINBURGH TRAMWAY COMMITTEE have recommended the Town Council to accept the tender of M'Hardy & Elliot, the lowest

* Particulars from the Department of Overseas Trade

... for the new station bodies at £14 50. Hurst, Nelson & Co. are valued at £1120 per car body.

SOCIETY OF SIX Companies have accepted the tenders of the Holophone Company for 100 lamp refractors and holders at prices from £2 5s. 9d. to £5 each.

CHIESTERFIELD Corporation have accepted the tender of the Metropolitan-Fields Electrical Company for two sets of Merz-Price gear and one earthing resistance at £570 14s.

ALDERLEY ELEC. Urban Council has accepted the tender of the Alderley and Wilmslow Electric Supply Company, Ltd., for connections from mains to the meters in twelve houses at £125 2s. 6d.

CANNOCK Council have accepted the tenders of Ferranti, Ltd., General Electric Company, and British Insulated & Helsby Cables, Ltd., for plant required in connection with the supply of current to the West Cannock Colliery Company.

SUNDERLAND Corporation have accepted the tenders of British Insulated & Helsby Cables, Ltd., for low pressure service cables, switch gear, and Cowans, Ltd., for distribution board, Revrolle & Company for switch gear, Ferranti, Ltd., and Reason Manufacturing Company for motor, and J. Heydon for partial rebuilding of A.E.G. turbine.

KYNETON (Victoria) Shire Council have accepted the following tenders in connection with the equipment of their new electricity supply station:—Ruston & Hornsby, two gas engines, £3853; Cherry & Sons, poles, £609; Foster & Fysh, erection of poles, £286; switchboard, £340; and outside distributors, £485; Noyes Bros., insulated cable, £116; Grant Bros., core cable, £1541; Thomas Bros., alternators, £953; Edison Swan Electric Company, meters, £600; British Electric Company, insulators, £219; Lawrence & Hanson, suspension fittings, £140. The total cost of the scheme is estimated at £11 200.

Catalogues, Price Lists, &c.

H. O. STRONG & SONS, Bristol, send us their latest catalogue of electric lifts and lifting and hoisting appliances.

L. G. HAWKINS & COMPANY have issued a descriptive folder, No. 760, relating to their "Universal" electric washer and wringer.

A new list of shunt and speed regulators for generators and motors has been issued by BILL & BERRY, 18 to 26, Constitution-hill, Birmingham.

A new price list of MILL, CLOTHING, SHIP AND DOCK FITTINGS has been issued by the Engineering & Lighting Equipment Company, Ltd., St. Albans.

Patentees of the "Visco" are further engaged in a pamphlet which has been issued by the Visco Engineering Company, Ltd., 21, Bedford-row, London, W.C. 1.

The catalogue of the WATT MOTORS, LTD., 150, Southampton-row, W.C. 1, gives a good deal of technical information, with a general specification, dimensions, sizes, &c., of various types of the "Watt" squirrel cage motor supplied by the company.

A revised edition of the first section of the catalogue of the WELLMAN-SMITH OWEN ENGINEERING CORPORATION, LTD., 36-8, Kingsway, London, W.C. 2, has been recently issued, and gives a good idea of the progress made in the design of charging machinery for open hearth furnaces during the past few years. The present catalogue is copiously illustrated, and contains particulars of the design and operation of the various types of machines supplied.

Cast iron that is not magnetic is among the latest productions of FERRANTI LTD. The magnetic permeability of this material.

No-Mag," as it is called, is as low as 1'03, compared with brass at 1'00, and ordinary cast iron at 330. Its specific resistance in micro-ohms per cm. cube is 140, compared with brass at 7'5, and ordinary cast iron at 95. It should, therefore, be an admirably suited fuse where eddy currents are prevalent, or where high electrical resistance is required.

METAL COILS AND MOTORS will be introduced in the

KENDRICK "inspection lamp, which has just been placed on the market by the NEALE CONSTRUCTION COMPANY, LTD., 7, Suffolk-street, Pall Mall, S.W. 1. The "Kendrick" is a combined lamp and electric magnet, which adheres firmly and immediately to any metallic surface. It can be fixed at any desired angle, and therefore the light can be thrown on the desired spot or object, thus making it superior to other lamps on the market.

A new catalogue of HELSBY JOINTING MATERIALS has been prepared by the British Insulated & Helsby Cables, Prescott. Particulars are given of the company's various rubber, calico, and other tapes, paints, rubber solutions, soldering paste, &c., and the purposes for which they can be used. Having considerable practical experience, extending over twenty years, the firm's products have acquired a high-class reputation for quality and reliability. Prices are not given in the list, but they may be obtained on application.

Messrs. Johnson & Phillips are publishing a useful series of "TRANSFORMER ABSTRACTS," which are written by the designer of the company's transformers. The first is a nicely-printed and well-illustrated booklet of twelve pages, which contains a brief but clearly-written description of some of the special features of a few of the typical transformers manufactured by the company. These booklets should prove useful, not only to the salesman, but to the potential purchaser or user of the transformers. Having a long and successful experience in the manufacture and installation of transformers, the company are in a position to supply machines for all purposes.

Companies' Meetings, Reports, &c.

EASTERN TELEGRAPH COMPANY, LTD.

The nineteenth ordinary general meeting of the Eastern Telegraph Company, Ltd., was held on Tuesday, Nov. 29, Sir John Denison-Pender, G.B.E., K.C.M.G., chairman of the company, presiding. The secretary (Mr. A. R. Hardis) having read the notice convening the meeting and the auditors' report.

The CHAIRMAN said: Gentlemen, you will find on reference to the accounts that the gross revenue for the year under review again shows an increase over that for the previous year, which at that time stood as the record year in the history of the company. It has now reached the substantial figure of £4 381 855; for the year 1919 it was £4 059 062, or an increase of £322 062. This is satisfactory as far as the gross revenue is concerned, but the very large increase in our working charges for the present year is relatively considerably greater; so that our net revenue, after providing for all working expenses and other revenue charges, is £352 500 less than it was last year. I am glad to say, however, that in anticipation of the further increase in expenses, and to provide for the uncertainty of future taxation, we carried forward from last year's 1919 accounts the sum of £416 082, so that our available balance for the year ending December, 1920, was £1 335 140. Out of this sum we have carried to general reserve fund £500 000, and to the maintenance ships' fund £100 000, and, after meeting the dividends on the ordinary and preference stocks, there remains £316 578, which we propose to carry forward.

Cause of Increased Expenses.

I do not propose to refer in detail to the various increases and decreases under the different headings in the accounts, but if anyone desires further information on any particular item, I shall be glad to supply it, and I will therefore only add that the principal increase is due to the revision of the standard scales of salaries and wages and to the temporary allowances granted to the staff on account of the exceptional conditions of life which they, in common with others working under similar conditions, have experienced both at home and abroad. I referred to this matter very fully last year, and explained the principle on which we have acted, and it will be unnecessary for me to go over the same ground again, but I may mention that there is an increase of 318 in the number of our staff as compared with 1919. The total number on Dec. 31, 1920, at our stations alone was 2 877, as against 2 559. You will, no doubt, remember that during the war period the training of young men was almost suspended, and it was impossible to make good the reduction of staff which is constantly occurring from the normal average of deaths, resignations and other causes. Therefore, as it takes several years of technical training, first at our school, and subsequent practice at stations abroad, to acquire the requisite efficiency for our main cable circuits, we are only now beginning to overcome the shortness of staff from which we suffered during the war and afterwards when the growth of traffic increased. I am glad to say, however, that our staff, though reduced in numbers, responded loyally to the expansion of our business, and willingly worked long hours in order to meet the demands of the Government and the public, but as this condition of affairs could not continue indefinitely, we have been making every effort to speed up the training, and I am glad to say that the additional numbers which have passed through our college and been distributed over the various stations abroad, is having the effect of reducing the amount of overtime, and allowing the usual well-earned home leave, thus, to some appreciable extent, relieving those who had to bear the brunt of the exceptionally heavy work during the last few years.

Increased Dividend Maintained.

Fortunately our financial resources have enabled us to deal generously with our staff. It was also a source of satisfaction that we were able to justify an increase in the rate of dividend on our ordinary stock from 8 to 10 per cent. for the year 1919, so that the interests of the proprietors and the staff, which are so closely allied, were thereby benefited by the prosperity of the company. To meet the claims of both it is necessary to maintain and improve the financial resources of the company, and this result can only be achieved by providing the Government and the public with a service equal to and, if possible, better than that which earned for us a good reputation in past years.

New Cables and Improved Service.

When I last had the pleasure of addressing you on this subject I stated that we were making every effort possible to re-establish the efficiency of our service, which had, in common with other public services, been adversely affected during the war, when it was impossible to transmit commercial traffic without very heavy delay owing to our inability to lay new cables or carry out the necessary constant renewals of our older sections. This drawback naturally prevented us from carrying satisfactorily the greatly increased volume of traffic with which we had to deal at that time, but I then informed you that an improvement had already taken place, and foreshadowed a still greater improvement when the whole work on hand was finished. This work is still proceeding, and as each section is completed the good effect is realised, and when the whole programme is finished we anticipate a cable service even more efficient and faster than that prior to 1914. These improvements will have entailed an expenditure by this company alone of about £3 750 000 sterling. So far, £1 300 000 has been charged against the general reserve fund, only £1 000 000 additional ordinary capital being raised—offered to and readily taken up by our stockholders, and we at present propose to meet the balance out of reserve fund accumulation. The traffic

this year has been very variable, at which no one can wonder, but when business becomes more normal I hope we may look for a traffic little short of that we have been carrying during the last two or three years, and, if so, we may find it advisable to still further increase our carrying capacity by laying additional cables in order to provide a larger margin of capacity in the possible event of an abnormal succession of temporary interruptions to our main line sections occurring. The depreciation of our reserve fund investments has been fully provided for, and the sum of £2,215,000 odd shown in the accounts represents approximately the actual value in December last. The maintenance ships' fund, after adding the contribution of £100,000 from revenue account this year, has been charged with the balance of the cost of the new cable repairing ship "Lady Denison-Pender."

Triple-Rate Service.

Before I conclude my remarks I should like to refer again to the triple-rate service. We should have welcomed its universal cancellation, but so long as foreign countries recognise this express system of communication at a charge of three times the ordinary rate, the merchant on British territory would be at a disadvantage if the same facilities were not accorded to him. Therefore, the only way to modify the objections to this system which have been raised in certain quarters is for us to give such an efficient service at ordinary rates as would make the difference in the time of transit between the two services so small that it would not be worth the while of the merchant to pay for the use of a triple-rate service, and it is this object your directors have always in view, and hope to attain.

The report and accounts were then adopted. The retiring directors, Sir Robert M. Kindersley, G.B.E., and Lord Inchcape, G.C.M.G., were re-elected; and Messrs. Deloitte, Plender, Griffiths & Company were also re-elected auditors. With a vote of thanks to the chairman, the directors and staff the proceedings terminated.

EASTERN EXTENSION AUSTRALASIA AND CHINA TELEGRAPH COMPANY, LTD.

The eighty-seventh ordinary general meeting of this company was held on Wednesday, Nov. 30, at Electra House, Finsbury-pavement, E.C., under the presidency of Sir J. Denison-Pender, G.B.E., K.C.M.G., the chairman of the company.

The General Manager and Secretary (Mr. F. E. Hesse) having read the notice convening the meeting and the auditors' report.

The CHAIRMAN said: In presenting their report with the audited accounts for 1920, your directors have, once more, to express their regret that, for the same reasons that prevailed in the war years, they were unable to hold the meeting as in pre-war days during the month of May. They hope, however, to effect a substantial improvement next year. The enforced delay in holding the meeting did not, however, prevent the payment to the shareholders at the usual time of the final dividend for the year 1920, as your directors considered from the estimated figures before them that they would be justified in making a total distribution of 10 per cent., free of income tax, without waiting for the shareholders' approval. Turning now to the printed accounts, which I think you will agree are highly satisfactory, it will be seen that the gross receipts for 1920 amounted to £2,514,825, against £2,446,865 for 1919, showing an increase of £67,960, notwithstanding the fact that the revenue for the latter year was £376,000 higher than in 1918. Comparing the revenue of the past year with that of the pre-war year of 1913, there is an increase shown of over 300 per cent. During the current year the traffic has naturally been affected by the acute commercial depression in all parts of the world, but, in all the circumstances, the revenue is considered to be not unsatisfactory.

Increased Traffic and Expenses.

The transmission of the greatly augmented traffic, to which I have just referred, necessarily involved a considerable addition to the working and other expenses for the past year, which, in round numbers, amounted to £1,196,000 against £962,000 in 1919, or an increase of £234,000. The increased excess profits duty of 60 per cent., against 40 per cent. for the previous year, and the new corporation tax, together with the debenture interest, &c., have to be added to the working and other expenses, making the total expenditure for 1920 £1,898,000, against £1,406,000 for 1919, or an increase of £492,000. It has not been found necessary to provide any further sum to meet depreciation of the reserve fund investments, owing to the good policy of your Board in past years having made provision for this contingency, the total amount of which to-day covers such depreciation. The principal items of increased expenditure are practically due to revised staff salaries and special allowances, and the exceptionally heavy cost of maintenance of cables during the past year.

The balance of the reserve fund was £1,100,000 at the end of 1919, £617,000, plus the balance of £232,000 brought forward from 1919, making together £849,000. From this amount, £450,000, or £100,000 more than in 1919, has been transferred to the general reserve fund, and £318,000 paid in dividend, leaving £81,000 to be carried forward to the current year's account. Turning to the balance sheet, it will be seen that the new capital offered to, and practically all taken up by the shareholders, has been added to the capital account, and the account debited with £559,824 in part payment of the new Madras-Singapore cable, and the acquisition of land and staff buildings at many of the Company's stations, to meet pressing needs for additional house accommodation. The cash at the end of the year was £1,100,000.

the new capital have been paid since the close of the year under review, and the shares, representing fractional interests, sold, and the proceeds distributed amongst the shareholders entitled thereto.

Improved Traffic Facilities.

At the last annual meeting I referred to the public complaints in connection with the regrettable delays in transmitting the Far Eastern and other traffics, and expressed the hope that when the cable renewals and additional new cables, which the Eastern and Eastern Extension Companies had in hand were completed, the efficient working provided in pre-war days would be restored, if not improved upon. Unfortunately, however, this has taken longer than was anticipated owing to a variety of adverse circumstances arising, which added to our troubles during the early part of the current year; but now, I am glad to say, the working is greatly improved, and it is expected that, ere long, the public will have a faster service, even at times of exceptional interruptions in the main line sections, to which cables are always liable. Having gone so fully into this question at the Eastern Company's annual meeting held yesterday, and the two Companies being so closely connected, it would be a waste of time to repeat what I then said, and I will therefore not trouble you with further details on the present occasion. I now beg to propose the adoption of the report and accounts.

The resolution having been seconded by Sir Albert J. Leppoc-Cappel, K.C.I.E., was adopted.

Col. BIRT asked whether the recent developments in wireless were likely to affect adversely cable business.

The CHAIRMAN said the shareholders at their general meetings for some years past had tried to get him to make some prophecy with regard to wireless. He was not going to do it, but he would give certain facts, and the shareholders could judge for themselves. Germany was supposed to be well up in wireless before the war, and her only means of direct communication during the war was by wireless. That fact ought to have assisted very materially in making wireless efficient in Germany. At the present time, however, Germany was about—if she had not already done so—to enter into an arrangement with the big Atlantic companies for direct cable communication with the United States. Italy was looked upon as the birthplace of wireless, yet, at the present time, endeavours were being made to obtain direct communication between Italy and Central and South America by cable. That being the case, did it look as if the days of cables were over? If wireless communication should prove to be better than cable communication, it would cut it out, but it had some work to do before it would be in that condition, whatever might happen in the future.

The retiring directors, Col. the Hon. A. G. Broderick, Lord Inchcape, and the Hon. George Peel, were re-elected, and the auditors, Messrs. Deloitte, Plender, Griffiths & Company, were re-appointed.

The meeting concluded with a vote of thanks to the Chairman and directors, the officials, and the staff, both at home and abroad.

WESTERN TELEGRAPH COMPANY, LTD.

The eighty-eighth ordinary general meeting of the Western Telegraph Company, Ltd., was held at Electra House, Finsbury-pavement, E.C., on Wednesday, Nov. 30, Sir John Denison-Pender, G.B.E., K.C.M.G., chairman of the company, presiding.

The SECRETARY (Mr. E. Steer Hodson), having read the notice convening the meeting and the auditors' report.

The CHAIRMAN said: Gentlemen, allow me to make a short reference to the loss we have sustained by the death of Lord Balfour of Burleigh, who sat on this Board for over fifteen years, during which time, although matters of detail he left for others to work out, when big questions came up for consideration, his knowledge, experience, and ability were of material assistance to your Board, for his judgment was sound; he will therefore be, as you will well understand, a difficult man to replace.

Receipts and Expenditure.

Although the accounts for the year ended June 30 last, now before you, do not show such a large balance of profit as the previous year, which constituted a record in the history of the company, they are certainly of a satisfactory nature, when you take into account the state of trade generally, and the question of exchange which is causing, not only in South America, but in other parts of the world, so much anxiety in commercial dealing. Receipts from messages show a decrease of nearly £613,000. The general depression in trade and commerce is accountable very largely for this, as it has, of course, affected the business of our company, and this year the depreciation of the currency of all the countries which we serve, against an appreciation in the previous year's accounts, is responsible for a very heavy loss on remittances, and also forms a large part of the decrease in revenue.

The balance of sundry increases and decreases in other items of revenue, namely, interest, rents and transfer fees, reduce the net decrease to under £610,000. On the other side of the revenue account the total working expenses were more by nearly £85,000, which includes special allowances given to the staff both at home and abroad to meet the exceptional times they, especially, have been passing through. Income tax, excess profits duty, and corporation profits tax, were less by over £381,000. I am glad to say excess profits duty will not appear in our next year's accounts, having terminated as far as the company is concerned in July last. There was also relief, compared with the previous accounts, to the extent of £6,500, expenses of the issue of the new capital and interest on

The Miami Cable Dispute.

sion when I had the pleasure of

New Cables and Renewals.

the older section between Lisbon

Urgent Telegrams.

the opportunity to mention

The Right Hon. the Earl of MIDLETON, K.P., seconded the resolution, which was adopted.

The CHAIRMAN said he would not express any opinion in regard to the tax. Of course, it was their business to oppose taxes in every shape and form. They had got rid of the excess profits duty, and perhaps they could stand the ills they had better than what they might get in the future.

Sir John Denison-Pender, Mr. J. C. Denison-Pender, M.P., and Mr. Francis Alex. Johnston, the retiring directors, were

2nd (to-day)

INSTITUTION

(STUDENTS' SECTION.)

JUNIOR INSTITUTION OF ENGINEERS.

NDAY, Dec. 5th.

Geological Society, Burli

INSTITUTION OF ELECTRICAL ENGINEERS,
(INCORPORATED BY CHARTER.)

INSTITUTION OF ELECTRICAL ENGINEERS.

ESDAY, Dec. 6th.

W

INSTITUTION OF ELECTRICAL ENGINEERS.

8.15 men At the Institution of Electrical Engineers, Savoy.

WEDNESDAY, Dec. 7th.

At Savoy-place, London, W.C. Paper
 of Transmuting Aerial Resistor

INSTITUTION OF RAILWAY SIGNAL ENGINEERS.

INDUSTRIAL LEAGUE AND COUNCIL.

THURSDAY, Dec. 8th.

At the University, Birmingham, Pa.

[illegible]

THE ELECTRICIAN

ESTABLISHED 1861.

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Notes of the Week.

Railway Electrification in South Africa.

WE are able to announce that the Government of the Union of South Africa have decided to proceed with the electrification of the section of the Durban-Pietermaritzburg Railway between Pietermaritzburg-Glencoe, a distance of about 171 miles. It will be remembered that in the original report of the consulting engineers, Messrs. MERZ and McLELLAN, it was suggested that the whole line, as well as the Cape Town-Simonstown Railway, should be converted to electric traction, but on the advice of Sir Wm. Hoy, general manager of the railways, the scheme will be limited for the present to the section mentioned. It is not, however, proposed to alter the present 3 ft. 6in. gauge. The direct current system at 3 000 V will be employed, and the total cost will be between £3 000 000 and £4 000 000. Details of the scheme, including the design of the locomotives, are being worked out, and no doubt tenders will be invited ere long. As an extensive electrification scheme for the Bombay suburban lines has also been adopted, it would appear that we are on the eve of important electric traction developments in the Dominions—a movement which will no doubt extend to this country in due course.

Reparations—A New Phase.

DURING the past few days events in connection with German reparations have caused the matter to pass to a great extent out of our object glass. Herr STINNES and Dr. RATHENAU have both visited this country with a proper air of mystery, and discussion has, as a result, now rather turned on whether Germany can pay at all than on the methods by which she shall pay. There are those, like Mr. Mr. J. M. KEYNES, who state that Germany can pay the next instalment of her debt, but will go bankrupt if she

does. There are those who think that Germany cannot pay the next instalment, but can pay all the others; and there are those, like Sir JOHN BRADBURY, who contend that Germany can pay the next and all the other instalments, if she chooses to do so. The last class add that Germany possesses vast hoards of wealth in foreign countries which the tax collector has not laid hands upon. These are matters of high finance, with which we have only an academic concern. The only thing of which we wish to be assured is that if Germany is to liquidate her debt she shall do it at her own expense and not at the expense of the British electrical industry. It is not yet realised by the public generally how harmful any system of payment in kind would be. It is a matter to which they should give close attention.

A Significant Attitude.

It is a little significant in this connection that, while Herr STINNES favours payment by creating a series of first debentures on German industries on which the British Government or the British private individual would draw dividends, Dr. RATHENAU's suggestion is that we should take our indemnity in kind. He thinks, according to the "Sunday Times," that if Germany were to agree to supply for nothing the plant for the electrification of railways that might be a form of payment that would do us no harm. On the other hand, we know it would do us a great deal of harm. We are under no delusions on the subject. It is, again, more than a little significant that Dr. RATHENAU is the controlling spirit in the A.E.G., and that the A.E.G. is anxious and willing to take on contracts for railway electrification. "The question," as the "Sunday Times" says, "is how you can stimulate Germany's power to pay without, at the same time, encouraging her as a competitor with ourselves and increasing unemployment at home?" Dr. RATHENAU's is not one of the solutions we should advise any British industry to adopt

for answering that question, and we are glad to see that Sir ROBERT HORNE is opposed to the idea for the sound reason that Germany can only, in the main, supply with the goods that we can make ourselves.

Electric Welding Problems.

AS MESSRS. L. J. STEELE and H. MARTIN truly said in their Paper on the "Cyc-Arc Process of Automatic Electric Welding," read before the Institution of Electrical Engineers last week, from the earliest times workmen have had to deal with the problem of fixing something to something else. It is a problem which is never easy, and becomes quite complicated when the fixing has to be done between dissimilar materials or between metals of different characteristics. It is not made any easier by the fact that the operation of uniting the two materials often results in the weakening of one or other, or both of them, and in certain particular cases, as MESSRS. STEELE and MARTIN showed, opens up potential avenues for leakage and corresponding evils. The development of the "Cyc-Arc" system was primarily the result of war conditions, but it has culminated in an equipment which allows welding processes to be largely extended in scope, to be facilitated in practice and to be carried out without many of the disadvantages which we have summarised above. It is simple and speedy in operation, and, if the conditions which existed at the demonstration given at the Institution are anything to go by, it can safely be entrusted to the least skilled workman.

Some Problems for Solution.

WE hope, however, that, having achieved this large measure of success, those responsible for the technical development of the process will not hesitate to go further. There are still many problems, both metallurgical and electrical, to be solved in this connection. It is only right to say that the authors themselves are under no delusion that they have reached finality. For, though they have, as a result of a good deal of hard work, succeeded in reproducing some excellent welds under a variety of conditions, there is still much to be learnt regarding the electrical and metallurgical processes involved. Some of these are hinted at in the Paper, but they whet our appetite for more. This is still another opening for the use of electricity in industry, and, that being so, these are matters which the research associations concerned might well take up. But the problem is far from being merely theoretical. Such a machine as that shown in operation at the meeting is, in the best sense of the word, labour-saving. It reduces the number of men employed under unsavoury conditions on a monotonous task, and it allows very much better work to be performed.

A Misconceived Criticism.

IN replying to the toast of "The City of Birmingham and Electricity Supply" at the annual dinner of the South Midland Centre of the Institution of Electrical Engineers last Friday, Councillor H. K. BEALE, Chairman of the Birmingham Electric Supply Committee, exhibited a state of mind towards electrical development which is, we fear, only too common among gentlemen holding similar exalted positions. His plaint, roughly, was that the Electricity Commissioners were forcing electricity undertakers to embark on a large capital expenditure without giving them any very clear idea of when the return was coming or where it was coming from. This to those who

have studied the Commissioners' work is but a travesty of the true position. But since Councillor BEALE holds this opinion, we were not surprised to find him protesting against the inauguration of Joint Electricity Authorities, and expressing a desire to be left alone to carry on on the old lines.

Sauce for the Goose and the Gander.

THAT he should have made such views public is a pity. For, in our opinion, the policy which has been adopted in the Birmingham district with regard to the inauguration of the new electricity area, is one whose principle might be more widely followed. Apart from that, his views are not a little inconsistent. Birmingham, as has been often pointed out, is one of the most progressive of municipalities. It has not shrunk, when occasion demanded it, from publishing the benefits it could confer on adjacent townships, or in insisting on them sharing in the facilities which it could bestow; and it has on occasion, as the LORD MAYOR remarked, "taken in" these smaller bodies, doubtless for their own good, though we believe some of them still have lingering doubts on the subject. The policy of the Commissioners with regard to electricity supply is but an extension of that policy for which Birmingham has been so highly commended, adapted to meet modern conditions. Those responsible for the conduct of city affairs should, therefore, be the first to fall into line.

British Submarine Cable Companies.

FROM every point of view, the position disclosed at the annual meetings of the Eastern and Associated Telegraph Companies last week was a particularly strong one. Not only was the Chairman, Sir JOHN DENISON-PENDER, able to announce a record gross revenue on the Eastern and Eastern Extension Companies account and a continuance of the 10 per cent. Ordinary dividend, which has been paid since 1918, but he was also able to give an excellent account of the substantial progress made in the laying of new cables and the renewal of old ones. The result of all this work is that the service is now rapidly approaching the high standard of efficiency maintained by the companies in pre-war days. The magnitude of the work involved is made evident when we say that the Eastern Company's programme of cable laying and renewals will entail an expenditure of about £3 750 000, of which sum only £1 000 000 has been provided by new capital, the remainder being met out of the Company's large reserves.

The Western Company's Progress.

THE Western Telegraph Company also has renewed the older section of the cable between Lisbon and Madeira, and the original Madeira-St. Vincent cable will be renewed early next year. When this task is accomplished it is proposed to lay the new cable between Pernambuco and Maranham, and also other cables connecting Pernambuco with Maceio and with Victoria and Rio de Janeiro, and a third cable between Rio de Janeiro and Santos, thus strengthening the Company's coast connections and increasing the efficiency and speed of the commercial service to South America. This expedition will entail an expenditure of about £700 000, bringing the total expenditure since 1918 on new communications and on renewing older sections of the Company's system up to £3 000 000. The fact that these large sums have been provided so easily and without any adverse effect on the dividend is proof of prudent management and sound financial methods in the past, and as soon as the South

American business revives the various extensions and renewals should add greatly to the revenue-earning capacity of the Company.

Position of Wireless.

THE inevitable question as to the effect of the competition of radio-telegraphy was put at the meeting of the Eastern Extension Telegraph Company, but the chairman prudently declined to play the rôle of wireless prophet. He pointed out, however, that Germany, which, owing to her isolated position during the war, ought to have developed an efficient wireless service, was about to make arrangements with the large Atlantic cable companies for direct submarine cable communication with the United States. Italy also wanted to have a direct cable service to South and Central America. The fact that these and other countries are considering the necessary steps to strengthen their position in regard to cable connection is evidence that wireless telegraphy cannot yet compete with the submarine cable, and, from the point of view of secrecy, efficiency and reliability, the latter has at present no rival. Of course, substantial progress has been, and no doubt still further advances will be made in radio communication; it will gradually develop new fields of commercial service, and by acting as a feeder for the telegraph companies it will become increasingly useful, but the end of the submarine telegraph is far off yet.

The Institution—Two Possible Paths.

Two different views as to the future functions of the Institution of Electrical Engineers were taken by Mr. J. S. HIGHFIELD and Prof. W. CRAMP respectively at the annual dinner of the South Midland Centre of the Institution of Electrical Engineers last Friday. Mr. HIGHFIELD would see the base of the Institution's activities broadened so that those who were not primarily electrical engineers could help it, and so that the Institution in its turn could be of use to the outside world. Prof. CRAMP, on the other hand, is an advocate of amalgamation. He would like to see all the engineering bodies, great and small, welded into one, so that the membership of one would mean easy delivery of the proceedings of the lot. Prof. CRAMP, we learn, indulges in a wide range of reading, but if he is to read all the papers on engineering that are published he will require not only a gargantuan energy, but a diurnal elasticity of a pseudo-Einstein variety. We know a little of the task of absorbing the contents of many engineering papers, and can assure him that he does not realise what he is asking for. The housing problem under such conditions would take on a new difficulty for engineers. With commendable reticence we say nothing about the financial aspect of the idea.

A Little Necessary Selfishness.

BUT for more serious reasons we incline rather to Mr. HIGHFIELD's views than to Prof. CRAMP's. For we feel that the allegiance of all electrical engineers must first be given to their own profession, as represented by the Institution of Electrical Engineers. Their attention must first be devoted to their own problems. Their efforts must first be turned to the development of the electrical industry. If after that they have any time or energy to spare, they may turn to other matters. But, as with other people, the electrical engineer's own tasks are sufficient unto the day, and can best be solved by specialisation rather than by devolution.

Electricity Supply in Rural Areas.

HOWEVER good a thing is, there will always be people to decry it. An example of this is to be found at Hereford, where there has recently been a little pother about the rural electricity supply scheme which the Electricity Department has so enterprisingly developed. This criticism has taken the insidious form of maintaining that the city ratepayers were financing the country scheme. The report of the Development Commissioners for the year ended March 31, 1921, does not bear out this view, and were it the case it is as well to note, it would contravene the conditions under which the scheme was started. It will be remembered that when, at the end of the war, a large amount of plant that had been installed in a shell-filling factory was left on the hands of the Hereford Electricity Committee, they applied to the Development Commissioners for £100 000 to purchase this plant in order to be able to give a supply for agricultural purposes outside their own area. The Commissioners consented to this arrangement on the ground that it was well that a test should be made on business lines as to the possibilities of employing electric power in agricultural and rural districts. Those who have followed the development of the scheme will agree that there is now no doubt as to its success, and this view is borne out in the Report.

The Advantages of the Scheme.

IT is also stated that for the time being these extensions, which would cost in all some £27 000, are to be held over until financial conditions improve. Nevertheless, some extensions are possible, as one of the conditions of the grant is that the net profits obtained on the rural supply account are to be applied to further extensions of the system. To those who consider that the city consumers are being milked for the advantage of the more rural community, the remark of the Commissioners that these same city consumers are having the use of modern electric equipment and the advantage of a lower price for electricity should be of interest. It is, of course, true that the city ratepayers are providing security for the rural scheme, but, as it is likely before long to be on a paying basis, they also possess a rosy prospect of becoming the owners of a valuable plant in twenty years without any call on the rates being necessary.

A Queue of Consumers.

AS to the general success of the scheme there can be no doubt. The electricity department have a waiting list of farmers and factories of all sorts in every area served by a transmission line, and, were conditions normal, there is no doubt that before long non-users of electricity would be in the negligible minority in these areas. As it is, thirty farms of 5 285 acres have been connected up, and it is estimated that 1 500 farms, aggregating 268 000 acres, will come into the scheme when completed. Sixty-nine houses and cottages have been provided with electricity for all purposes, and on completion it is expected that there will be 2 500 such domestic consumers. There is no doubt as to the future of the electric idea in this area, not the less because experiences of the last summer show what a help electrically-operated pumps will be in giving an adequate water supply in many of the villages, while a wide development of many country industries may confidently be expected.

Electricity in Mines.

FROM the 1920 statistics of the Chief Inspector of Mines we learn that the aggregate horse-power of electric motors in use in mines amounted to 1 080 822, or an increase of 5.04 per cent. over the preceding year. The total horse-power underground was 618 868, or 5.37 per cent. over 1919, while the surface motors aggregated 461 954 H.P., an advance of 4.61 per cent. In addition, motors of 20 045 H.P. are employed in metalliferous mines. Charts which accompany the statistics show that the progress in the introduction of electrical machinery has been more rapid in Scotland than elsewhere, and then come the South Wales, the Northern and the Yorkshire and North Midland divisions in the order named. The total quantity of mineral got by machines in 1920 was 30 746 274 tons, or 1283 per cent. of the total output; but one-third of the whole of the coal so cut was produced in Scotland, where nearly half the mines employ coal cutters. Curves of the rate of progress between 1910 and 1920 show that there has been a steady increase in the use of chain machines and a rapid increase in percussive and rotary drills.

Fatal Accidents.

NOTWITHSTANDING the increase in the number of electric motors, the accidents were below the average. During the year there were nine fatal electrical accidents, of which three were below ground, compared with six in 1919. As usual, the majority of the accidents were due to carelessness or ignorance. Only one accident was attributable to defective earthing of apparatus, but the Mines Department rightly continue to emphasise the value of this safeguard and of adequately maintaining and regularly testing the earthing circuit. In order to avoid the difficulty and delay entailed by carrying out a test from end to end of a long cable or of a complete cable system, H.M. Electrical Inspector of Mines has recommended a simple portable outfit for making tests at frequent intervals from point to point on the cable armouring.

Rating of Electricity Undertakings and Factories.

AMONG the present troubles of electricity supply authorities not the least burdensome is the incidence of the high and increasing local rates, and it is not, therefore, surprising to learn that many such bodies are taking steps to obtain a decrease of their assessments. Discussing this important question at the Auctioneers' Institute recently, Mr. FARADAY recommended local authorities to spend as little as possible commensurate with providing essential services. This is good advice, and we hope it will be followed so far as—and only as far as—non-productive services are concerned. But to adopt such a policy for productive undertakings such as electricity supply or tramways would be not only unwise, but would do far more harm than good. For instance, Edinburgh Corporation has both electric and cable tramways. But, while the working expenses of the electric lines are 15.4d. per car-mile, they are 19.63d. for the cable system, so that by converting the latter for electric working a margin of over £53 000 a year will be obtained after meeting interest and sinking fund charges on the capital required for the conversion. Again, some electricity authorities are working with inefficient generating plant, and by replacing this with modern machinery the works costs would be greatly reduced and the price of current lowered, thus conferring a great benefit on the supply authority and its consumers. Other instances of remunerative capital expenditure might be cited, but those given are sufficient to indicate

that only by the wise and economical outlay of capital can progress be made and the industrial situation improved.

Rating of Factories.

THE position in regard to factories and industrial works is more difficult, and the changes introduced by the war, coupled with the upward tendency of the district rate, have added to the difficulties. The owner-occupier of a factory is no longer ready to pay the usual 5 per cent. upon the capital invested, and, owing to the change in the value of the occupation, he is naturally seeking to obtain a revision of his assessment so as to make it more consonant with existing conditions. The law relating to rating—and particularly the rating of machinery—badly needs amendment, and we agree with Mr. FARADAY that we must have either a change in the law, or assessment committees must apply their minds to the new conditions in order to avoid injustice to industry.

Private Bill Notices for 1922.

THOUGH the projects for Private Bill legislation in the next Session of Parliament are not so numerous as in 1921, the percentage of those which relate to electrical developments is unusually high. For out of the total of fifty-two Bills twenty-six contain clauses which confer additional electricity supply or tramway powers, and, in addition, there are four interesting Scottish Provisional Orders. It must be remembered that the replacement of provisional electric lighting orders by special orders has something to do with reducing the year's aggregate.

London Electricity District.

The most important of the Bills is that promoted jointly by the London Electric Supply Companies to obtain additional financial and other powers for themselves and the local authorities in the area of the London and Home Counties Electricity District, with a view to full co-operation in the formation and operation of any Joint Electricity Authority which may be established. This is an ingenious way of getting over the difficulty created by the failure of the Electricity Supply (No. 2) Bill to pass in the last Session, and, provided all the parties interested are agreed upon the general principles of the measure, it would be an effective way of achieving the desired end.

It will be seen from the summary of the extensive powers demanded that the companies are seeking to amend the London Electric Supply Acts 1908 and 1910 and the Electric Lighting Act 1888, and also to postpone the date of purchase of the existing electricity undertakings. Some of the local authorities may object to this extension of the companies' powers, though we believe it would be in the best interests of the privately owned portion of the supply, and, indeed, of the electrical industry as a whole, if agreement could be reached on the question of prolongation, under reasonable safeguards, of the distributing powers of the companies. If this point were settled satisfactorily, the companies could then apply themselves seriously to the development of the lighting, power and domestic demands in their respective areas, and this, in turn, would assist any Joint Electricity Authority that may be formed for the whole district.

Power Companies' Proposals.

Another interesting and ambitious Bill is the joint bantling of the North Metropolitan Electric Power Supply and the North Metropolitan Electrical Power Distribution Companies. If the powers sought be conceded, the result

will be to transform the Power Company into a distribution authority for the whole of its area, and the Distribution Company will go into liquidation. The present conditions as to the method of charging for energy being too rigid, the company desires to be able to revise the prices and methods of charging from time to time. Another interesting departure is the provision to take from—and to give to—the Metropolitan and the London and North-Western Railway Companies supplies of electricity in bulk, and to distribute within the County of London electrical energy supplied to the Company outside the County by the railway companies.

There can be no doubt that many unnecessary restrictions have been imposed upon power companies, but it is probable the Bill will encounter opposition from some local authorities on the question of purchase rights. The Power Company's business is not purchasable, but the various undertakings of the Distribution Company are, and if the two are amalgamated the identity of the latter will be more or less lost, so that local authorities may consider their interests to be involved in the projected change. Apart from this, we think that the closer co-operation of the generating and distributing sides of the business would be to the advantage of the public, and would lead to economy of administration.

Development in South Wales.

The South Wales Electrical Power Distribution Company is also seeking authority to distribute electricity in certain districts, and to enter into agreements with the Urban and Rural Councils for the supply of electricity, &c. In addition, the company, as well as the Yorkshire Electric Power and the North Metropolitan Electric Power Supply Companies, are seeking further capital powers, including the right to issue one statement of accounts annually and to pay interim dividends.

Scottish Water-Power Schemes.

It is interesting to notice the revival of the Bill to incorporate the Grampian Electricity Supply Company for the erection of hydro-electric works and for supplying electricity in the Counties Perth, Kinross and Forfar, and in parts of the Counties of Inverness, Argyll and Stirling. This important measure is not unlike last year's project, but is modified a little in ways which may disarm the opposition of local authorities, and there is, therefore, a better prospect of success on this occasion. The Bill contains powers to sell, supply and distribute electricity, and to enter into agreements with local authorities and supply companies, to manufacture, sell and let electrical machinery and apparatus, to pay interest out of capital during construction, &c. An equally interesting but less ambitious scheme for the utilisation of the water power of Loch Doon is put forward by Ayr Corporation.

Miscellaneous Electric Supply Powers.

Some local authorities, including the Blackburn, Worthing and Neath Corporations, desire permission to give and receive a bulk supply of electricity, and several authorities are seeking additional powers for carrying on their electricity undertakings. Some of these powers can be obtained by means of Special Orders, but the opportunity of inserting the necessary clauses in omnibus Bills has been taken. The fact that they are considered essential for the proper execution of the duties and obligations of electricity undertakers is a good indication of the nature of the problems requiring solution, and is a proof that

electricity supply has outgrown the existing legislation. Among the exceptional powers desired are the right to sell and let for hire electric motors and fittings, to refuse supply to persons in debt or who use electricity contrary to the terms of their agreement, to make a charge for re-connection where supply has been disconnected through a consumer's fault, to alter authorised methods of charging and to revise prices from time to time, to allow the suspension of the sinking funds, to use sinking funds instead of borrowing, to create working capital accounts, to allow discounts, &c.

New Powers Necessary.

The majority of these powers are necessary for carrying on electricity supply on modern business lines, but tampering with the sinking fund should only be allowed under strict conditions and to a limited extent. Also we fancy that the ambition of Swansea Corporation to prescribe the nature and materials of wires, apparatus and fittings in any building supplied with the Corporation will not be gratified. At all events, it is so much in conflict with the principles of the Electricity Supply Acts and with the practice of the Electricity Commissioners that we cannot believe it has the smallest chance of being granted.

Tramway Bills.

Seven of the Tramway Bills and four of the Provisional Orders contemplate the construction of new lines, but several other local authorities want power to use trolley vehicles, to run trailer cars, to provide and run motor omnibuses, to run special services of cars on special occasions, to carry goods and parcels, to enforce the queue system, &c. The Birmingham and District Power and Traction Company and five other companies are promoting a Bill to postpone the purchase date of their undertakings, to extend their leases and to unify the whole into one system. The present depressed condition of tramway enterprise requires some stimulus, and it may be that the additional powers required, including a more extended use of the trolley vehicle system, which seems to be coming into increasing favour in some towns, may give the desired fillip to the industry.

Electric Railways.

Undeterred by previous failures, the promoters of the Canvey Island wharf and railway are again seeking sanction for their scheme, which includes the erection of a generating station for supplying electricity for traction and industrial power. The London, Brighton and South Coast Railway Company want to raise additional money for various purposes, including the equipment of the railway for electric traction. As light railways are now entirely under the control of the Ministry of Transport, and as applications can be made at any time, these schemes do not swell the total on this occasion. Taken altogether, the traction Bills are not as important as usual, and are indicative of the slump in tramway construction. However, it is to the electrification of the suburban lines of the railways that we look for the next advance in electric traction. No further powers are required for undertaking this work, and we believe that as soon as the amalgamation schemes are completed we shall have evidence of activity in this important branch of electrical engineering. There is, therefore, no lack of prospective orders, with the result that as the financial and industrial situation improves we may expect a rapid increase in the number of electric traction schemes.

Auxiliary Features in Automatic Telephone Systems.*

An Impulse Equalising Device.

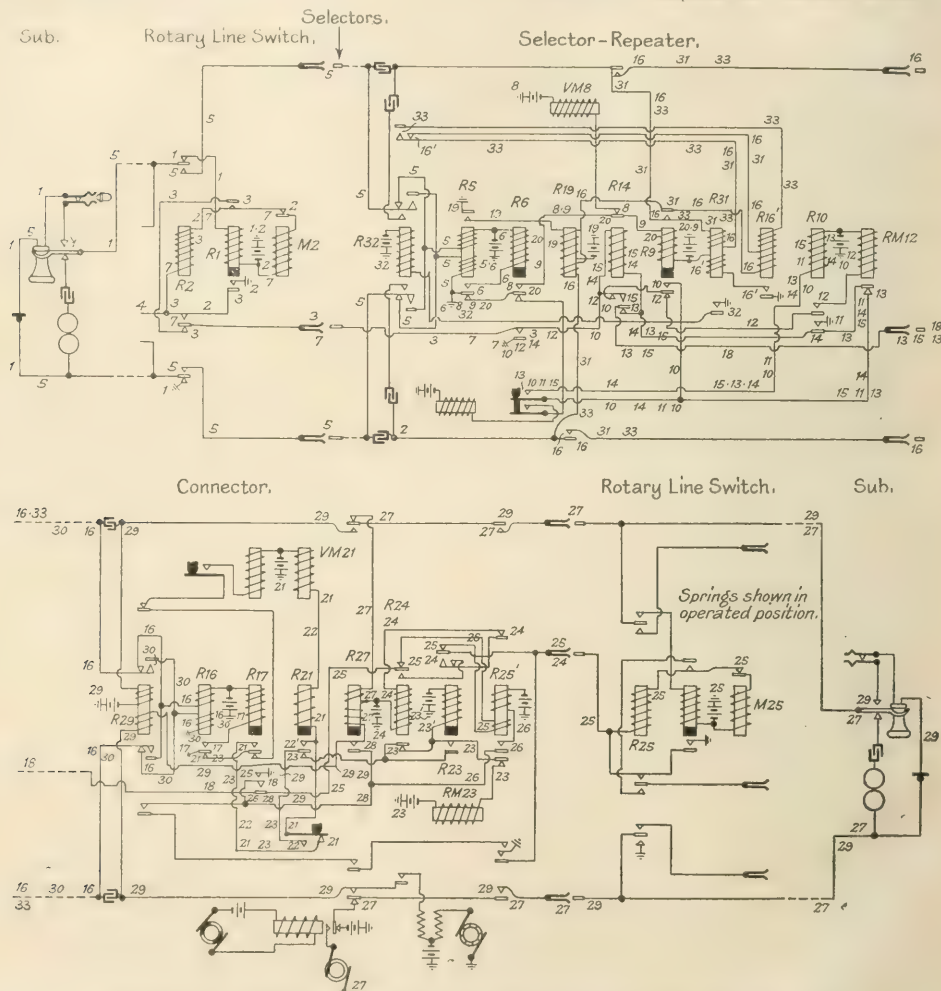
By W. AITKEN, M.I.E.E.

In automatic systems the calling impulses are distorted and attenuated by the quality of the line just as the speech vibrations are. Repeaters and other corresponding devices are introduced at intermediate points on trunks to relay or repeat the impulses so that they are sent forward again in proper shape and at correct intervals.

It sometimes happens that the same repeater or switching

The circuits are numbered as follows:—

1. R' energises when the receiver is lifted and completes circuits 2 and 3.
2. R2 energises if the line switch rests on an idle line.
3. If the line on which the line switch wiper rests is busy, R2 is short-circuited and M2 energises to find an idle line. R2 energises when an idle line is found. R' de-energises.
4. Calling line made busy over wire to connector terminal.



DIAGRAMS OF THE AUTOMATIC TELEPHONE MANUFACTURING COMPANY'S IMPULSE EQUALISING DEVICE.

device will be used in connection with trunks of different lengths. The following invention of the Automatic Telephone Manufacturing Company is designed to equalise the impulse current strength so that it is of the same value whether the trunk is long or short.

The diagram shows an arrangement whereby the dial impulses are maintained practically uniform when transmitted over trunks of varying lengths. In a multi-office system this is a matter of very great importance.

* All rights reserved

5. Caller's loop extended to selector-repeater. Impulse relay R5 energises.

6. Guard relay R6 energises.
7. Holding circuit of line switch.

The impulses are now sent and R5 de-energises and re-energises according to the digit value.

8. VM8 energises and steps up the shaft.
9. R9 energises for the duration of the impulses.
10. Rotary interrupter relay R10 energises.
11. R10 holding circuit. When the first digit is completed R9 de-energises.
12. RM12 energises and steps the wipers to the first set of terminals.

Circuit 11 is opened and R10 de-energises. Circuit 12 is opened and R11 de-energises.

13. If the first line is busy, R10 again energises to step the wipers to the next terminals.

14. If the first line is idle there is no short-circuit of R14 over the test circuit, and R14 energises in series with R10. R10 does not energise. Circuit 8 is open to cut off the vertical magnet VM.

15. R14 holding circuit.

16. The selector-repeater is extended to the connector. R16 and R16' energise.

16'. Neutralising winding of R31.

17. Guard relay R17 energises.

18. Connector made busy and R14 holding circuit completed. Second digit sent in and R5 de-energises and re-energises.

19. R19. The two windings of this relay neutralise each other. R19 energises and de-energises with R5, and opens and closes circuit 16.

20. R9 (slow) energises for the duration of the impulses, and short-circuits a winding of R16' and R31.

R16 responds to the impulses of R19. Relays 5 and 19 may have to repeat impulses to a short or a long trunk. R19 therefore operates in a peculiar manner to make the impulses uniform. The two windings of R19 oppose each other. When circuit 19 is closed, R19 energises to close the contact in the B wire. Circuit 16 is then completed through the lower winding. Now, if the trunk line is short (to relay R16), and therefore of low resistance, a heavy current will flow through the low resistance of R19 so that when circuit 19 is again opened the heavy current will cause R19 to de-energise quickly,

so that the impulses are comparatively short. If the trunk is long and, therefore, of high resistance, the current in circuit 16 will be smaller and R19 will de-energise more slowly and increase the length of the impulse. R19 therefore automatically adjusts itself to the value of the outgoing trunk. The winding in the circuit 19 has more turns, so that the current in the winding in circuit 16 is never strong enough to prevent R19 operating.

21. VM21 energises and steps up the shaft. R21 energises for the duration of the impulses.

22. New circuit for VM and R21, circuit 21 being opened at off-normal contact on first step. After impulses R21 de-energises and opens circuit 22 at 22'.

Final digit impulses.

23. RM23 rotates wipers. R23 energises for the duration.

24. If the called line is busy R24 will energise over earth on the terminal and busy-tone will be given in known manner.

25. If the line is idle, R25 and R25' will energise.

26. R25' holding circuit.

27. Ringing circuit. When called-receiver lifted R27 operates.

28. R27 holding circuit.

29. Called subscriber's battery feed and back-bridge relay R29 energises.

30. Connections of R16 are reversed to reverse the battery to the repeater.

31. The currents in R31 now assist each other.

32. R32 energises to reverse battery to calling line.

33. Holding circuit of connector, two windings of R16 in series.

Both receivers are replaced to clear.

Wave Length Relations for Progressive Antennæ Generation.

By A. PRESS.

The problem of progressive wave generation of electromagnetic phenomena has engaged the attention of investigators since the days of Maxwell and Hertz. However, it is necessary to distinguish rather sharply between the conditions for stationary wave propagation as against those for waves of progressive character. The differential characteristic of wave motion does not of itself distinguish between the two physically different types of phenomena, as Abraham himself saw clearly enough. Keeping, therefore, to strictly Maxwellian conceptions, it will be shown whether the Fleming five-times factor for the simple Marconi aerial obtains, or the 4.6 to 4.9 factor of Pollock, or whether the 4.2 factor of the Bureau of Standards prevails. The precise factor will be shown to depend rather upon the efficiency for radiation of the antenna system itself.

It should go without saying that if progressive waves are to be set up in the ether, then progressive waves (as against stationary waves) should also be set up along the antenna. Otherwise it is a little difficult to see how the one stationary wave length can connote one of the progressive type. The fact that heretofore mathematical investigations have all led to waves of stationary character is entirely beside the issue. To assume a progressive wave function for radiation, as Hertz had done, for a purely stationary wave type of oscillation is hardly satisfactory. The so-called method of deferred potentials is not very much better. It savours of begging the question.

The Generalised Problem.

Turning, therefore, to a more general type of development for the transmission of energy along wires, yet in thorough keeping with purely Maxwellian principles, it will be shown first to what extent one can look for a non-reflected, purely progressive type of wave along wires of finite length, fed from a source of sustained oscillations, and secondly how, with such type of progressive electric and magnetic waves of potential produced along the wire, progressive waves can be set up in the circumbient ether. The next problem will be to show how the antenna wave length factor for the progressive waves set up depends on the radiating efficiency of such antenna system.

In so far as electromagnetic radiation implies a progressively divergent flow of the stored field energies, electric and magnetic, it may be stated that in general each element of the antenna contributes its share of potential energy of both

types to the medium. If, then, the source is of the sustained oscillation type, radiation will imply that the power factor necessarily differs from zero and, therefore, the energies stored in the field per half cycle do not entirely return thereto in the corresponding second half of the cycle. This type of action is analogous to hysteresis, so that radiation of itself is equivalent to a hysteretic loading of the antenna per unit of length.

Representation of Sustained Oscillations.

With sustained oscillations, magnetic and electric hysteresis for a given frequency can be represented by resistances. Thus for magnetic hysteresis (elliptic) it will be necessary to load up the line of the antenna with distributed

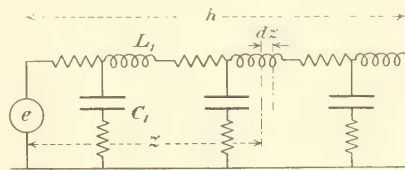


FIG. 1

fictitious resistances in series. For the electric hysteresis correspondingly, it will be necessary to introduce fictitious resistances in series with the distributed capacitances to ground. The theory of such elliptic hysteresis has already been dealt with in the writer's "Harmonic Algebra." Solving for such a hysteretically loaded line, we have the following formulae for current:

$$i = i_s + i_p = \text{stationary wave} + \text{progressive wave} = \frac{2\pi h(h-z)}{\lambda}$$

$$i = \frac{V C_1 e_0}{\sqrt{a^2 + b^2}} \times \frac{1 + h_1^2}{\lambda} \sin \frac{2\pi a(h-z)}{\lambda} \cdot \sin \left\{ \rho d + \tan^{-1} \frac{a + b h_1}{a h_2 - b} \right\}$$

$$i = \frac{V C_1 e_0}{\sqrt{a^2 + b^2}} \times \frac{1 + h_2^2}{\lambda} \sin h \frac{2\pi b(h-z)}{\lambda} \cdot \sin \left\{ \rho d + \frac{2\pi a(h-z)}{\lambda} + \tan^{-1} \frac{a h_1 - b}{a + b h_2} \right\}$$

where the voltage obtaining at the end of the antenna $z = h$ is given by the expression

$$e = e_0 \sin pt.$$

The derivation of the above formulæ is given elsewhere. The principal aim of the present article is to show how the wave length of the progressive wave of radiation depends on a progressive wave as against a stationary wave being set up on the antenna. The constants a , b , n_2 , really depend upon the resultant hysteretic loading of the antenna. The voltage wave along the antenna is characterised as follows:

$$e = e_0 \sin \left[\frac{2\pi h(h-z)}{\lambda} \cos \left\{ \frac{2\pi a(h-z)}{\lambda} \right\} \sin pt \right] \\ + \sin \left[\frac{2\pi h(h-z)}{\lambda} \right] \sin \left\{ \frac{2\pi a(h-z)}{\lambda} + pt \right\}$$

It may be stated that the above voltage characteristic is borne out in particular by the work of Chant and Braun.

The Effect of Progressive Waves.

The thought occurs to one that if resultantly radiation involves hysteretic phenomena, provided the antenna has a suitable initial hysteretic loading, such progressive waves of e_z and i_z (electric intensity E and magnetic intensity H) should give rise to progressive waves in the ether. It is this type of investigation that had been undertaken as mentioned above, and the result in accordance with the methods disclosed in the writer's Paper of December, 1920, in the Proceedings of the Institute of Radio Engineers, gives the following for the voltaic effect (condenser effect of antenna at potential e_z):

$$D_z \left(\frac{a}{r} \right) = \frac{a}{\mu V} \cdot \frac{2\pi N(\gamma - a_1)A}{\lambda} \sin \left[\frac{2\pi h(h-z)}{\lambda} \right] \sin \left\{ pt + \frac{2\pi a(h-z)}{\lambda} + \frac{2\pi NB(r-a_1)}{\lambda} \right\} \\ + \sin \left[\frac{2\pi h(h-z)}{\lambda} \right] \sin \left\{ pt + \frac{2\pi a(h-z)}{\lambda} + \frac{2\pi NB(r-a_1)}{\lambda} \right\} \\ + \sin \left[\frac{2\pi h(h-z)}{\lambda} \right] \sin \left\{ pt + \frac{2\pi a(h-z)}{\lambda} + \frac{2\pi NB(r-a_1)}{\lambda} \right\}$$

The above exhibits a radiant wave of electrical displacement, not only in the z direction (along the wire), but what is more

remarkable, there is clearly a divergent (progressive) type of wave actually set up in the r direction (at right angles to the antenna). This development has been obtained by strictly Maxwellian methods involving only instantaneous potentials. A further component of displacement takes place necessarily due to the galvanic effect (variation of H produced at any point in space due to the current i_z along the antenna).*

If now the above D_z formula is scrutinised, it will be seen that the progressive wave depends on the expression

$$\frac{-2\pi N(\gamma - a_1)A}{\lambda} \sin \left[\frac{2\pi h(h-z)}{\lambda} \right] \sin \left\{ pt + \frac{2\pi a(h-z)}{\lambda} + \frac{2\pi NB(r-a_1)}{\lambda} \right\}$$

where a_1 refers to the effective diameter of the antenna wire. Experimentally in connection with antennæ, it has been determined by Prof. Eccles that an exponential formula such as the above obtains. The exponent $2\pi NA$ appears to be negligible in comparison with unity. It should, moreover, follow that in the free ether the quantity NB above ought to be unity. The above two conditions, therefore, must lead to a possible evaluation of the constants a and b .

In the development above noted we have the formulæ

$$N^2 = a^2 - 1 - b^2 \\ \text{and } B = \sqrt{\frac{1}{\lambda}} \cdot \sqrt{1 + 4a^2b^2} - 1$$

so that with the condition that N in NA is negligible, in order to avoid an imaginary exponent, it follows

$$a = 1.27 \quad ; \quad b = 0.786$$

Thus in the sine expression above, for a Marconi aerial, we should have

$$4ah = \lambda \quad ; \quad 4a = 5.08$$

In other words, for an efficient radiating aerial, the natural wave length should be practically five times the antenna height as Dr. Fleming has found.

* The "voltaic" and "galvanic" effects amount to considering separately the distant effects produced from the condenser portion of the circuit and the effect produced by the material self inductance of the circuit.

The Alexanderson System for Long-Distance Radio Communication.†

Historical.

The system of radio communication described in this article has been developed during the last few years by the General Electric Company (U.S.A.) under the direction of Mr. E. F. W. Alexanderson. It has been adopted by the Radio Corporation of America, which recently absorbed the interests of the American Marconi Company, and it is their intention to employ it at all its stations devoted to long-distance signalling. It is stated, moreover, that the Alexanderson system has been adopted for future installations by the British Marconi Company.

Some years back Fessenden, seeking a means of generating continuous waves for long-distance transmission, turned to the General Electric Company with the request for the development of an alternator with frequencies from 50 000 to 100 000 cycles, which until that time had been considered impracticable. The result of this was the development of a 2 kW, 100 000 cycle alternator.† A number of these 100 000 cycle alternators were built and one of these found its way to the laboratory of Mr. Marconi, who took a personal interest in this development. In 1915 Mr. Marconi made a visit to Schenectady in order to witness the tests of a 50 kW, 50 000 cycle alternator, and on his invitation this alternator was installed experimentally

in the transoceanic radio station of the American Marconi Company at New Brunswick, N.J., which had been erected to communicate with Carnarvon, but was not then in use. This provided the opportunity not only to test the alternator and other features which had been developed in connection with it, such as the magnetic amplifier and speed regulator, but gave the inventor the opportunity to demonstrate on a large scale his ideas for improvements in antenna design.

Experimental demonstrations of telegraph and telephony were made during 1917, and attracted the attention of the United States Government. An urgent need for transoceanic radio communication was at that time making itself felt in connection with American military operations in France, and in January, 1918, the 50 kW alternator set in New Brunswick, though installed in an experimental way, was commandeered for official transoceanic service by the United States Navy, and was operated until it was replaced by the 200 kW set, which was installed in September, 1918, and is now in use.

Radio Transmitting System.

The important features of the Alexanderson transmitting system are:—

(1) *The Alternator*, which generates currents *directly* at the working radio frequency, in contrast to certain other systems in which the radio frequency currents are obtained *indirectly* by means of "reflector circuits" or frequency raising transformers electrically associated with the alternator. The

† Based on articles by Mr. E. F. W. Alexanderson and others in the "General Electric Review."

† Alexanderson, "General Electric Review," January, 1915.

frequency is dependent solely upon the number of field poles on the machine and the speed at which its rotor is driven.

(2) *The Magnetic Amplifier*, which provides a non-arcng control of the alternator output for radio telegraphy and also a means of modulating the alternator output for radio telephony.

(3) *The Multiple-Tuned Antenna*, an arrangement which has greatly reduced the wasteful resistance and increased the efficiency of the long, flat-top antenna.

Alternator Details.

The Alexanderson alternator is of the inductor type. The rotor is a solid steel disc, near the periphery of which several hundred poles are formed by milling out radial slots on each

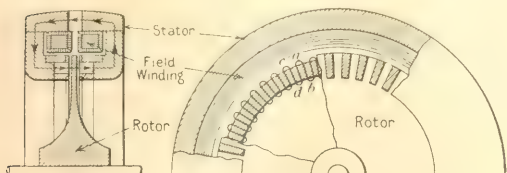


FIG. 1.—SECTION OF THE ALEXANDERSON ALTERNATOR.

side of the disc, the slots being filled with non-magnetic material so as to present a smooth surface and reduce air friction to a minimum. Embracing the periphery of the rotor-disc, as shown in section in Fig. 1,* is a laminated yoke, between the faces of which the slotted portion of the rotor passes. On the yoke is wound circumferentially a field-coil, supplied with direct current, which produces a magnetic field flux passing through the yoke faces and across the rotor disc, as shown by the arrows. The armature-winding is placed in slots cut radially in the yoke faces on each side of the rotor-disc; there is but one conductor per slot, which is wound back and forth in the slots, zig-zag fashion. Thus both armature and field-windings are stationary, a periodic variation of flux through the armature being produced by the variations of the reluctance as the rotor poles move past the stator poles between the armature slots.

Standard Sizes.

The standard sizes of alternators, as at present constructed, are 5, 25, and 200 kW. In order to provide a range of frequencies, the 25 kW and 200 kW alternators are manufactured with different numbers of poles, and with different gear-ratios between the alternator and the motor driving it. Thus the 25 kW machine can be arranged for any wave-length from 6 000 to 10 000 metres, and the 200 kW machine for any wave-length from 10 500 to 25 000 metres. A set can be run at a frequency below that for which it was designed by running the motor at a reduced speed.

The older 50 kW alternator at New Brunswick was driven by a d.c. motor, the speed control of which is comparatively simple, but the 200 kW alternator is driven by an induction motor running off the available two-phase, 60-cycle, 2 300 V supply. The 50 kW alternator was operated at wave-lengths of 8 000 and 9 300 metres, and the 200 kW alternator is normally operated at 13 600 metres, with a speed of 2 170 revs. per min.

The New Brunswick Alternator.

The following description relates to the 200 kW alternator at New Brunswick. It is coupled to the motor through double-helical gear with a speed step-up ratio of 1 to 297, running in an oil bath. The main bearings and thrust bearings have forced lubrication at a pressure of 5 to 15 lb.; the oil gauge on the main feed pipe is fitted with a signalling circuit to call attention in case the oil supply fails. The main bearings are water-cooled; the stator (which is built of laminations $1\frac{1}{2}$ thousandths of an inch thick) is also water-cooled. It will readily be seen that magnetic leakage would reduce the variations of flux through the armature, unless the airgap were made very small, and in the machine in question the gap is 1 millimetre. It is important that the rotor be kept accurately centred half-way between the stator-faces, for otherwise the armature coils on one side would be overloaded and there would be a strong end-pull on the rotor. This is accomplished by the use of specially designed thrust-bearings, which are interconnected by a set of equalising levers with an adjustable controlling leaf between them. These automatically take up

any slack in the bearings and compensate for any tendency of the airgap to become unequal on the two sides; they also prevent binding between the thrusts, due to expansion of the shaft from heating.

Armature Coils.

The armature coils are shown in Fig. 2 as though tipped away from the rotor on each side. There are two distinct armature windings, one on each side of the rotor, and each of these is divided into thirty-two independent sections, each generating about 30 A at 100 V. There is no electrical connection between the individual armature sections, each of which is connected to a separate primary winding of two turns on the transformer; with this arrangement the potential on any armature coil is very low, and a faulty armature coil may be cut out of circuit and the operation of the alternator continued with but a slight decrease in its output.

There are two air-core transformers, one for the armature coils on either side of the rotor; these are mounted above the alternator. Besides the primary coils connected to the armature sections, each transformer has an intermediate coil of twelve turns and a secondary coil of seventy-four turns. The two intermediate coils are connected in parallel and are shunted by the magnetic amplifier; the secondaries are also in parallel and are connected in series with the antenna circuit. The connections are illustrated in Figs. 2 and 3, and more simply in Fig. 4. The full load output of the alternator, on the secondary side of the transformer, is 100 A at 2 000 V.

Automatic Speed Regulator.

Any variation in the speed of the alternator would throw it out of resonance with the tuned antenna circuit; it is, therefore, necessary for the speed to be kept constant within very close limits, and this is effected by an automatic regulator. One of the armature coils of the alternator, L_{10} , Fig. 3, is set apart for supplying the current for controlling the speed regu-

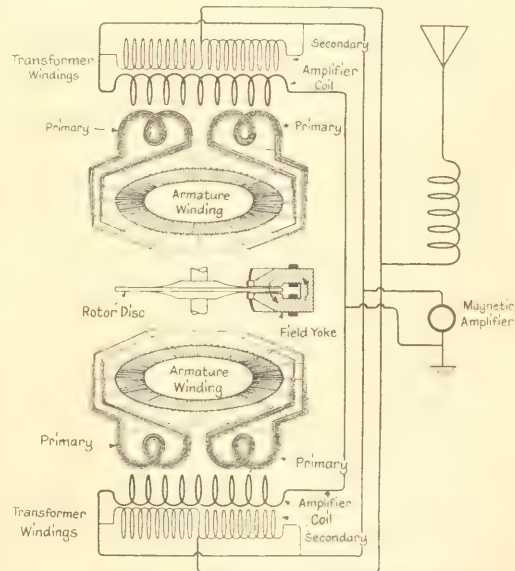


FIG. 2.—SCHEMATIC DIAGRAM OF ALEXANDERSON RADIO FREQUENCY ALTERNATOR CIRCUIT.

lation; it is connected to a condenser C_1 and an inductance P_1 , the circuit being tuned to a frequency slightly above that at which the alternator is to be worked. The coil S_1 is coupled closely to P_1 , but not so closely as to affect appreciably the tuning of the resonant circuit, and is connected through a rectifier E (which may be of the "Tungar" thermionic or the mercury-vapour type) to the control-coil of a special form of Tirrill regulator. M_1 and M_2 indicate the two usual control-coils of the regulator, and T_1 its vibrating contacts, which vary the field of a d.c. dynamo K_1 . The latter supplies current to the windings P_2 on the variable choking coils N and O , the windings S_2 being connected in series with the leads supplying current to the induction motor M driving the

* Fig. 1 is Fig. 106 from p. 124 of Lauer and Brown's "Radio Engineering Principles" (McGraw-Hill).

alternator, one in each phase. R_3 is a liquid resistance in the rotor circuit of the motor.

Impedance Regulation.

The impedance of the choking coils is varied by varying the direct current flowing through P_6 ; this varies the magnetic flux in the iron cores of N and O, which varies the permeability of the iron. When the exciting d.c. is at its maximum value

it back to the normal value. If the speed of the motor falls, the opposite action takes place.

Effect of the Signalling Key.

The effect of changes of load on the alternator due to the manipulation of the signalling key is further compensated by a "compensating relay," which, when the key is closed, closes contacts T_2 which short-circuit a resistance R_6 in series with

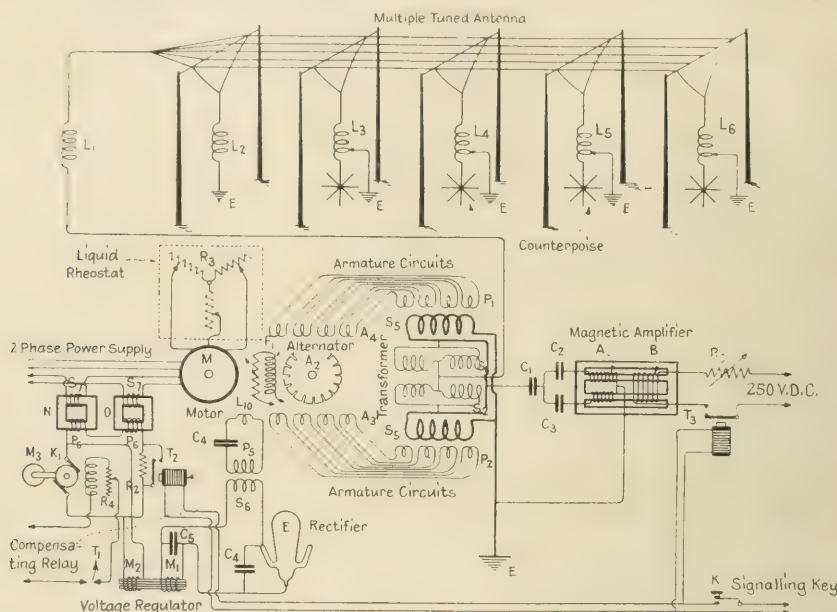


FIG. 3.—FUNDAMENTAL STATION DIAGRAM OF 200 kW ALEXANDERSON ALTERNATOR SET, RADIO CORPORATION'S TRANSOCEANIC STATION, NEW BRUNSWICK, N.J.

the iron core is saturated and its permeability is hardly greater than that of air, so that the impedance of the choking coils falls to a minimum; when the exciting d.c. is zero, the impedance is a maximum, and any intermediate value of impedance may be obtained by adjusting the exciting d.c. to a suitable intermediate value.

The high frequency current in the resonant circuit L_{10} C_4 P_1 rises sharply to a maximum at the point of resonance, as shown in the curve, Fig. 5, i.e., at a speed slightly above the normal,

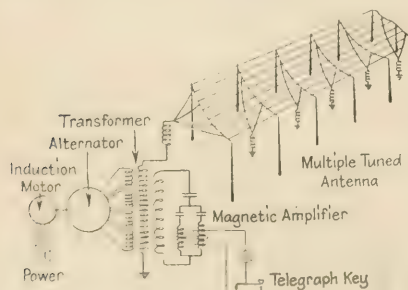


FIG. 4.—DIAGRAM SHOWING METHOD OF CONTROLLING HEAVY ANTENNA CURRENT BY MEANS OF A COMBINATION OF TUNED CIRCUITS.

so that over the working range of the speed regulator the controlling current rises very rapidly with increase of speed of the motor. Suppose, now, the motor speeds up, whether through drop of load on the alternator on opening the signalling key or from any other cause, the current in the resonant circuit and therefore the rectified current supplied to M_1 increases, the Tirrill regulator reduces the field of K_1 , the d.c. through coils P_6 is reduced, the impedance of coils S_1 is increased, tending to reduce the speed of the motor and bring

the coils P_6 . The regulator keeps the speed constant within 0.1 per cent.

The Magnetic Amplifier.

The magnetic amplifier, like the choking coils just described, works on the principle of varying permeability, produced by variation in the exciting or controlling current. In this case two cores, each having a separate a.c. winding A (Fig. 3), are both magnetised by a common winding B. The controlling current passing through B is interrupted by the signalling key, or is modulated by a microphone through the medium of valve-amplifiers. Any variation in the controlling current through B produces a corresponding alteration in the impedance of coils A; these are connected across the winding S_3 on the alternator-transformer. When the signalling key is open, the relay T_1 is closed, and a direct current flows through B sufficient to saturate the core and reduces the impedance of windings A to that of coils without any iron core; windings A then short-circuit winding S_2 —that is, in effect, the alternator is short-circuited, while at the same time the antenna circuit is detuned. The voltage of the alternator is pulled down to a low value, and so is the antenna current. When the key is closed, T_2 interrupts the current through B, the impedance of windings A becomes so high that they divert a comparatively small current from the alternator, the voltage of which rises to the normal value, while at the same time the antenna system returns to a state of resonance and the alternator output flows into the antenna system.

Advantages of the Magnetic Amplifier.

The great advantage of the magnetic amplifier is that large radio-frequency power can be controlled very rapidly with very little sparking at the key or relay contacts, and it therefore permits rapid telegraph signalling. The amplifier has been operated experimentally at speeds exceeding 500 words per minute. When working at high speeds, a control current is used in coil B larger than is required to produce saturation in the core, so as to magnetise the cores more rapidly and so reduce lag in the functioning of the amplifier.

The two coils A are wound in opposite directions, so that they produce fluxes in opposite directions through B, and do

not tend to induce a high-frequency E.M.F. in B. The coils A are connected in parallel, which is found to give the amplifier a better characteristic than if they were connected in series. In order to prevent the fluctuating current in B from inducing audio-frequency currents in the closed circuit formed by the two windings A in parallel, condensers C_2, C_3 are connected in series with each of the windings A; these condensers have

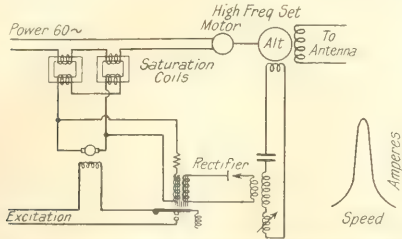


FIG. 5.—DIAGRAM OF SPEED REGULATOR FOR HIGH FREQUENCY ALTERNATOR.

a very high impedance to audio-frequency currents, but a low impedance to the radio-frequency current. Another condenser C_1 is also connected in series with the amplifier, its capacity being chosen to neutralise the inductance of the windings A for some definite value of excitation current in coil B, at which the impedance of the circuit C_1A then becomes a minimum. This greatly increases the sensitiveness of the amplifier, as may be seen from the curves in Fig. 6. Curve A shows the antenna current for different control currents, without the series condenser C_1 ; even under these conditions the antenna current can be reduced to a low value by a further increase in the control current. Curve B shows the control obtained with a series condenser of 0.33 mfd, and curve C with 0.125 mfd; the former shows almost complete modulation of the antenna current. It is further noticeable that curves B and C show an almost linear proportion between control and antenna currents over the working range; this is of great importance in radio telephony, since it enables the microphone current to be reproduced in the radio-frequency circuit almost without distortion, which is essential for satisfactory speech reproduction.

In telegraphy, the antenna current is reduced during spacing to 9 per cent. of its full value during marking, and its wave-

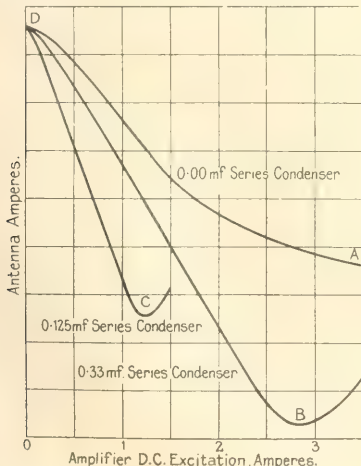


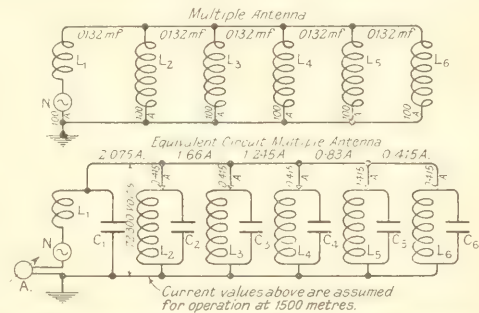
FIG. 6.—CONTROL CHARACTERISTICS OF THE MAGNETIC AMPLIFIER.

length is also altered. At the same time, the amplifier itself absorbs only a small proportion of the total output of the alternator, so that the load on the alternator is considerably reduced while the signalling key is open. In construction the magnetic amplifier is very similar to a small oil-cooled transformer, the core being built up of extremely thin laminations.

The Multiple-Tuned Antenna.

Alexanderson found at New Brunswick a long, low, horizontal antenna, which had been erected by the Marconi Com-

pany. It was 5 000 ft. (1 500 m.) long, 600 ft. wide, supported on towers 400 ft. high. It was designed with the object of obtaining directive radiation for working to Carnarvon, but it was found that, with the long wave-lengths actually employed, from five to ten times the length of the aerial, the directive effect was inappreciable beyond 300 miles from the transmitter. The resistance, 37 Ω , was high because the charging current passing between aerial and earth at the far end had to be carried over nearly a mile of earth and back again through a mile of antenna wire, most of the loss being in the earth. This loss could not be materially decreased by laying more wires in the ground, for, owing to the inductive impedance of such long wires, a large percentage of the earth current will still pass through the soil. The antenna originally had one tuning inductance connected at one end in the ordinary way, and in order to reduce the wasteful resistance Alexanderson connected six inductances between antenna and earth at equal intervals. The action of these inductances is analogous to that of the Pupin loading coils on a telephone line, inasmuch as their inductive reactance to earth neutralises the capacitive reactance of the flat antenna at six points. Each inductance-coil is tuned with the adjacent one-sixth portion of the antenna to the fundamental wave-length, so that each coil has to have about six times the inductance that a single tuning-coil for the whole antenna would have. The circuit is then the equivalent of six antennae, each 830 ft. long, operating in parallel,



FIGS. 7 AND 8. FUNDAMENTAL AND EQUIVALENT CIRCUITS OF ALEXANDERSON MULTIPLE-TUNED ANTENNA.

the radiations from the six antennae being added together; the oscillatory current in each of the six resonant circuits being, say, 100 A, the effect is equivalent to that of a current of 600 A fed into the single 5 000 ft. antenna at one end, according to the original arrangements.

Current Variations.

The diagram of connections of the multiple antenna is illustrated in Fig. 7, and this is equivalent to the circuit shown in Fig. 8. The current supplied by the alternator to the first portion of the antenna, through the first inductance L_1 , is 100 A, and this current, in the antenna and in the earth, tapers down to nearly zero half-way to the next tuning coil. The potential, which is about 2 000 V at the alternator terminals, is about 60 000 V at the upper end of the inductance which is connected to the antenna. The current in the inductance lags nearly 90° behind the antenna potential, whereas the condenser charging current leads by nearly 90° . The current of 100 A is, therefore, nearly all "wattless," the energy current being only 0.5 A at 60 000 V, which represents the amount of power required to compensate the resistance losses (including radiation resistance and wasteful resistance) of the first resonant circuit. A current of 100 A also circulates in the second tuned circuit, but the current supplied to this circuit from the alternator, which flows along the antenna and through the earth below it, is only the energy-component of 0.5 A at the antenna-voltage of 60 000 V, and the same for each of the other four tuned circuits. Thus, instead of a current of 600 A in antenna and earth at one end, tapering down to zero at the other end, as with the ordinary arrangement with a single inductance at one end, there are currents of 50 A in each direction in the antenna, at each of the six inductance-tappings, tapering down half-way between the inductances to zero, plus a very small energy-current.

By this arrangement the wasteful-resistance losses were very greatly reduced, the equivalent multiple resistance of the antenna (defined as the energy consumption divided by the square of the sum of the currents in all the earth connections) being reduced to 0.9 Ω as compared with the original figure of 38 Ω . (To be concluded.)

The "Cyc-Arc" Process of Automatic Electric Welding.*

By L. J. STEELE and H. MARTIN.

Evolution and Development.

The "Cyc-Arc" process was developed primarily in connection with ship construction. The advantages of a process which will rapidly and satisfactorily attach suitable studs without perforation of bulkheads or decks, are obvious. The first attempt at any form of electric stud-welding for cable clips was made in 1917. These experiments showed that great skill was required, on account of the small size of the studs. At first the studs were retained in position for welding by means of tongs, held by one operator, while the welding was carried out by another individual. In 1918 a light magnetic stud-holder was designed and constructed, retaining the stud accurately in position upon the iron or steel plate, thus eliminating one operator.

A Semi-Automatic Device.

The Admiralty subsequently requested that experiments on a "semi-automatic device for stud welding" should be made. This apparatus, intended primarily for the welding of iron or steel studs or screws to iron or steel plating, consisted of a pair of pot magnets supporting, but insulated from, a stud-holder attached to a plunger, the latter being movable against the pressure of a spring, and fitted at one end with an insulated striking knob. The stud-holder, stud, and plate were in circuit with a switch and regulating resistance, the stud being welded upon a steel or iron plate by simply energising the magnets. With the spring holding the stud out of contact with the plate, the switch was closed, after which the knob at the end of the plunger was so struck as momentarily to bring the stud in contact with the plate, and also to close the welding circuit. The stud, however, after momentarily touching the plate, would be released and at once forced out of contact by the action of the spring, thereby drawing an arc which would rapidly melt the stud end and the plate opposite to it. This arc was maintained for a sufficient time, as checked by a stop-watch, at the end of which the molten stud was forced against the adjacent molten plate by again pressing the knob of the plunger, thereby welding the stud to the plate, the current flowing in the main circuit through the stud, weld and plate and being finally switched off by hand.

Experimental Difficulties.

When testing apparatus made in accordance with these proposals, it was found that the chief defect was the difficulty in striking the arc, owing to the stud sticking to the plate. Another difficulty was that of timing the arcing period correctly by means of a stop-watch and hand-operated apparatus.

New apparatus was accordingly designed and constructed for trial. The arc-striking difficulty was surmounted by an apparatus operating in exactly the same manner as an arc lamp.

Unfortunately, although apparently good welds were obtained, they were later proved to be of very low mechanical strength, and therefore almost useless for practical purposes. Much better results could be obtained by welding brass studs to iron or steel plates. Not only were better welds produced, but the necessary adjustments for current, timing, &c., appeared to be less close, and, in consequence, attempts at welding iron and steel studs were practically abandoned.

Three Essential Variables.

The three variables requiring correct adjustment to obtain even apparently satisfactory welds, were the amount of current through the arc, the length of the arc upon striking, and the length of time it had to be maintained before making the weld. Obviously, one or more of these factors must vary for every different size, shape, and material of stud. In view of the extremely short time during which it was found necessary to maintain the arc, prolonged experiments with hand-timing against a stop-watch led to great confusion in results, and consequently delayed improvement. Meantime, mechanical testing apparatus, arranged to make tensile tests of the stud welds in position, fully confirmed the unreliability of the welds. A careful analysis was next made of the various adverse factors, including (a) the accurate timing of the sequence of operations; (b) the influence of the shape of the stud end in preventing the decentralisation of the arc; (c) the length of the arc upon striking, and the accurate adjustment thereof; and (d) the apparent chilling of the molten metal during the period of replacement of the stud on the plate after switching off the current. It was decided to experiment with an automatic timing and control system, which ultimately was found to yield important improvements in uniformity of the welds.

The Influence of Arc Length.

The earlier experiments with small studs were carried out with studs having plain square ends, or cone-shaped ends terminating in

a fine point. The majority of welds obtained with both types were defective, largely owing to the fact that the arc became decentralised relatively to the axis of the stud.

This effect was attributed to the magnetic influence of the holding-on magnets. Decentralisation of the arc also received study. Ultimately a form of ball-headed stud was adopted which tended to centralise the arc and assisted the forming of an enlarged crater of molten metal into which the stud end was inserted. In the original Paper the authors illustrate a simple and effective method ultimately adopted for determining the exact length of arc struck when the solenoid is energised. This is based on an arrangement ensuring that the plunger projects exactly 1/10 in. beyond the adjusting head. These measures had the effect of largely eliminating troubles under headings (a), (b), and (c). In regard to (d) attention was drawn to the formation of blow-holes in the centres of welds, caused by chilling of the molten metal when current is cut off prior to replacement of the stud on the plate. This central "cavitation" was ascribed to a bubble of nitrogen being entrapped. Distinctly better results were achieved with the following sequence of operation: (1) striking the arc by the series solenoid, (2) after a suitable interval the replacement of the stud through the path of the arc, current still being maintained, (3) opening the main circuit a short time after the replacement of the stud. This sequence was adopted, the duration of the arc being, however, automatically timed. To effect this the series solenoid was replaced by a shunt solenoid controlled by the automatic timing apparatus already tested. Various difficulties were met, but were finally overcome by altering the connections so that the shunt solenoid was energised as the result of closing the main circuit contactor, reactance being introduced into the main circuit to delay the rapid rise in value of the main welding current and permit the shunt solenoid to act and strike the arc without the stud sticking to the plate.

A Practical Apparatus.

This method has been substantially adopted in more recent apparatus, and the welds obtained exceeded expectations both in quality and uniformity, the strength of the weld in fact actually exceeding that of the stud itself. The timing and control apparatus was based on the use of a partially dismantled ordinary Morse inker. The portion used consisted merely of the spring-operated mechanism, mounted in its frame and controlled by an air-speed governor and brake. Brass cams were fitted to the spindle and insulated contacts mounted on the framework so as to close and open circuits as desired. Two cams and contacts, one opening and closing the main contactor control circuit before and after each weld, the other short-circuiting the shunt solenoid for a short time during each welding operation, were used. At first the timing apparatus was started and stopped by hand operation of the brake lever. Afterwards the sequence of operations was started by merely pressing a bell-push attached to the welding tool, and this device yielded very successful results. The latest timing and controlling apparatus is similar in principle to those already described, but, besides being more robust and accurate and better finished, it embodies three main improvements. It is driven by a very powerful, double-spring motor, has a gravity-loaded vertical plunger contact for its main involute cam, and is provided with a uniformly divided and clearly marked timing dial and accessories, which can be simply and instantaneously adjusted to ensure that the apparatus will accurately maintain the arc for any period between 0.1 and 3 seconds, variations of 0.01 second being readily obtainable.

Timing and Control Device.

This improved timing and control apparatus has so far quite justified itself. The period of each complete rotation of the cam spindle is 7 seconds, necessitated by the fact that the first half of the revolution (about 4 seconds) takes place before the cam spindle is running at full and uniform speed. With this accurate timing device it would be unsatisfactory to attempt to carry out any welding operations except as the result of the main and short-circuiting cams making contact in the latter half of each rotation of the cam spindle when it is revolving at a perfectly uniform speed. In cases, however, of the use of the apparatus continuously and rapidly on one particular class of job which requires a practically uniform time period, a cheaper and simpler timing and control apparatus can be provided, so designed that instead of each operation of the timing apparatus occupying a 7 second period, the arc strikes practically instantaneously when the push-button is pressed the total time period of this form of direct-acting timing device being practically the same as that of the arc.

Types of Apparatus.

The type A portable, "Cyc-Arc" apparatus, as now constructed commercially, consists of two main parts, viz., the controller and the welding tool. The controller is constructed with a strong angle-

* Abstract of Paper read before the Institution of Electrical Engineers.

iron framework completely enclosed in sheet iron and expanded metal, and is divided into three compartments containing first the automatic timing and control apparatus, the regulating panel, the adjustable reactance, the non-inductive resistance, and the carbon-filament lamp resistance; the second contains the resistance coils for current regulation, with supports and insulators; and the third the automatically operated electric contactor.

The regulating and connecting panel is fitted with a set of terminals connected to the ends of nichrome resistance coils, so that the latter may be arranged either in series or in parallel, or practically in any combination thereof. Then large variations, both in current-carrying capacity and resistance of coils, can be obtained, permitting of a wide range of adjustment for welding purposes. The maximum current-carrying capacity which can be obtained by this means is much higher than can be dealt with by the usual contactor supplied with the apparatus, the rating of which is 500 A at 100 V. One great advantage of the design is that, in case it is desired to supply a controller for larger work, the only modifications necessary in the standard controller are the substitution of a contactor of greater capacity and an increase in the size of the main connecting leads. Certain improvements in the welding tool have been made. The controller and welding tool are connected by two cables, which are required for the two separate control and main welding circuits.

Provision is made in the standard type controller for the connection of two welding tools, if it is desired to use two such tools together to double the output of a single-controller set of apparatus. These two tools are operated on a dual-control system.

The "Cyc-Arc" apparatus is designed for ordinary a.c. supply. Only slight modifications are necessary to make it suitable for any voltage between 60 and 100. The normal current-range is from 200 to 500 A. The actual energy consumed per weld is small, the usual duration of the welding current being about 1 second.

Performance of Apparatus.

The apparatus will satisfactorily weld naval brass or manganese-bronze studs up to $\frac{1}{2}$ in. diameter on to brass, manganese-bronze, iron, or steel of practically any thickness, and also on to galvanised iron or steel. Operation is practically automatic, and the tool can be worked by semi-skilled labour. In making a weld the stud is placed in the holder of the welding tool, and the latter is secured in the desired position by means of the hold-on magnets. The arc-limiting device is then set, after which a single action of the bell-push starts the timing and control apparatus, thereby making the welds. The tool is then removed from the surface, leaving the stud welded in position.

The welding tool of the portable "Cyc-Arc" apparatus can be taken to any position where work has to be performed, such as on the bulkheads or decks of ships. The entire equipment can be transported by two men; the welding tool itself can be handled by a single operator, its weight being under 20 lb.

A skilled artisan should make the requisite adjustments for current and timing to suit any given size and quality of stud, tube, or other fitting, after which the apparatus can be handed over to semi-skilled labour for repetition work.

The hold-on magnets of the welding tool are provided with an adjustment to allow of the tool being readily adapted and fixed to uneven or curved surfaces.

The Electric Pneumatic Pattern.

The type B electro-pneumatic "Cyc-Arc" apparatus also consists of two main parts, i.e., the controller and the welding tool, but additional arrangements have to be provided for the supply of compressed air. The controller is practically the same as that provided in type A. The welding tool consists essentially of a combined solenoid and air cylinder provided with the necessary accessory piston, piston-rod and solenoid core, to the outer end of the latter of which is attached the holder for the stud, tube or other fitting, which has to be welded. A piston-valve chamber forms part of the main cylinder casting, the valve itself being operated from a small solenoid mounted upon the casting.

The type B welding tool will deal with work requiring currents up to 1 500 A.

Results of Welding Experiments and Tests.

When dealing with studs or plates of varying size, or different metals, it is necessary to alter the welding current as well as the time of operation. It has been possible to draw up a table of the adjustments of current and timing necessary. Perfect welds can be obtained between naval brass or manganese-bronze studs, and steel, iron, or brass plates. Equally satisfactory welds are obtained if the iron or steel is galvanised, provided that the zinc deposit is not unduly thick. Surprisingly good and strong welds can also be made with brass tubes on to steel plates, and the latter may be less than 30 mils in thickness. Excellent welds can also be made on to spring steel. When welding brass tubes $\frac{1}{2}$ in. in diameter on to steel plates about 0.03 in. thick, the time during which the arc is maintained is extremely short, viz., only 0.1 second. Molten

brass rises into the interior of the tube at its base and forms a solid section for an appreciable height, thus increasing the strength.

This useful effect is due partially to the fact that the air pressure in the tube is less than atmospheric pressure at the moment the tube is returned to the plate at the end of the cycle of operations. Although it is possible to weld studs on to cast iron, the result is necessarily unsatisfactory, owing to the weakness of the cast metal. Accordingly, in treating cast iron casings, &c., a mild steel angle or tee having holes punched through the portion which projects into the casting, is placed in the mould near the centre-line of the flange. The casting is formed round it, the surface of the mild steel angle or tee, to which the studs are to be welded, being left flush with the face.

Another interesting application of the "Cyc-Arc" process is for the tipping of machine tools. It is possible to weld with surprising strength small pieces of high-speed steel on to ordinary carbon-steel shanks, and the welds are quite satisfactory. It is necessary, however, to anneal the tool as soon as possible after tipping before attempting to grind or work on it in any way. Confirmatory data on the strength of tools so treated are given in the original Paper.

The great strength of the welds obtained by this process of welding was attributed originally to three causes: (1) Absence of oxides in the welds; (2) extreme local heating in the region of the weld; (3) penetration (in each direction) of the metals to be welded. Photo-micrographs confirm these conclusions.

In the original Paper reports of examinations of welds of brass on mild steel, high speed steel on mild steel, and mild steel on mild steel are quoted. It is concluded that the effect of heating does not extend for more than 0.05 inch from the weld, the extremely local heating effect and the absence of oxidation having a most beneficial effect.

Practical Applications.

As mentioned, the process was originally developed for naval construction. A large number of fittings, many miles of electric cable and other communicating apparatus are fixed to bulkheads on the undersides of decks. Formerly bulkheads were drilled and tapped where necessary, cables and fittings being held in position by screwed plugs, with red lead grummetts applied to render them as water-tight as possible. Nevertheless, the shock of gunfire and vibration causes studs to work loose so that joints are no longer watertight. On such a ship as the "Queen Elizabeth" at least 350 000 studs have been fixed into bulkheads, and the aggregate effect of such a large number must be weakening. With welded studs this source of weakness is removed. Similar considerations apply to merchant vessels, and Lloyd's Register of Shipping has approved the welding process for ship construction. At least ten studs can be fixed in the time occupied in fitting one bolt or screw by drilling and tapping. Large studs can be welded at the rate of at least forty per hour. The condition of metal surfaces to which studs or other fittings are welded needs attention. Such surfaces are often painted, red-leaded, or are oily or greasy. A circular patch 1 in. diameter should be prepared, ordinary paint-remover being suitable for this purpose. Unless the surfaces are heavily rusted or pitted no special preparation is needed, but the use of a wire-brush is advisable to remove rust or scale. The good electrical conductivity, as well as mechanical strength of welds between brass and steel or iron should be of great interest to electrical engineers. Electrical bonding is now being applied to lightning protection connections in naval work, and it seems ideal for rail-bonding. Many other applications in connection with locomotive construction, cranes, carriages, motor vehicles, boilers, and tanks, tool making, &c., suggest themselves.

Electrical Conditions.

The "Cyc-Arc" process has the special feature of involving a heavy rush of current for a very short time. The supply pressure need not exceed 60 V, and thus relatively little energy is needed per weld. Thus a $\frac{1}{2}$ in. diameter stud weld takes only 12.5 Wh. Where facilities for electric supply are limited, special "kinetic generators" have been applied. These can be run from the welding supply mains as motors, but automatically become generators at the moment a weld takes place, owing to the combined effect of the fly-wheel and the arrangement of the field windings. Motor generators can be used in cases where electricity supply, but no welding supply is available. In cases where there is no supply of electricity special petrol driven plant is provided. These have interesting features, which are described in the original article.

Although alternating current is not at present used with this process, experiments have been conducted with a view to overcoming various difficulties. These troubles are not due to any difficulty in completing the weld after the arc has been struck, but are associated with the uncertainty of striking the alternating arc. It is expected, however, that in course of time this difficulty will be overcome and that ultimately alternating current will be used.

Institution of Electrical Engineers.

The experimental circuits, of which we heard so much at the time the Institution building was first opened, were in evidence on Thursday evening in last week, when Messrs. L. J. STEELE and H. MARTIN read a Paper on "The Cyc-Arc Process of Automatic Electric Welding." The wings of the Council table had been removed to provide space for the necessary equipment, and the well of the theatre had the appearance of a small electrical exhibition. Before the demonstrations took place, however, Mr. Steele occupied rather more time than usual in reading practically the whole of his Paper, of which an abstract will be found on another page of this issue, and in throwing on the screen some of the more important illustrations contained therein.

A "Cyc-Arc" of Accidents.

In order to see the slides and the demonstration better the Council left their customary seats to sit in the front rows, which were therefore unusually well occupied. In this they did well, as Mr. Steele read so fast that most of the information he gave had to be taken in pictorially. At the beginning of the demonstration, which was the most interesting part of the evening's proceedings, Mr. Steele apologised for the fact that there had been no dress rehearsal, owing to what may be termed a "cyc-arc" of accidents. For first, the lorry sent out with the necessary cable was unable to ascend the hill at the back of the building, and, though Johnson & Phillips with commendable promptitude stepped into the breach with a special lorry, this, through some mistake, went all round London on other errands before delivering the cable. Nevertheless, the demonstration was given without a hitch, and a regular Maskelyne and Cooke's performance much enjoyed by the audience occurred, with Mr. Steele as the conjurer and distinguished members of the audience as assistants. We hate to be cynical, but perhaps it had all been arranged like this to show how reliable the "Cyc-arc" equipment really is.

Reproducing Conditions and Results.

In the course of the short discussion, Capt. R. J. WALLIS JONES, said that it was important in welding brass and copper to be able to repeat exactly the essential conditions. He had experienced this difficulty in the early days and had overcome it by substituting a self-exciting alternator by a separately excited machine. The process described in the Paper should be successful for welding aluminium, and he would like to know the authors' experience in this direction. The authors had referred to the impossibility of welding metals of widely different melting points, but he demonstrated that by the Thomson process such welds could be successfully effected, while by the same process the difficulty of welding surfaces of different sizes together could also be overcome.

The Cost Question.

Mr. J. R. COWIE supported the authors' contention that the welds obtained by this process were absolutely sound. From his own personal experience he knew this was the case even before the insertion of the timing apparatus. In the earlier experiments the studs, after welding, were not all of the same length, but he noticed that in the samples shown that evening that difficulty had been overcome. It would be interesting to know whether this was solely due to the improvements in the timing apparatus or whether some other factor was responsible. It would be useful to have the cost of a certain number of welds of different sizes made according to Temperature Regulation.

Temperature Regulation.

Mr. T. F. TATE said the problem of welding dissimilar metals of widely different cross sections was primarily one of temperature regulation. In the Thomson process devices were employed to bring both the pieces to be welded to their respective welding temperatures simultaneously. This could be done by the use of two welding transformers or, when welding a brass stud on to a steel plate, by making the former the negative. Though this was, of course, not possible with alternating current he agreed that the alternating current would eventually supersede direct current for stud welding, possibly by the employment of some modification of the Thomson process such as flash welding.

The Author's Reply.

Mr. L. J. STEELE, in replying to the discussion, said that they had tried welding aluminium with a moderate degree of success, the chief difficulty being that the result was of rather low mechanical strength. He did not think the Thomson process could be used for welding an ordinary pin to a steel plate. The studs now shown were all of the same length owing to the accuracy to which the timing could be reproduced, and because the current was maintained during welding at its right value. They preferred making the studs

positive and the plate negative, as that gave a rather more concentric and less porous weld. For that reason they expected that alternating current would be particularly useful when welding the larger sections.

Correspondence.

ATLANTIC CABLE PIONEERS.

To the Editor of THE ELECTRICIAN.

SIR,—Whilst appreciating your remarks under Telegraph and Telephone Notes in your issue of to-day, I am afraid I cannot hold by all its wording. If I did I should not be doing justice to others now dead. As I explained in my contribution to your Diamond Jubilee number, the arrangements for the 1865 and 1866 Atlantic cables were entirely different from those of the 1857-8 cable. In the interval, the Telegraph Construction and Maintenance Company (formerly Messrs. Glass, Elliot & Company) gathered together a staff of engineers and electricians that enabled them not only to manufacture cables, but also to lay them. Mr. (afterwards Sir Samuel) Canning was their engineer-in-chief, and the assistant engineer included the late Mr. Henry Clifford (a highly-skilled mechanical engineer) and Mr. Temple (now Mr. John Temple, C.B.), whilst the late Mr. Willoughby Smith was electrician-in-chief. Messrs. Bright and Clark acted as engineers to the companies for whom these 1865-6 cables were laid, but it was the Telegraph Construction Company, with the above staff, that were responsible for the laying, and to the late Sir Samuel Canning all credit is due for the picking up of an Atlantic cable for the first time.

It should be added that the Telegraph Construction Company also took a large part in the financing of the 1866 cable, ten directors leading off with £100,000, each guaranteeing £10,000. Their names were Henry Ford Barclay, Henry Bewley, Thomas Brassey, A. H. Campbell, George Elliot (afterwards Sir George Elliot, Bart., M.P.), Cyrus West Field, Richard Atwood Glass, (afterwards Sir R. A. Glass), Daniel Gooch (afterwards Sir Daniel Gooch, Bart., M.P.), John Pender (afterwards Sir John Pender, Bart., G.C.M.G., M.P.), and John Smith.—I am, &c.,

London, Dec. 2.

CHARLES BRIGHT.

I.E.E. Dinner at Birmingham.

THE ANNUAL DINNER of the SOUTH MIDLAND CENTRE of the INSTITUTION of ELECTRICAL ENGINEERS was held at the Grand Hotel, Birmingham, on Friday last, Mr. R. A. Chattock being in the chair. Those present included the Lord Mayor of Birmingham (Ald. David Davies); Mr. J. S. Highfield, President of the Institution of Electrical Engineers; and representatives of the other Birmingham engineering associations.

In reply to the toast of the I.E.E., proposed by Mr. R. A. Chattock, Mr. J. S. HIGHFIELD said it was now everyone's job to do his best by the Chartered Institution. The granting of the Charter meant an immense change in status and a widening of the basis of activities. People a little outside the Institution's original scope must be enlisted to help, and members at the same time must make themselves useful to the outside world. This raised the question of qualifications for admission to membership of the Institution, and whether a written examination was the best criterion of these qualifications. For they must be careful not to get only academic knowledge. In conclusion, Mr. Highfield referred to the proposal which had been put forward for liquidating the German reparation debt by the building of large power stations in this country, and said the Institution were keeping their eye on the question.

Ald. W. WALKER, in proposing the toast of the "City of Birmingham and Electricity Supply," said that industries could not be founded within a great city without a cheap supply of electricity, because only in this way could difficulties of space, of fuel and water supply and of ash disposal be overcome. If, therefore, cities were to retain their industries, electricity supply must be developed to the utmost limit.

In the course of the reply to this toast, the LORD MAYOR paid a tribute to the services rendered by Mr. Chattock in connection with the Corporation's undertakings.

Councillor H. K. BEALE, chairman of the Birmingham Electricity Supply Committee, also replied, and the substance of his remarks is referred to in our editorial notes.

The toast of the "Kindred Societies and Guests" was proposed by Prof. W. CRAMP, who said that the engineers must draw together. He looked forward to the day when they could welcome those who were their guests to-night as colleagues by the amalgamation of the great engineering institutions into one body. It was impossible much longer for the electrical engineering industry of this country to be centred in London, and he hoped, therefore, the year would not go by without the presidents of the great institutions meeting to see what could be done to bring the various bodies more closely into touch.

Mr. E. C. R. MARKS, chairman of the Midland branch of the Institution of Mechanical Engineers, in reply, said that engineering was so wide a term, and covered such a multitude of different sorts of work, that he was not quite sure it was a good thing to do to bring all the institutions together in the way suggested by Prof. Cramp.

Co-operation Between Manufacturer and Reseller.

All keen retailers of electrical household utensils realise that there is much business to be done if only consumers of electricity can be made to see how much home comfort can be attained by the general use of electricity for the many and varied purposes for which it is particularly adapted. Such resellers, however, find it difficult to carry a stock sufficiently large to meet all demands, particularly in districts where more than one supply voltage obtains, while the cost of arranging a continual demonstration in the use of electrical household appliances is usually prohibitive.

The METROPOLITAN-VICKERS ELECTRICAL Company in order to meet the requirements of the retailer in this direction, is therefore opening up in various centres thoroughly equipped showrooms and



EXTERIOR VIEW OF NEW SHOWROOM AT BRISTOL.

demonstration kitchens. Retailers and electrical contractors by means of a special instruction card, can send their clients to these centres to see for themselves electrical appliances of all kinds in actual operation, the sales resulting therefrom being credited to the reseller concerned.

Such a showroom and demonstration kitchen has recently been opened by the Metropolitan-Vickers Electrical Company at 43, Park Street, Bristol. The illustration shows the exterior view. Inside, a comprehensive range of electric fittings is on exhibition in the main showroom. These items comprise styles to suit all pockets of every conceivable type of electrical lamp fittings, shades and lighting accessories. There is also an immense array of electric fires, cookers, kettles domestic irons, jugs, and boiling plates. Experts are at hand to demonstrate the use of vacuum cleaners, washing machines and similar applications of the "silent servant."

In general, this company's new showroom and demonstration centre at Bristol marks a real and practical attempt to educate the British Public in the more general use of electricity for household purposes. The result of this movement is sure to be to the mutual interest of the retailer, the supply authority and the manufacturer.

Proposed N.E. Coast Trading Association.

In July last a question arose between the Newcastle-upon-Tyne Electric Supply Company and the Electrical Contractors' Association as to the GRANTING OF TRADE DISCOUNTS. The point bristled with so many difficulties and opened out so many controversial matters that the contractors called together representatives of the manufacturers, cable makers, wholesalers and electric supply companies, and members of their own body, and had the matter before them. After considerable discussion, extending over two meetings, it was recognised that at such large gatherings it was impossible to make progress, and a committee was appointed to consider the advisability of forming a protective association similar to the Bradford Electrical Trading Association, and, if formed, if it should be national or local in scope. The committee have now issued their report. After going carefully into various details, they find that there is considerable dissatisfaction, which is not confined to any particular section, and they are of the unanimous opinion that the remedy should be national, but suggest that local joint committees should be set up for the settlement of local matters.

ARMSTRONG COLLEGE, NEWCASTLE-ON-TYNE, was thrown open to visitors last Saturday, and demonstrations were given of Tesla coils, high-frequency discharge tubes, under-water signalling, singing arcs, stroboscope and oscillograph working, wireless reception, &c.

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Steam Jet Air Pumps.

The advantages of the STEAM JET AIR PUMP, when compared with those of the reciprocating type, are now generally recognised. For an increasing number of the latter are being replaced by the more modern form of air pump, though when first introduced, a certain amount of doubt was expressed regarding their stability under all conditions of load.

In most, if not all, steam jet apparatus, a tube termed a combining tube is used, into which the steam jet discharges, the inlet end being a convergent cone, and the outlet a divergent cone, the short portion joining the smaller ends of the cones being termed the throat of the tube. The area of the throat determines the capacity of the apparatus.

The steam nozzle is designed to give as nearly as possible a parallel flow of steam at its outlet, so as to pass through the throat of the combining tube located some distance away from it. The steam jet passing across this space entrains air, and forces it through the throat of the combining tube, the area of which has to be proportioned to accommodate the steam-air mixture. Providing the steam pressure before the nozzle remains constant, the weight of steam passing will also be constant, the pressure after the nozzle at no time approaching the critical.

In the case of the air, this varies with the load on the turbine and the development of air leaks. Should the amount of air decrease to such an extent that the pressure in the space being evacuated falls to slightly over 2 lb. per sq. in. absolute, the steam jet will become unstable and admit atmospheric air into the vacuum space. To prevent this taking place, a continuous supplementary supply of air is admitted in some designs, thus preventing the above low pressure at no time being reached. It is accordingly necessary to provide two steam jets in series to produce high vacuum. It was noted that a continuous admission of air called for a corresponding increase of steam to the jet discharging to atmosphere.

By admitting air when required, to prevent instability, constitutes the patent embodied in the Hick-Breguet Ejectair. This apparatus, which has become so widely known during the last few years, represents a high vacuum air pump in its simplest and most efficient form. The standard design, as made by HICK, HARGREAVES & COMPANY, LTD., comprises two steam jets in a series with intermediate condenser, a patent automatic stabilising valve being fitted to the jet discharging to atmosphere. When required to suit special conditions, the intermediate condenser may be dispensed with, the jets being then placed in tandem. The use of air as a stabilising medium has proved, without exception, simple and effective. When once adjusted the Ejectair needs no further attention of any kind, a fact quite naturally appreciated by power-station engineers.



New B.T.H. Showrooms.

We recently referred to the new MANCHESTER showrooms of the BRITISH THOMSON-HOUSTON COMPANY, and the accompanying illus-

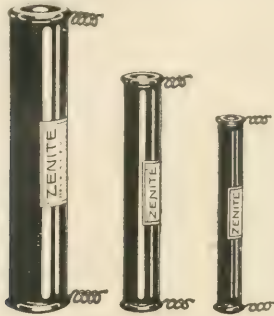


PORTION OF NEW SHOWROOM AT MANCHESTER.

tration shows the fittings showroom, which is artistically arranged and decorated. Contractors are invited to pay a visit of inspection to the new showrooms.

Zenite Resistance Units.

The ZENITH MANUFACTURING COMPANY, Villiers-road, Willesden Green, who have been carrying out experiments in order to manufacture embedded resistance units equal to those formerly imported from abroad, claim that they have solved the problem, and that their Zenite units are quite equal, if not superior, to the foreign products. Many experiments and trials were necessary in order to obtain the blend of vitreous material having the same co-efficient of expansion as the resistance wire and porcelain tubes, and which would adhere firmly over considerable variations in temperature.



ZENITE RESISTANCE UNITS.

It is interesting to learn that the company have decided, after trying a great variety of furnaces, to adopt an electric furnace as the most satisfactory and economical for this class of work.

It is claimed that the Zenite units provide in a compact form a relatively large ohmic resistance and current-carrying capacity. The resistance wires are embedded in a vitreous refractory mass, and are therefore protected against mechanical damage and the corrosive influence of the atmosphere. The units comprise a porcelain tube of suitable dimensions, wound with a special high-resistance alloy wire, having a temperature co-efficient of 0.00023 per degree C., and subsequently embedded in a vitreous refractory mass, fired at high temperature to a smooth glossy finish in various colours. The leading-in wires are of stranded flexible copper, and provide easy means for connecting to the outer circuits. Units can be made to any degree of accuracy, and in a price list recently issued by the company particulars of the standards, sizes, prices, &c., are given.

Rating of Electricity Undertakings.

Discussing the subject of "Rating and the War," at a meeting of the Auctioneers' and Estate Agents' Institute, Mr. F. MICHAEL FARADAY said that in the case of electric light companies and similar companies the cost of coal and the additional cost of labour had risen altogether out of proportion to the increased price obtainable for the service. Hence there were deficits, and the companies were seeking to reduce their assessments. Local authorities needed money to carry on the services they were compelled to provide, and it seemed to him that the solution was to be found in a policy under which the spending authorities must spend as little as possible, commensurate with providing essential services, in order that the rate-payers might not have to pay more than they could afford. Otherwise we reached the breaking point, and his experience showed him that the profits of a large number of companies would not possibly enable them to pay the rates they did in 1914. There was, perhaps, no class of property more difficult to deal with than factories. Since the war the burden had been anything but light, and it was increasing. The old-time amiability of the owner-occupier of an industrial concern had given place to a desire for something more correctly interpreting the law than the old assumption that a business man stood ready to pay 5 per cent. in perpetuity upon capital invested over a long period of years. If the conditions were not carefully considered, and their effect on industry properly appraised, it was impossible to estimate correctly the change that had taken place in the value of the occupation of a given works to the tenant. New factories, workshops, and new industries were created during the war to such an extent that the relative position of former factories has been completely changed. The productive capacity in many lines of trade had enormously increased, and that must have a serious influence on the beneficial occupation to be derived from the new subjects themselves, and a far greater influence on those of an earlier date. It should be a rating truism to say that the value of beneficial occupation could only be fairly estimated by a thorough and intelligent analysis of any changes that had taken place to affect the demand for a particular class of hereditament. As a result of the conditions created by the war we must do one of two things—change the law of rating or apply our minds to understand thoroughly the effect of the new conditions. Only by so doing could we avoid causing grave injustice and inequalities. The time-honoured rule-of-thumb methods must give place to considered thought upon the new problems, and we must bear very strongly in mind that this country earned its living by its industries. It seemed clear to him that one of the greatest problems in rating that had arisen directly from the war was how industrial undertakings were to be treated.

Legal Intelligence.

Patent Amendment.

A motion to amend the specification of Letters Patent No. 142,934, granted to G. H. Jones and the Alloy Welding Processes, Ltd., was allowed on Nov. 29 by Mr. Justice Sargant, with leave to apply.

Mr. R. STAFFORD CRIPPS, in support of the motion, said that the proposed rectification related to the striking out of certain paragraphs of the specification. The patent was for improvements relating to the manufacture of electrodes for soldering and depositing metals by the electric arc, which are manufactured of metal wire or rod covered with a slag-forming material. It was proposed to add to the slag-forming material a suitable chemical substance in order to produce a compound of the nature of cement, which sets hard on drying; but in covering the wire or rods by an extruding process the cement gradually sets in the extruding machine, and renders the extrusion thereof difficult. According to the invention, one of the materials or substances, which acts with the other or others to form the cement, is withheld from the fluid composite, and is applied by itself to the metal wire or rod, and may be allowed to dry thereon, so that the prepared wires or rods may be stored ready to receive the covering of fluid compound as required. When the compound is applied to the prepared wires or rods chemical action commences and proceeds gradually to set the compound.

Mr. J. HUNTER GRAY, K.C. (for the Quasi-Arc Company, Ltd.), raised no objection, as no additions were made to the specification by the rectification.

A Transformer Oil Contract.

Last week Mr. JUSTICE ROWLATT heard an interesting action by R. O. Weener & Company against James B. Berry's Sons Company for the recovery of damages for a breach of contract relating to the sale of transformer oil. It appeared that in November, 1920, a contract was made for the sale of 800 barrels of oil, and plaintiffs accepted delivery of 200 drums of oil, but refused to accept a further 600 drums. Damages were claimed because the oil was delivered in drums and not in barrels, this being alleged to be a breach of description of the goods under the contract, and the damage was put at £380. Defendants, an American company, pleaded that the word "barrel" meant "drum," and that plaintiffs knew Americans used the word "barrel" when drum was meant. They further pleaded that the word "barrel" was not a word of description, but only of quantity.

A good deal of technical evidence was given on both sides, and this went to show that it was the practice of transformer manufacturers not to accept oil except in steel barrels. Wooden barrels were unsuitable for transporting transformer oil, as it became affected by moisture.

Ultimately Mr. JUSTICE ROWLATT came to the conclusion that the word "barrel" meant a wooden barrel; that it had not been made out that a little moisture getting into the oil would not make it answer to the description "transformer oil." An overwhelming case would have to be made out before he could say that in that particular case, with that particular commodity, the words had anything but their natural meaning. From all the facts, and having regard to the falling market, he was unable to say that plaintiffs had suffered any damage, nor could they claim loss of profits. He gave judgment for plaintiffs on their claim for 1s., without costs, and defendants' counter-claim for damages for breach of contract was dismissed without costs.

Electric Light Accounts.

At Brentford County Court the Teddington and Twickenham Electricity Supply Company recently sued Gilks & Pullen for £7 16s. for electric current and nine and a-half quarters' rent of meters and wires, between March, 1919, and September, 1921.

Plaintiffs' solicitor said that the matter had been in abeyance for a long time because it was not known that the current was being used. Some time ago the current was disconnected on the premises changing hands. Latterly, on a man going to see to fittings in another part of the building, he came across some switches which turned on a light in defendants' shop, and investigation showed that the disconnected current had been connected again. Evidence was given that in March, 1919, the fuses were withdrawn. The last record of current being used was March, 1919, and plaintiffs had charged defendants with its use since that date.

Mr. GILKES, one of the defendant firm, said that when they took the premises in March, 1919, they used oil for lighting until September, 1920. He applied to have the current put on and was sent a form, which was so drastic that he would not sign it. Then later plaintiffs wanted to run a cable through his premises and offered to connect him up free. He referred them to the agents, but next morning he found plaintiffs' men at work, and he was told that all he had to do was to touch a button and have light. Since then he had used one light, and he was willing to pay for what he had used. He used the light about twenty hours a week.

Other witnesses were called for the defence, and His Honour held that there was no light used until October, and found for the plaintiffs for £4 10s.

The same company also sued Mr. C. L. Smith for £8 10s. 9d. current and rent of meters at premises in Richmond-road. Defendant gave up possession in February, 1921, and the current was disconnected. The account was sent to defendant, but he was lost sight of, and had only recently been traced. Credit had been given him for £5 paid down when the current was connected. The defence was that the agreement was made by defendant on behalf of the Ota Motor Company, and His Honour adjourned the case for plaintiffs to look into the point.

Private Bill Notices.

The following is a list of the private bills relating to electricity supply and electric traction schemes which are being promoted in the ensuing session of Parliament. On this occasion there are no Provisional Electric Lighting Orders, and the year's total is therefore below the average. A summary of the chief powers sought is also included.

Electricity Supply Proposals.

It is proposed to bring in a Bill to give effect to any scheme which the Electricity Commissioners may approve or formulate for the whole or any part of the LONDON AND HOME COUNTIES ELECTRICAL DISTRICT, or any scheme establishing a joint electrical authority for the district, to lease to the authority any buildings, works, or machinery forming part of the undertaking of any of the companies named in the first schedule to the London Electric Supply Act, 1908, and in the schedule to the London Electric Supply Act, 1910; to authorise formation of sinking fund by the authority and the application of it towards purchase of any property so transferred, and to authorise a lease to the authority of the whole undertaking of the Central Electric Supply Company; to enable the authority to create and issue stock and bonds and to borrow on mortgage, &c., and to allow the payment of interest out of capital; to suspend payments to sinking funds, &c.; to authorise any undertaker or local authority within the area to lend money to and subscribe for securities of, or to give other financial assistance to the authority; to make agreements for execution of works or performance of duties in relation to the supply of electricity on behalf of the authority; to make provision as to the prices to be charged by the authority or any undertaker; to make further provision as to the supply of electricity by the authority or any of the London companies, or other undertaker to any railway, tramway, dock, canal or navigation; to amend or repeal all or any provisions of the London Electric Supply Acts, 1908 and 1910; to amend or repeal the provisions of Secs. 2 and 3 of the Electric Lighting Act of 1908, and to empower the Commissioners to vary the date at which any undertaking is purchasable, &c.

THE NORTH METROPOLITAN ELECTRICAL POWER SUPPLY COMPANY and the NORTH METROPOLITAN ELECTRICAL POWER DISTRIBUTION COMPANY seek power to revise and alter from time to time the prices and methods of charging for electricity supply; to provide for the separate metering of energy supplied and used for lighting; to provide for the transfer to and vesting in the Power Company of the undertakings and powers of the Distribution Company, and to liquidate the Distribution Company; to increase the borrowing powers of the Power Company, to issue short-term notes, &c.; to authorise Company to make one annual statement of accounts; to take supplies of electricity in bulk from the Metropolitan and L. & N.W. Railway Companies; and to repeal any provisions restricting Company from supplying within the County of London electrical energy supplied to the Company outside the county to the said Railway Companies; to make provision for expense of re-connecting discontinued supplies; to introduce profit-sharing schemes, &c.

In the Bill of the SOUTH WALES ELECTRICAL POWER DISTRIBUTION COMPANY, power is sought to reduce the ordinary capital by the cancellation of lost capital, and for the conversion of the ordinary and preference shares into stock; to amend the Company's 1900 Act in regard to the price of electricity and the dividends payable; to supply and distribute electricity in the parish of Betws, in St. Mellons Rural District; to empower Councils in Company's area to enter into agreements with the Company, &c.

THE YORKSHIRE ELECTRICAL POWER COMPANY seeks authority to sub-divide the ordinary and preference capital into £1 shares; to make further provision in regard to the payment of dividends; to authorise payment of interim dividends, the holding of general meetings annually, &c.

In the NEATH CORPORATION BILL for the extension of the Borough boundaries, powers are sought to supply electricity in the added areas, and to transfer the electricity undertaking and rights of Neath Rural Council; to take electricity in bulk from the South Wales Electrical Power Distribution Company; to alter method of charging for electricity, to refuse supply in certain cases, &c.

WORTHING CORPORATION desires to extend the supply area to the parish of Durrington; to construct sub-stations, to lay mains in streets not dedicated to public use; to supply electricity in bulk within or outside present limits of supply; to attach brackets to buildings; to provide, sell, and let for hire electric motors, fittings, and apparatus; to refuse supply to persons in debt for other premises; to grant discounts; to make provision for stand-by supply, &c.

Tramway and Electricity Schemes.

In the Bill of BLACKBURN CORPORATION for the extension of the Borough, power is sought to extend the area of electricity supply to Rishton, Ramsgrave and Livesey; to authorise the construction of three additional tramway routes; to provide and work motor-omnibuses within and beyond Borough; to authorise the use of trailer cars on tramways; to provide waiting-rooms and barriers for regulating entry of passengers into tramcars and omnibuses; to enforce the queue system; to increase the maximum prices for the supply of electricity, and to provide for the revision of prices and methods of charging from time to time; to authorise the cutting-off of supply where supply is used contrary to agreement; to supply electricity in bulk both within and beyond the Borough; to provide for suspension of sinking fund payments in respect of moneys borrowed for Whitebirk electricity generating station, and the mains from that station to Jubilee-street station; to authorise use of any

sinking fund instead of borrowing; to make provision as to rate at which the accumulation of the annual payments to any sinking fund may be reckoned; to alter dates for making up annual accounts, &c.

In the omnibus Bill of BOLTON CORPORATION, power is sought to construct seven specified lengths of tramway, and to carry out various works in connection with the tramway undertaking; to suspend service of cars when deemed expedient; to increase maximum tolls and fares; to provide and run motor-omnibuses; to introduce special services of cars, &c.; to lay mains in private streets; to make provision for the reconnection of electric lines which have been disconnected owing to default of consumers; to construct under any street sub-stations, transforming stations, &c.; to authorise discontinuance of supply where electrical energy is not consumed in accordance with terms of agreement; to make provision with reference to erroneous meters; to fix standby charges; to form a special fund for renewals, repairs, and depreciation, and to provide working capital, &c.

SWANSEA CORPORATION seeks to extend the borough boundaries and to supply electricity in the added area; to make Corporation the purchasing authority for tramways; to authorise minimum payments for stand-by supply; to authorise the cutting off of supply to a consumer who uses electricity contrary to terms of agreement; to provide penalties upon persons hindering officers of Corporation in the exercise of powers of entry, and to authorise the entry upon unoccupied premises; to require payment of expense of reconnecting a supply after disconnection, and to prescribe the nature and materials of wires, apparatus and fittings in any building or premises supplied with electricity.

DONCASTER CORPORATION desires power to provide and work motor-omnibuses on six routes, to run a special service of cars on the light railways, to erect shelters and barriers, and to enforce the queue system; to empower Minister of Transport to revise maximum prices for electricity supply, or to vary method of charging therefor, &c.; to use any sinking fund instead of borrowing, to authorise formation of reserve funds and funds for working capital, &c.

Traction Bills, &c.

The Bill of the METROPOLITAN RAILWAY COMPANY contains authority to guarantee or subscribe towards loss on the British Empire Exhibition, to enable a person holding office under the Company to become a director, &c.

Authority is sought to incorporate a company to construct a wharf, quay, or landing stage, partly on the northern bank of the river Thames, and partly on the bed or shore of that river, in the parish of CANVEY ISLAND; to construct four short lengths of electric or steam railway; to construct electric generating stations, &c.

THE NOTTINGHAM & DERBYSHIRE TRAMWAYS COMPANY proposes to construct additional tramways in Heanor, to increase fares on existing lines, to run special and through cars; to alter gauge of tramways in Ilkeston from 3 ft. 6in. to the standard; to erect waiting-rooms, to increase capital, &c.

THE LONDON COUNTY COUNCIL Bill confers authority to construct two short lengths of tramway from the Seven Sisters-road to Stamford Hill, to reconstruct part of the existing tramway in Amhurst Park; to provide and maintain trolley vehicles on route from the West Norwood tramway terminus to Lee Green, &c.

NORTHAMPTON Corporation seeks power to provide and maintain omnibus services; to run a special service of tramcars, trolley vehicles and omnibuses, to set apart special cars for special occasions; to erect waiting-rooms and barriers for regulating traffic, to enforce the queue system, &c.

BIRMINGHAM CORPORATION desires to obtain sanction to the use of trolley vehicles along certain routes, to exclude operation of the Locomotives on Highways Act, the Locomotive and Motor-car Acts; to authorise applications to Minister of Transport for use of trolley vehicles on other routes, &c.; to erect cloak-rooms and barriers, to run a special service of cars, &c.

In a Bill promoted by the BIRMINGHAM AND DISTRICT POWER & TRACTION, the SOUTH STAFFORDSHIRE TRAMWAYS (LESSEE) the DUDLEY, STOURBRIDGE, & DISTRICT ELECTRIC TRACTION, the WOLVERHAMPTON & DISTRICT ELECTRIC TRAMWAYS and the BRITISH ELECTRIC TRACTION COMPANIES, power is sought to postpone the dates for the compulsory purchase of the tramway and light railway undertakings of the companies, and to extend the terms of leases; to prohibit the compulsory purchase of the undertakings of some of the companies unless all are so purchased; to revise maximum tolls and fares, &c.

THE TRAFFORD PARK COMPANY seeks powers to provide and maintain trolley vehicles along eight specified routes, and to authorise the Ministry of Transport to issue Orders for their use on other routes; to attach brackets and wires to buildings; to manufacture, purchase and hire trolley vehicles; to exempt trolley vehicles from being classed as locomotives or motor-cars; to empower company, in case of neglect or failure on the part of Stretford Urban Council to supply electrical energy on demand, to enter into an agreement with Manchester Corporation for such supply, &c.

BRISTOL CORPORATION are promoting two Bills. The first is for an extension of time for the compulsory purchase of lands and for completing the purchase of the tramway undertaking of the Bristol Tramways & Carriage Company. The second seeks powers to construct three lengths of tramway in the neighbourhood of the Docks, to work or lease the lines; to use trailer cars; to authorise use of trolley vehicles, to carry goods, animals and parcels; to provide shelters and waiting-rooms, to enforce the queue system, &c.

In the Bill of the LONDON, BRIGHTON & SOUTH COAST RAILWAY, authority is sought to raise additional money by borrowing or the issue of debenture stock for the general purposes of the Company's

understanding, including the equipment of the railways for electric traction.

KINGSTON-UPON-HULL Corporation desires to construct and work two additional lengths of tramway.

The MORECAMBE Corporation Bill confers power to construct a new tramway, and to reconstruct and adapt existing tramways for electric or traction, &c.

There is only one application for a TRAMWAY PROVISIONAL ORDER, viz., by the LIVERPOOL Corporation, which seeks power to construct new tramways.

Scottish Provisional Orders.

ABERDEEN Corporation desires to obtain sanction for the construction of new tramways and tramroads, to revive powers granted by the Corporation Order of 1915, to run motor omnibuses outside city, &c.

In the GLASGOW Provisional Order authority is sought for the construction of seven lengths of tramway and three tramroads, to use trailer cars, to provide and run motor omnibuses, to enforce queue system, &c.

AYR Corporation is applying for authority to erect hydro-electric works at Loch Doon, to extend the area of electricity supply, to pay interest out of capital, to increase maximum prices of electricity, to lay mains in private streets, to discontinue supply in certain cases, to give bulk supply within and beyond extended area, &c.; also to double portion of existing tramways, to increase fares, to run motor omnibuses, &c.

A Provisional Order is being promoted to incorporate the GRAMPAN ELECTRIC SUPPLY COMPANY for the construction of hydro-electric works to utilise the water powers of the River Tummel, Lochs Rannoch and Erlich, &c., in the counties of Perth and Inverness; to supply electricity in the counties of Perth, Kinross and Forfar, and parts of Stirling, Argyll and Inverness, to enter into agreements for bulk supply, to manufacture, sell and let for hire electrical machinery and apparatus, to apply for Special Orders, &c.

Special Orders.

A number of applications are being made to the Electricity Commissioners for amendments of existing Provisional Orders, so as to authorise the revision of the maximum prices. Among recent applications of this character are the following:—

URBAN ELECTRIC SUPPLY COMPANY.—To amend the Berwick-on-Tweed Order (1900), Illogan Order (1903), Redruth (1900), Dartmouth (1900), Kingswear (1913), Godalming (1896), and Glossop Order (1899).

ISLE OF WIGHT ELECTRIC LIGHT & POWER COMPANY.—Ventnor Order (1897), Sandown and Shanklin Order (1899), Newport (1899), Bonchurch (1900), East Cowes (1901), Cowes (1902), and Carisbrooke and Northwood (1903).

EDMUNDSON'S ELECTRICITY CORPORATION.—Cromer Order (1899) and Torquay (1897).

ALDERLEY & WILMSLOW ELECTRIC SUPPLY COMPANY.—Alderley Edge Order (1895) and Wilmslow (1903).

LYMINGTON ELECTRIC LIGHT & POWER COMPANY.—Lymington Order (1899).

NORTH OF SCOTLAND ELECTRIC LIGHT & POWER COMPANY, LTD.—Brecchin and Montrose Orders of 1898.

SCARBOROUGH ELECTRIC SUPPLY COMPANY.—Scarborough Order (1891).

The Electricity Commissioners have submitted to the Minister of Transport for confirmation a Special Order granted to ELECTRICAL DISTRIBUTION OF YORKSHIRE, LTD., amending the following Electric Lighting Orders by increasing the maximum prices which may be charged for the supply of electricity:—Selby and District (1915), Stanley (1915), Featherstone (1917), Garforth (1917), Horbury (1917), Otley (1917), Penistone (1917), and Rawdon (1917).

In addition to the above, the STRATHCLYDE ELECTRICITY SUPPLY COMPANY has applied for two new Special Orders, to authorise the distribution of electricity in the burgh of Johnstone and in the burgh of Renfrew and parts of the parishes of Renfrew and Paisley respectively.

"Just Switch On—That's All."

We have received from the General Electric Company, Ltd., a booklet (No. H. 2 612) with the title "JUST SWITCH ON—THAT'S ALL," which has been produced for wide distribution among consumers of electricity. The primary object of this booklet is to arouse the interest of users of electric light in the possibilities and advantages of electricity for heating and cooking. A well-written disquisition on the "All-Electric" house, couched in a simple and interesting style, is followed by a brief description of the most generally-used heating and cooking appliances. It contains useful information on "How to calculate the cost of using electrical appliances," "How Electricity can be used in the Home," and valuable hints on electric lighting complete the table of contents. We think that the booklet will prove very useful for the purpose intended, but it would be more effective if the type were somewhat larger and the paper better in quality. The company will supply the booklets in quantities to supply authorities, contractors and dealers. Page 2 of the cover is left blank for printing thereon (free of charge) particulars of the local electricity supply, charges, &c. Application should be made to Magnet House, Kingsway, London, W.C. 2, or to any of the company's provincial branches.

Electric Traction.

SALFORD tramway men have agreed to run services on Christmas Day.

On Christmas Day all London tramcars will be worked to depôts by 4 p.m.

L.C.C. TRAMCARS now run between Aldersgate and the West India Docks, by way of Dalston, Hackney and Burdett-road.

The METROPOLITAN RAILWAY is making special arrangements for the rapid handling of Christmas parcels to all parts of the United Kingdom.

LIVERPOOL Corporation are making an application to the Ministry of Transport for a Provisional-Order to construct several new tramways in the city.

In consequence of the more powerful motors installed on some of the BRIGHTON tramcars, the journeys on certain routes are made in 10 per cent. less time than previously.

DONCASTER Corporation have applied to the Minister of Transport for authority to contract and work a short length of additional light railway, and to alter certain authorised light railways.

CHESTERFIELD Tramways Committee report that they cannot recommend at present the re-introduction of 1d. or reduced fares; they propose, however, to extend the hours of the workmen's cars.

BIRKENHEAD Tramways Committee has rescinded a resolution regarding the proposed expenditure of £99 800 for carrying out work on certain tramway routes to provide work for the unemployed.

The Central London Railway are now running ADDITIONAL THROUGH TRAINS between EALING BROADWAY and LIVERPOOL-STREET during the morning and evening rush hours, and on Saturdays between 12.16 p.m. and 2.16 p.m. from Liverpool-street.

DUDLEY, STOURBRIDGE & DISTRICT ELECTRIC TRACTION COMPANY state that until there is a sufficient reduction in wages to affect appreciably the running costs, they are unable to consider a reduction in the tramway fares or a revision of the stages.

NEWCASTLE Trades Council have passed a resolution strongly supporting the tramway men in their endeavour to withstand the suggested extension of their working hours, and protesting against the action of the Tramways Committee in trying to extend the hours, in view of the unemployment in the city.

The Council of the Association of Municipal Corporations have decided to take steps to secure LEGISLATION to REGULATE TRAFFIC and to provide that when a tramcar is standing at a recognised stopping-place every vehicle intending to pass on the left or near side shall draw up immediately before arriving at the stopping-place until the roadway is clear of passengers.

The trackless 'buses at KEIGHLEY are to be replaced on certain routes by motor-buses. Since their introduction in 1913 the trackless 'buses have never really been a success. It will be remembered that a short time ago, as an experiment, one of the present 'buses was reconstructed on the front-drive principle, but though a better service was obtained, the difficulty was not solved.

In his annual report the WILLESDEN engineer and surveyor (Mr. F. Wilkinson) states that the Orwell electric vehicles used for refuse collection are as reliable as any other form of mechanical transport. The fourteen refuse vehicles worked a total of 4 146 vehicle days, and the working time lost was only 99½ hours (12½ days), or less than one day per vehicle per year, hard to equal by any other form of transport. The average mileage per day per vehicle was 12.3, the current consumption 1 250 units, and the tons carried 6.11.

The widening of the road from Annieland Cross to Scotstounhill Railway Station, undertaken by the GLASGOW Corporation Statute Labour Committee, is now nearly completed, and the Sub-Committee on Tramway Extensions intend to proceed at once with the extension of the city tramway system along the new thoroughfare. They recommend the adoption of the roadside standard system. In connection with the tramway extensions to Milngavie and Coatbridge, the Tramways Committee recommend that work should be begun at the ends furthest from the city, as well as on the city side.

Obituary.

The death has taken place of Mr. WILLIAM BRITTON GOODMAN, for sixteen years electrical engineer at Shernfold Park, Frant, near Tunbridge Wells.

The Right Hon. F. HUTH JACKSON, a director of the Eastern Telegraph Company and the South-Western Railway Company, died on Saturday, aged fifty-eight.

We regret to announce the death on Sunday, at the age of fifty-three years, of Mr. FRANK WORRALL, surveyor and electrical engineer to the Long Eaton Urban Council.

We regret to record the death last week of Mr. MONTAGUE BROWN MOUNTAIN, M.I.E.E., at the age of fifty-eight. Mr. Mountain was managing director and secretary of Mountain & Gibson, Ltd., from 1905 to 1910, and prior to 1905 was engaged with the British Westinghouse Company at Manchester. After the liquidation of Mountain & Gibson, Ltd., in 1910, the business was taken up by the M. & G. Truck and Engineering Company, Ltd., in which Mr. Mountain was also interested. Some time later he owned the works in which the Wilson Rolling Shutter was manufactured, and since the purchase of that business by Mr. R. Gill in 1917 and until recently Mr. Mountain acted as technical adviser to the undertaking.

Electricity Supply.

The new sub-station at Heavitree (Exeter) is now completed. ST. HELENS Electricity Committee are applying for a loan of £40,000.

LANCASTER Town Council has received sanction to borrow £7,600 for extensions to the electricity works.

WILLESDEN Urban Council has received sanction to borrow £4,100 for the provision of a rotary converter and switchgear.

The North Metropolitan Electricity Company have decided to extend their supply cables to CHESEBUNT. Work is to be begun at once.

To encourage the use of electricity, YORK City Council is allowing tenants on the housing estate to test electric flat irons and heating apparatus.

The official inauguration of the hydro-electric plant at the Scar House Reservoir of the BRADFORD Corporation Waterworks took place on Wednesday.

AMESBURY Rural District Council has granted permission to the BULFORD Parish Council to have overhead poles and wires erected for electric lighting purposes.

BLACKPOOL Electricity and Tramways Committee are applying for sanction for the extension of the mains outside the borough boundary into the rural district of Marton.

A canvass is to be made of prospective consumers of electricity at CREDITON, with a view to a supply being obtained from the Exeter Corporation Power Station at Cowley Bridge.

At a meeting of FERNY gas consumers and other interested rate-payers recently it was decided to appoint a committee to go into the question of lighting the town by electricity.

Work on the new electric power station at Neechells, BIRMINGHAM, is progressing rapidly, and it is hoped that the first section of the plant will be brought into use early in the New Year.

DARWEN Town Council have forwarded a letter to the District Joint Board of Employers and Staff Members (Electricity Supply Section), protesting against the preponderance of electrical engineers on the Whitley Council.

The Electricity Commissioners notify that they will hold an inquiry at the Manchester Town Hall on Thursday, Jan. 17, into the scheme submitted for the organisation of the ELECTRICITY SUPPLY in the SOUTH-EAST LANCASHIRE DISTRICT.

NELSON Town Council are applying to the Ministry of Health for £2,600 for the laying of electricity cables. A deputation has been in London, urging the urgency of the work, and it is expected that permission will be given almost immediately.

TAMWORTH Rural District Council are applying to the Electricity Commissioners to include the parishes in the Staffordshire portion of Tamworth rural district in the electricity scheme of the Shropshire, Worcestershire & Staffordshire Electric Power Company and the Birmingham Corporation.

BARROW Town Council discussed on Monday certain proposed increases in their electricity charges. They were referred back, but it was stated that during the six months ended September last there had been a loss of £10,000 on the corporation electricity undertaking, largely owing to the coal strike.

The Clay Wheels Rolling Mills Company is the latest firm in SHEFFIELD which has been obliged to close down part of its works on account of the high prices charged for gas. Mr. F. Lloyd, the managing director, states that he is just completing a new mill, and has arranged to drive it by electricity.

BLACKBURN Town Council, on Dec. 1, appointed a special committee to deal with all matters arising in connection with the erection of the new electricity station, with arrangements governing the land, with supplies to surrounding localities, and with all proposals to the Electricity Commissioners for the formation of electricity districts.

ACCRINGTON has not yet received sanction to proceed with its electrical extensions, and there is a danger that work already done at the station may be left in an incomplete state. The cost of the last extension was £79,146. Provisional sanction was given to borrow £65,000, leaving a balance of £14,146, in respect of which another application is now necessary. Sanction will also be sought to borrow £2,000 for normal cable extensions.

GUILDFORD Town Council has adopted the following scale of charges for electricity as from Dec. 31: Lighting up to 10 units, per quarter 10s., the next 1,000 units per quarter 10d. per unit, beyond 9d.; power and heating up to 1,000 units per quarter 4d., the following 3,000 3d., beyond 2d.; theatres and picture-play houses, up to 100 units per week, 8d., after 100 units 5d.

SCUNTHORPE and FRODINGHAM Urban Council has decided to oppose the scheme submitted for the North-East Midlands Electricity District by the Sheffield Corporation. The Council have already applied for authority to purchase a supply of electricity in bulk from John Lysaght, Ltd., or any other company, and to distribute same within their district.

CHESTER Corporation intends to apply to the Electricity Commissioners for a Special Order to extend the area of supply under the Chester Electric Lighting Order, 1890, to include therein thirty odd parishes and townships in the Rural Districts of Chester, Tarvin,

Hawarden, and Hoole, and in part of the Parish of Alford. On Monday the Corporation took over control of the electricity plant at H.M. Factory, Queensferry.

WEST BROMWICH Electricity Committee recommend that as from Dec. 1 the price of current for power purposes be reduced by 12½ per cent., representing the last increase, which took effect in December, 1920. They are unable to recommend any further reduction, but as an alternative propose to offer power consumers electricity at the rate of £9 per kW demanded, and 1d. per unit, such prices to be subject to the usual coal and labour clauses.

The suggestion of GRAVESEND Electricity Committee that the borough electrical engineer be asked to act as consulting engineer in connection with the proposed extensions, his remuneration to be considered on the completion of the work, aroused considerable discussion at the last meeting of the Council, and on the motion of Councillor Priestley the matter was referred back for consideration. It was felt that such an appointment should not be made without fixing the remuneration.

A scheme for the formation of a joint electrical authority of twenty members for the East Midlands District was approved by NOTTINGHAM Corporation on Monday. The district includes Nottingham, Leicester, Derby, Burton-on-Trent, Mansfield, Newark, and Long Eaton. The Derbyshire and Notts and Leicestershire and Warwickshire Electric Power Companies, and also railway companies purchasing current for traction, will be accorded representation on the joint authority.

At the invitation of DENBIGH Town Council, Mr. H. J. Jack, managing director of the North Wales Power & Traction Company, recently addressed a meeting of the Council and representatives of the Councils of the surrounding districts on Denbigh's scheme—which was drawn up before the war and has now been revived—for the supply and distribution of electricity for lighting and power purposes. The main transmission cable for the district would commence at Rhuddlan, pass through to St. Asaph, and on to Denbigh and Ruthin. The delegates are to report to their various Councils.

To minimise the risk taken by the Corporation with regard to the plant for the new generating station on Freeman's Meadows, LEICESTER, the Electricity Committee recommended that the English Electric Company, who are the contractors for the manufacture of the generating plant, should also be made responsible for the steam-raising plant, for which Babcock & Wilcox have received an order at £91,716. Their proposal that this firm should be made sub-contractors to the English Electric Company, which should receive a commission of 2½ per cent. on the amount of the tender (£2,200) for the added responsibility was, however, referred back at the last meeting of the Council, many members being strongly against the added expenditure.

The new Runcorn power station of the MERSEY POWER COMPANY, which was referred to in our last issue, has generating plant of 25,000 kW, but there is room for increasing this to 100,000 kW. There are two Parsons' turbo-alternators of the horizontal tandem reaction type, and steam is supplied by three Babcock & Wilcox marine type water-tube boilers. The condensing plant and feed pumps are by G. & J. Weir, and the ash plant is by E. J. Bennies & Company. Three-phase current at 440 V. will be supplied for power, and single-phase at 250 V. for lighting. To Ellesmere Port current is transmitted at 33,000 V., and the voltage is raised from 6,500 V. by two banks of six Metropolitan-Vickers transformers of 1,675 kVA each. The transmission cables were supplied by the British Insulated & Helsby Cables.

A meeting of professional and business men was held at TEIGNMOUTH recently to consider the formation of an electric light company. Mr. A. P. Dell said it was proposed to form a company with a capital of £10,000, in ordinary shares of £1 each. The committee thought it was desirable to lay mains in about one and a half miles of street. The total expenditure was estimated at £9,000, and the revenue from the premises received £4,500. If they could not get £5,000 it would be better to abandon the scheme. Dr. Purves and his friends had offered to put £1,000 into the concern, so that only £2,600 had been promised in Teignmouth. The committee had decided there should be seven directors, whose holding should be £100 each, and that they should receive £25 a year for their services. Nine thousand pounds was the minimum sum with which to make a start, and they had decided not to go on until the money was forthcoming. It was decided to call a meeting of shareholders and intending shareholders to decide whether they shall go forward with the scheme or not.

DUNDEE Electricity Committee have felt that since the general adoption, as an alternative charge, of the two-part tariff for the supply of electricity for all purposes to houses, viz., a fixed sum per quarter based on the area of the house plus ½d. per unit for all electricity used, there has been no attempt to take advantage of it. In order, therefore, to encourage the use of electricity by lessening the present heavy cost of installation, they have fitted up a seven-roomed house employing a method of surface wiring. Among the chief advantages claimed for this method of wiring are that expensive ceiling fittings or electrolites are unnecessary, and that a complete installation for lighting, heating, and cooking can be carried out quickly and expeditiously in houses at present using other methods without a great deal of preliminary work, and much more cheaply than any other system. It is also claimed that the present elaborate system of switching and fittings is done away with. In explaining the system to the Council, Major Richardson, the engineer, said that it was already very popular, and they wanted to make it universal.

Telegraph and Telephone Notes.

Direct telegraphic communication has been established between the Central Telegraph Office in London and Amsterdam.

On account of the severe frost on the Continent on Nov. 30, no communication at all was possible with BRUSSELS, and only very restricted communication was obtainable with PARIS. Almost the same conditions prevailed on the following day also.

The Melbourne correspondent of the "Times" states, with reference to the DUPLICATION OF THE PACIFIC CABLE, that Sir Joseph Cook, High Commissioner of the Commonwealth, will act on the Cable Board, and will be authorised to support the scheme.

In recognition of the hospitality shown by the Amir of AFGHANISTAN towards Sir Henry Dobbs' Mission, the British Government in India will present the Afghan Government with sufficient telegraph material to link up the 460 miles separating Kabul from the Indian telegraph extension at Herat, via Kandahar.

The Postmaster-General announces that the TELEGRAPH RATE of 5½d. a word has been reduced to 4½d. for Estonia, 4d. for Latvia, and 3½d. for Lithuania. The rate to Russia is 5½d. a word, both by the Government-owned Anglo-Russian cable and by the Great Northern Telegraph routes via Finland and via Latvia. Telegrams for Russia by any route are still only accepted at the senders' risk.

Mr. T. A. BATES, the new district manager of telephones in Leeds, was present last week at the monthly meeting of the Council of the Leeds Chamber of Commerce, when telephone grievances were discussed. It was generally acknowledged that the automatic telephones were very successful, but great dissatisfaction was expressed regarding the Headingly, Roundhay, and Chapeltown exchanges. It is hoped in course of time to make the whole system automatic, but in the meantime Mr. Bates has promised to try to effect an improvement in the exchanges complained of.

The "John W. Mackay," a TELEGRAPH CABLE REPAIRING STEAMER, which is being constructed by SWAN, HUNTER & WIGHAM RICHARDSON, LTD., for the Commercial Cable Company, of New York, was launched from the Neptune Shipyard, Walker, Newcastle-on-Tyne, last week. The vessel is propelled by twin-screw steam engines, which, together with the boilers, are being constructed at the Neptune Works of the company. She is 360 ft. long by 48 ft. beam by 35 ft. in depth. Her overhanging bow carries three cable sheaves, whilst a stern sheave is fitted aft. The cable will be carried in four cable tanks placed forward of the machinery, which have altogether a coiling capacity of over 50,000 cub. ft. The machinery required for working the cables, including picking-up and paying-out gears, electric turning-over gear, Lucas dynamometers, and a Lucas patent sounding machine, are supplied by the Telegraph Construction & Maintenance Company, Ltd. The propelling machinery will consist of twin-screw triple-expansion engines, supplied with steam by three boilers, working under Howden's system of forced draught, and fitted to burn oil fuel on the Wallsend-Howden system. The comfort and safety of the officers and crew have been most carefully studied, and the arrangements made include ample ventilation, steam heating, electric light, electric bells, telephones, wireless telegraphy, and submarine signalling apparatus. Many distinguished guests were present at the naming ceremony, which was performed by Miss Blount, daughter of Mr. E. Blount, of the Foreign Office, London.

Wireless Notes.

A wireless telephone service was inaugurated between ROME and SARONNA last week.

It is hoped that a large wireless station at ELISABETHVILLE will be in direct communication with Belgium in 1923.

THE FIRST PRESS MESSAGE to be forwarded by wireless direct from ENGLAND to AUSTRALIA was sent by the "Daily Mail" on Friday to its correspondent at Sydney, New South Wales.

A WIRELESS EXHIBITION was held on the 2nd and 3rd inst. by the Newcastle and District Amateur Wireless Society at the North-Eastern Wireless School, Eldon-square, Newcastle-on-Tyne.

A message from MELBOURNE states that the Government has under consideration an offer by the Radio Communication Company, an exclusively British concern, to establish direct wireless communication with the United Kingdom. The offer differs in several respects from that recently put forward by the Amalgamated Wireless Company.

Prof. E. W. Marchant, of Liverpool University, gave a semi-technical lecture on wireless telegraphy to members of LLOYD'S REGISTER Staff Association recently. The lecture was illustrated by lantern slides, and a demonstration was given afterwards, messages being received from Paris, the North Foreland, and the Isle of Wight.

The State of Queensland is co-operating with the Federal Authorities of Australia in the establishment of a WIRELESS STATION on WILLIS ISLAND, 300 miles off the coast of Queensland. Willis Island is right in the track of the cyclones, and has been selected as the most suitable spot from which warnings of approaching storms could be sent out. The station is being erected under the joint supervision of the Radio Branch of the Postal Department and the Department of Navigation. It will be maintained by the Federal Government, but the Queensland Government will pay part of the cost. The initial cost is estimated at £4,000.

Personal and Appointments.

Councillor R. J. WILSON has been re-elected chairman of SUNDERLAND Electricity Committee and Alderman G. NEW of the Tramways Committee.

Mr. W. D. BRIGHTMAN, secretary of the Bournemouth and Poole Electricity Supply Company, has been appointed manager and secretary of the company.

The independent Conservative candidate for the South-East Southwark constituency by-election is Mr. HORACE BOOT, M.I.E.E., consulting electrical engineer.

Mr. JOHN LITTLE, chief engineer of Cammell, Laird & Company's works at Sheffield, &c., has been appointed vice-chairman of the Southport Electricity Committee.

On retiring from the staff of Babcock & Wilcox, Renfrew and Dumbarton, after thirty-one years' service, Mr. J. WILKIE has been presented with a gift of Treasury notes from the works staff.

Mr. C. B. COLLETT, deputy chief mechanical engineer of the Great Western Railway, has been appointed to succeed Mr. G. J. Churchward, the chief mechanical engineer, who is retiring at the end of the year.

Mr. J. LEADBEATER, A.M.I.E.E., who has been chief assistant engineer at Hampstead for some years, has been promoted to the position of borough electrical engineer and manager of the Electricity Department, in place of Mr. W. Wyld, who recently resigned.

The staffs of Chesterfield Electricity and Tramways Department have presented a roll-top desk to Mr. W. A. TOPPIN, assistant manager, who is leaving Chesterfield, after four years' municipal service, to enter into business as an electrical engineer in Leeds. His new address is Toppin & Knowles, electrical engineers, 202, Manningham-lane, Bradford.

Mr. D. H. DAVIES, manager of the Heywood Corporation Electricity and Tramways Department, who had been appointed assistant general manager of the Chesterfield Corporation Electricity, Tramways and Motor-bus Department, has decided to remain at Heywood, at an increased salary of £50 per year and an allowance of 5 per cent. commission on the net profits of the Electricity Department.

Business Items, &c.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, LTD., are opening shortly new showrooms at No. 7, Saville-row, Newcastle-upon-Tyne.

The reduction in prices of the WILLYS LIGHT AND POWER SETS will take effect from the 9th inst., and not from Dec. 1, as originally announced.

THE MANNESMANN TUBE COMPANY, of Landore, has just obtained a large order for boiler tubes for the All Russian Co-operative Society. This is the first order from Russia received locally for many years.

THE JACKSON ELECTRIC STOVE COMPANY, LTD., have appointed as their agent for Ulster Mr. Robert Garmany, of 1, Union-street, Belfast, who will transact business for them in that area. A range of samples and small stocks will be held at this address.

Owing to increased business, the PREMIER ACCUMULATOR COMPANY is being reconstructed under the name of the PREMIER ACCUMULATOR COMPANY (1921), LTD. To accomplish this the original company has gone into liquidation. The business will be carried on as usual, and will be under the same management.

Mr. J. S. CHILP, who recently resigned his position as joint sales manager to the Edison Swan Electric Company, Ltd., has opened temporary offices at 185, Wardour-street, London, W. 1. (telephone: Regent 6167; telegraphic address: "Jayesscee, Ox. London"), and will be glad to receive manufacturers' catalogues.

On Monday next, the 12th inst., JOHNSON & PHILLIPS, LTD., of Charlton, London, S.E. 7, are opening a branch office and warehouse at 57, The Albany, Old Hall-street, Liverpool. Stocks will be held there of V.I.R. cables, Association and Non-Association C.T.S. cables and flexibles, wire-armoured cables for ship wiring, and also of the cables and fittings for the well-known J. & P. Wiring System.

Within the last few months BRITISH INSULATED & HELSBY CABLES, LTD., have supplied, laid and jointed 320 miles of multiple twin telephone cable for the British Post Office, and at the present time have in hand 150 miles of the same type of trunk cable. They have also recently completed the supply, laying and jointing of a multiple twin telephone cable between Luxembourg and Diekirch—a distance of 35 kilometres.

We understand that arrangements have now been concluded whereby Mr. L. M. WATERHOUSE resigns his directorship and retires from the Board of Tube Investments, Ltd., Simplex Conduits, Ltd., and Credenda Conduits Company, Ltd., manufacturers of electrical conduits and fittings, art fittings and signs, and electrical heating and cooking apparatus. Mr. Waterhouse is starting in business at 19, Rathbone-place, W., and is specialising in the sale of electric heating and cooking apparatus generally.

Amended plans for new glass works have been approved by CHESTERFIELD Highways Committee in connection with the new electric lamp factory which the British Thomson-Houston Company are erecting.

Municipal Accounts.

For the year ended March 31, there was a loss of £32 000 on WALTHAMSTOW municipal tramways.

The annual accounts of TUDMORREN Electricity Department show a loss of £5 223, compared with £3 774 last year.

The half-yearly returns of ACCRINGTON Electricity Department show a loss of £4 620. The tramways show a loss on the half year of £2 760.

The annual accounts of the SHREWSBURY Electricity Department show a gross profit of £3 438 15s. 6d., but after payment of interest (£820 2s. 1d.) and sinking fund contribution (£2 810 14s. 3d.) there is a deficit of £192.

The revenue returns from the GLASGOW Corporation tramways show an increase of over £32 000 for the financial half-year, which closed on Nov. 30, compared with the corresponding period of the preceding financial year.

The receipts of BELFAST tramways undertaking for the six months ended Sept. 30 amounted to £334 130, and expenditure, including capital charges and depreciation (together with the proportion of the deficit from last year amounting to £19 818) to £356 569, involving a net deficiency of £22 431.

The accounts for the County Borough of SOUTHAMPTON Electricity Department for the year ending March 31 show that the total income was £143 216, against £111 992 in the previous year; working expenses £110 654 (86 714), leaving a gross profit of £32 562 (£25 275). After providing for interest, £10 413 (£9 557) and redemption charges, £11 561 (£11 012), there remained £10 587 (£4 709), but special expenditure amounting to £11 382 resulted in an adverse balance of £795. Items under this head included £3 556 for meters, £2 825 for wages of the permanent employees whilst engaged on work of a character usually brought to account under the head of capital expenditure. Other entries include £1 821 for re-laying of mains, £1 254 for the loss incurred by the employees' strike, £512 for repairs to the 3 000 kW turbo-alternator. The total number of units sold amounted to 10 916 989 (10 570 248); maximum load 5 111 kW (5 100 kW); load factor 24.58 per cent. (23.65 per cent.). In spite of the trade depression, the coal strike, and the extension of the "Summer Time" period, there was an increase of 626 067 units for private lighting, power and heating, equivalent to 9.44 per cent., due principally to the extended use of heating and small domestic appliances. Further, the economies in public lighting amounting to 246 191 units, and a reduction of 33 133 units in the tramway supplies—due to the tramways strike, the total loss of which was over 60 000 units—resulted in an increase in the total units sold of 346 741 units only, or 3.28 per cent. on that of the previous year. During the year 480 new consumers were connected to the mains, as against 371 in the preceding year, or an increase of 29.4 per cent. The number of consumers is now 4 781, and the total connections 12 280 kW.

Miscellaneous.

The plant at CARMARTHEN electric power station was destroyed by fire last Friday.

The memorial tablet in Westminster Abbey to the LATE LORD RAYLEIGH was unveiled on Nov. 30 by Sir Joseph Thomson.

BAUGHAN & COMPANY, electrical engineers, of London-street and Friar-street, Reading, have given £10 to the Mayor of Reading's Unemployment Relief Fund.

Considerable damage was done by a FIRE which broke out last week on the premises occupied by Mr. J. W. Carrack, electrical engineer, 6, Park-place, Leeds.

Mr. Curt Stille has applied for the RESTORATION OF PATENT No. 9 061/1913 for "Improvements in optical receivers for facsimile telegraphs," which expired on April 24, 1917, owing to non-payment of renewal fee. Any notices of opposition must be sent to the Patents Office by Jan. 30.

The report of the Development Commissioners for the year ending March 31, states that the Committee have reached the conclusion that the ELECTRIFICATION OF CROPS by an overhead discharge is capable of bringing about increased growth and yield. A grant of £1 365 is recommended for the completion of the investigations during the present year.

The Home Secretary has made an Order authorising the EMPLOYMENT OF MALE YOUNG PERSONS of sixteen years of age and over in extruding raw ebonite into tubes and rods at the Woodland Works of Fuller's United Electric Works, Ltd., Chadwell Heath, on two day-shifts, subject to the conditions that no worker shall be employed in the afternoon shift in consecutive weeks, and that suitable messroom accommodation shall be provided.

One man was killed and another seriously injured as the result of an accident which occurred at GLASGOW Corporation Electricity Department Sub-station, in course of construction in Great Wellington-street. A three-ton electric crane had been brought to the site to assist in unloading a tipping wagon belonging to a firm of contractors. A tying chain of the crane broke, and the jib fell forward, but a reinforced concrete beam stayed the progress of the body of the crane. J. M'Fadyen, who was working in the vicinity, in trying to make his escape, fell from a steel beam a distance of 40 ft., and was killed. J. O'Reilly was struck by a falling wooden beam, and was removed to the infirmary suffering from internal injuries.

Institution Notes.

The offices of the INSTITUTE OF TRANSPORT have been removed to 15, Savoy-street, London, W.C. 2.

At the 259th anniversary meeting of the ROYAL SOCIETY last week the Copley Medal was presented to Sir Joseph Larmor for his researches in mathematical physics; the Davy Medal to Prof. Philippe A. Guye, for his researches in physical chemistry; and the Hughes Medal to Prof. Niels Bohr, for his researches in theoretical physics.

A general meeting of members of the ROYAL INSTITUTION was held on Monday, Sir James Crichton Browne, treasurer and vice-president in the chair. Mr. A. K. Loyd was elected a manager to fill the vacancy caused by the death of Mr. J. H. Balfour Browne; Dr. Niels Bohr (Copenhagen), Dr. Johan Hjørt (Copenhagen), and Prof. Paul Langevin (Paris) were elected honorary members.

Mr. E. S. Byng read a Paper on "TELEPHONE LINE WORK IN U.S.A." before the Liverpool Sub-Centre on Monday, Nov. 21. The Paper, which was illustrated by lantern slides, gave a very good conception of the problems that American engineers have to contend with in covering wide and undeveloped areas, and in the installation of lines in buildings of the "skyscraper" type. Mr. Barnes opened the discussion, and was followed by Messrs. Bolton, Pratt, Morton, Cowburn, Holthum, Brookes, Mercer, and Adams.

War memorials to members of the INSTITUTION OF MINING ENGINEERS, and members, associates, and students of the INSTITUTION OF MINING AND METALLURGY were unveiled on Thursday, Nov. 24, by Field-Marshal Lord Haig. The two institutions jointly occupy Cleveland House, in City-road, London, and it is in the library of this building that the memorials have been placed. The memorial of the Institute of Mining and Metallurgy, designed by a member, Lieut.-Colonel F. N. Nissen, consists of a small bronze figure of a tunnelling officer of Engineers electrically firing a mine, on a pedestal of malachite and dark wood, the faces of which bear the names of the fallen inscribed on brass plates. The other memorial, the work of Mr. A. G. Wyon, is fixed against the wall, and consists of a small female figure in bronze, holding a banner, with a background of marble, on which appear the lists of the fallen. The number of names on the respective rolls of honour is: "Institution of Mining and Metallurgy, 126; Institution of Mining Engineers, 77."

Educational.

Applications are invited for the four CASSIOT TRAVELLING SCHOLARSHIPS and the Stern Scholarship in connection with Degrees in Commerce of the University of London.

The State Medicine Syndicate of Cambridge University have appointed Dr. GRAHAM-SMITH, Dr. G. H. OXTON, and Dr. S. MELVILLE (of Brussels) members of the Committee on Medical Radiology and Electrolgy for three years.

Cambridge University propose to appoint Mr. C. G. LAMB, reader in electrical engineering for five years. Mr. Lamb has taken a leading part in the teaching and administration of the Engineering Department for thirty years, and has been University lecturer for eighteen years.

The annual prize distribution at the NORTHAMPTON POLYTECHNIC INSTITUTE was held last Friday, when Lord Southdown gave away the prizes. In his report for the year, Dr. R. Mullineux Walmesley stated that 3 802 students were enrolled this year against 3 118 the highest in any previous year; the Engineering Day College entries were 295 against 252 last year.

The Government of India has appointed a Committee of Inquiry into the administration and workings of the TATA RESEARCH INSTITUTE at Bangalore, founded with the munificent donation of 30 lakhs of rupees, and subsidised both by the Indian Government and the Durbar of Mysore. Sir Alexander Pope, Regius Professor of Chemistry in the University of London, has been appointed president of the Committee.

Exhibition Notes.

The total amount guaranteed by Glasgow for the BRITISH EMPIRE EXHIBITION has now reached £100 05s.

The Coal Smoke Abatement Society will hold a SMOKE ABATEMENT AND DUST PREVENTION EXHIBITION at the Royal Agricultural Hall, London, from March 15 to April 8 next.

An Exhibition to demonstrate the various uses to which electric power can be put will be held in CHRISTIANIA from April 22 to May 7, 1922. Entries will be received up till Feb. 1, and foreign as well as Norwegian firms will be permitted to exhibit.

The FOURTH INTERNATIONAL SAMPLES FAIR OF PRAGUE will be held from March 12 to 19, 1922. Applications for space will be received at the Fair Offices at Prague up to Dec. 15. Full particulars can be obtained at the Czecho-Slovak Legation, 8-9, Grosvenor-place, London, S.W. 1.

A SAMPLE FAIR will be held in VIENNA from March 19-25 next year. This date falls between the Frankfurt and Leipzig Fairs, so that exhibitors at these two could utilise the same exhibit for Vienna. The time limit for sending in applications is Dec. 15, but it is stated that a few days' grace will probably be given to foreign applicants. Further particulars may be obtained from the Department of Overseas Trade.

Imperial Notes.

Work on the Underground Railway in SYDNEY, which was suspended during the war, has been resumed.

DELRORNE (Tasmania) Council have appointed Mr. H. A. Masters, of Launceston, advisory engineer for their electric supply and water undertakings.

THE SOUTH AFRICAN RAILWAYS AND HARBOURS BOARD have now definitely decided on the electrification of 171 miles of railway from Glencoe to Pietermaritzburg.

ST. LEONARDS (TASMANIA) and adjacent municipalities have asked the Minister for Works to send an officer to report on the possibility of generating electrical energy by the water-power of the North Esk River.

THE GRAHAMSTOWN (South Africa) City Council has been authorised to raise a loan not exceeding £65 000 for providing the city with electric light. It is understood that the Municipality will not call for tenders before July of next year.

Sir Denison Miller, governor of the Commonwealth Bank, recently opened the new portion of NEWCASTLE (N.S.W.) Council's power station. The Mayor said it was thirty years since the Council undertook the supply of electricity. The undertaking had had many vicissitudes, but had turned the corner, and last year yielded a profit of £8 350.

Tenders for the construction of a bridge over SYDNEY Harbour were called for in the "New South Wales Government Gazette" of Oct. 8, and the local Press. Similar announcements will in due time be published throughout the world. Tenders must reach the Under-Secretary for Public Works, New South Wales, not later than Oct. 31, 1922.

An official cable from the ELECTROLYTIC ZINC COMPANY of AUSTRALIA states that the first unit of the main plant at Risdon (Tasmania), which will absorb 15 000 H.P., started running on Nov. 22. It is expected that the complete plant, absorbing 30 000 H.P. per annum, will be running well before the end of 1922, with an output of 40 000 to 45 000 tons of refined zinc per annum.

Foreign Notes.

A serious fire occurred at the CHRISTIANIA ELECTRICAL WORKS last week.

GERMAN manufacturers of electric lamps have increased surcharges to basic prices from 300 to 400 per cent.

Steam cranes in the port of HAMBURG are to be replaced by electric ones. Twenty-nine of the latter are to be installed on the Asia Quay.

At a recent meeting, held in Washington, of American chemical manufacturers, the SYNTHETIC CHEMICAL MANUFACTURERS' ASSOCIATION of the UNITED STATES was formed, with Dr. C. H. Hertz as president.

The strike of the employees of the BERLIN electricity works last week ended, after ten hours, in the men's terms being agreed to. The increased wages granted mean an annual expenditure of 256 000 000 marks—£12 800 000 at the normal rate of exchange. The City Council is applying to the State for assistance.

Mr. R. V. Laning, Commercial Secretary to H.M. Legation at the Hague, in a report on the subject of tenders for public contracts in the NETHERLANDS EAST INDIES, states that in the case of contracts for railway material, dredging plants, cables, structural iron and steel, and the like, foreign firms may lodge tenders with the Colonial Office at the Hague, without the necessity for local representation in Holland.

The lightning strike on Nov. 22 of electricians and tramway employees in ATHENS was promptly and vigorously dealt with by the Government, and by Nov. 26 nearly all the strikers had resumed work. Forty of the men who were Reservists had been sentenced to eight years' and twenty-six to five years' imprisonment. The staff of the SALONIKA electric power station and tramways went on strike on the 24th ult., but measures have been taken by the Government to carry on the services.

For a period of five years from Jan. 1 next, the undermentioned Customs duties are to be levied per kilog on electrical machinery imported into Continental Portugal and the adjacent islands: Electrical machinery, including dynamos, alternators, commutators, transformers, continuous and alternating-current motors and apparatuses thereof, weighing up to 50 kilogs, 6 cts.; from 50 to 100 kilogs, 5 cts.; from 100 to 500 kilogs, 4 cts.; from 500 to 1 000 kilogs, 3 cts.; from 1 000 kilogs upwards, 2 cts.; welded tubes for use as conduit pipes for electrical power and parts for joining and fitting the same, 2 cts. The present duty on electrical machinery, &c., is 30 per cent. *ad valorem*.

THE FRENCH RAILWAY PROGRAMME for 1922 provides for the electrification of 9 000 kilometres of line. The work will, of course, not be completed within the year. The lines to be constructed include the laying of a quadruple track between the Pont St. Michel and the Pont de l'Archevêché (outside the Gare d'Orsay, Paris), and the enlarging of the Pont St. Michel Station, which is to replace the Gare d'Orsay for suburban traffic. A tunnel is to be bored through the Vosges in order to make Alsace-Lorraine more accessible to old France; the Suisse-Océan scheme is to be undertaken. New routes are to be created between Havre and Rouen, Nantes, and Paimboeuf, via le Pellerin, and through the City of Nantes itself.

Tenders Invited and Accepted.

UNITED KINGDOM.

DUBLIN UNITED TRAMWAYS COMPANY (1896), LTD. Dec. 12.—Electrical supplies for six months. Particulars from the General Manager's Office, 9, Upper Sackville-street, Dublin.

MANCHESTER TRAMWAYS COMMITTEE. Dec. 13.—(a) Motors and (b) controllers for tramcars. Forms and tender, &c., from the General Manager, Corporation Tramways, 55, Piccadilly, Manchester.

MANCHESTER GAS COMMITTEE. Dec. 14.—Two electrically-driven capstans and three dummy capstans on the site of the Bradford-road gasworks, Manchester. Specifications, &c., from the Secretary, Gas Department, Town Hall, Manchester.

COMMISSIONERS of HIS MAJESTY'S WORKS, &c. Dec. 14.—Electrical and mechanical labour in day work in connection with the maintenance of installations in the Glasgow and Edinburgh districts during three years. Forms of tender, &c., can be obtained at the Contracts Branch, H.M. Office of Works, London, S.W. 1.

MANCHESTER EDUCATION COMMITTEE. Dec. 14.—Wiring and fitting Chester-street and Thomas-street municipal schools. Specifications, &c., can be obtained at the Education Offices, Deansgate, Manchester.

WEST HAM GUARDIANS. Dec. 15.—Three months' supply of electric fittings, ironmongery, tools, &c. Forms of tender from the Clerk, Union-road, Leytonstone, E. 11.

EDINBURGH CORPORATION. Dec. 19.—Five months' supply of insulated cables to the Electricity Department. Specifications from the Engineer, Dewar-place, Edinburgh.

EDINBURGH CORPORATION. Dec. 27.—Fifty-three electrical equipments for tramcars. Forms of tender from the Tramways Manager, 2, St. James-square, Edinburgh.

BLACKPOOL CORPORATION. Dec. 23.—One 5 000 kW 3 phase, 50 period, 6 600 V turbo alternator (Sec. 1); one surface condensing plant, complete with auxiliaries (Sec. 2); one 2 000 kW phase and frequency changer, 6 600 V, 3 phase, 50 period to 2 200 V, 1 phase, 83 period, complete with exciter and starting motor.

BRADFORD CORPORATION. Dec. 24.—Rotary converting plant (Contract "R. 207"). Particulars from Mr. T. Roles, City Electrical Engineer and Manager, Electricity Offices, Town Hall, Bradford.

WEST DERBY GUARDIANS. Dec. 23.—Electric light and power installation (including generating plant), electric lift service, and telephone installation at the Walton Institution. Specifications from Mr. E. B. Bailey, 37, Moorfields, Liverpool.

LONDON COUNTY COUNCIL invite applications from firms, and particularly manufacturers, to be placed on the lists of persons or firms from whom the Council from time to time invite tenders for the supply of electrical and mechanical equipment and spares, &c., required for the Council's tramways. Applications for inclusion in the first lists of goods required must be sent in not later than Dec. 31.

BIRMINGHAM SALVAGE AND STABLES COMMITTEE. Jan. 2, 1922.—Contract No. 1 (a) eight-cell destructor in two units; Contract No. 2, electric garage. Particulars from Mr. J. Jackson, Superintendent, Salvage Department, Council House, Birmingham.

AUSTRALIA.

POSTMASTER-GENERAL'S DEPARTMENT, MELBOURNE.—Jan. 17, 1922.—"Supply and delivery of telegraph instruments, differential galvanometers, keys, relays, sounders, &c., to the stores branch. (Schedule No. 1 718.) Local representation is essential.

VICTORIAN GOVERNMENT RAILWAYS. Jan. 25, 1922.—"Supply and delivery of ten coasting recorders, or, alternatively, ten coasting and service recorders, for electric trains. (Contract No. 34 736.)

CITY ELECTRIC LIGHT COMPANY, LTD., BRISBANE.—Feb. 10, 1922.—"Supply and delivery of six miles of three-core 0.15 by 0.15 by 0.15 paper insulated cable, suitable for 5 500 V, with a non-earthed system. Tenders, accompanied by a preliminary deposit of £100, to the Engineer and Manager, Boundary-street, Brisbane.

POSTMASTER-GENERAL'S DEPARTMENT, MELBOURNE. Feb. 14.—"29½ tons Wheatstone tape of various patterns. (Schedule No. 3.) Local representation is essential.

THE COMMONWEALTH OF AUSTRALIA. Feb. 15.—Telegraph apparatus and parts (Schedule 544). Particulars from Supply Officer, Australia House, Strand, London, W.C. 2.

NEW SOUTH WALES GOVERNMENT RAILWAYS AND TRAMWAYS DEPARTMENT (Electrical Engineer's Branch).—Feb. 22, 1922.—"Supply, delivery, erection and maintenance of one 5 000 kW 50 cycle turbo-alternator with condenser and accessories, at Zorra-street power house, Newcastle. (Contract No. 556.) Tenders, or proper forms and accompanied by a preliminary cash deposit, to the Secretary for Railways, Phillip-street, Sydney, N.S.W. Local representation is essential.

NEW ZEALAND.

POST AND TELEGRAPH DEPARTMENT. Jan. 17.—"25 000 dry cells for telephone work.

BOROUGH COUNCIL of PALMERSTON NORTH. Original closing date Sept. 24. Extended date not yet decided.—"Service meters: (a) Single-phase, 230 V, 400 5 A, 150 10 A, 50 15 A; three-phase, balanced load, 400 V, 100 10 A, 30 25 A, 15 50 A, 10 75 A, 5 100 A.

* Particulars from the Department of Overseas Trade.

(b) 19 50 kVA single-phase transformers, with oil, complete; 1 complete winding h. and l. tension, for one leg; spare parts and accessories.

LYTTLETON, PUBLIC WORKS TENDERS BOARD OF NEW ZEALAND. Jan. 31.—"Two complete sets of 3 phase automatic oil circuit breakers suitable for 6 600 V, 1 200 A capacity, four sets of disconnecting switches for isolating the oil switches, and one 6 600 V air break lever operated switch for main transformer switches at Lake Coleridge power house. Tenders to the Secretary, Public Works Tenders Board, Government Buildings, Wellington.

PUBLIC WORKS TENDERS BOARD, WAIKATO POWER SCHEME. March 6.—"(Section 45) two 2 500 kVA alternators, three-phase, 50 cycle, 5 000 V, at 166½ rev. per min., with a power factor of .8. Excitation at 220 V. (Section 46) two 3 100 H.P. water turbines of the double-runner Francis type to operate the generators mentioned in Section 45. (Section 47) two exciter sets, each consisting of one 200 kW d.c. generator, and one 350 H.P. asynchronous motor, together with a Tirrill regulator. The generator shall have an output of 220 V, with a full-load current of 7 000 A. The motor shall be of 350 H.P., with a power supply of 400 V, three-phase, 60 cycle. The synchronous speed of the sets shall be 750. (Section 48) four Stoney sluice gates for the pits, appertaining to the turbines mentioned in Section 46. Tenders to the Secretary, Public Works Tenders Board, Government Buildings, Wellington.

SOUTH AFRICA.

MUNICIPAL COUNCIL OF JOHANNESBURG. Jan. 4.—"Supply and erection of one two-phase alternating-d.c. 2 000 kW converter, switchgear and spares. The h.t. supply is two phase, 3 000 to 3 300 V per phase, 50 periods, and the converter is to be capable of supplying (a) d.c. three-wire from 460 to 520 V as a shunt-wound machine; and (b) traction supply from 500 to 550 V as a compound-wound machine.

R. BLACKETT & COMPANY have obtained the contract for the erection of the new standage sheds at Gosforth for the Tyneside electric rolling stock of the North-Eastern Railway.

LONDON County Council have accepted the tender of H. J. Cash & Company (lowest tender received), for wiring and fitting Webb-street School, Bermondsey, £519. Four tenders received; highest £1 030.

HAMMERSMITH (London) Council have accepted the tender of the Enfield Edison Cable Works, Ltd. (lowest tender received), for 1 000 yards 1 sq. in. l.t. concentric cable, at £293. Eight tenders were received, the highest being £360.

HAMMERSMITH Council have also accepted the tender of the Hackbridge Cable Company (lowest tender received) for 500 yards 2 sq. in. l.t. lead-covered and steel armoured cable, £210. Eight tenders received; highest £250.

Catalogues, Price Lists, &c.

THE ENTERPRISE MANUFACTURING COMPANY has issued its monthly price list.

In the new catalogue issued by MR. S. UTTING, 82, Victoria-street, S.W. 1, illustrated particulars are given of the design, construction and use of "Thermix" air heaters, for which he is the British representative.

THE GENERAL ELECTRIC COMPANY have issued revised catalogues of prices (leaflets No. F. 2660) of electric light fixtures appearing in Section F of the fourteenth edition of their catalogue, and in supplementary publications; of electric light fittings accessories appearing in E and G Sections of the same catalogue, and of industrial and street lighting fittings and accessories in F I Section of the third edition of their catalogue. The prices given cancel all previous list prices, and are not subject to any advance.

In a neat booklet of thirty-four pages, entitled "Hints and Diagrams on Wiring with the Henley Wiring System," the W. T. HENLEY'S TELEGRAPH WORKS COMPANY has produced a little work which should prove very serviceable to wiremen. In addition to useful hints on wiring by means of the Henley system, there are thirty-two diagrams of connections, some of them being representative diagrams of daily use, and some of the more interesting but less wanted circuits. Section 1 of the diagrams deals with the "Looping-in" principle, and section 2 shows diagrams with joint boxes. There is also a chapter on the use of Rawplugs. The booklet, which is bound with a serviceable stiff-board cover and is of a handy, pocket size, is published at 6d., but the company will send a copy or copies to any contractor for his wireman, free of charge.

A good idea of the extent to which electric heating and cooking appliances are now used for domestic and industrial purposes may be gained from the new (1922) catalogue of the DOWNSING RADIANT HEAT COMPANY, 91 and 93, Baker-street, W.1. It consists of sixty-four Royal octavo pages, and contains illustrated particulars and prices of a great variety of apparatus, including a number of hot-bar and luminous radiators and convector heaters, a really fine range of electric irons for domestic and industrial use, sealing wax heaters, glue pots, bed warmers, kettles, coffee percolators, water urns, boiler or cooking plates, tumbler heaters, toasters, and several special appliances and accessories, &c. The stoneware bed warmers are heated by being connected to the electric supply for ten or fifteen minutes, when they can be disconnected, and the accumulated heat will be sufficient for several hours' use. A useful electric vulcaniser, a tumbler heater, and the range of immersion heaters also deserve notice.

Companies' Meetings, Reports, &c.

India Rubber Meeting.

THE annual meeting of the INDIA RUBBER, GUTTA PERCHA, & TELEGRAPH WORKS COMPANY was held in London last week, Major Leonard Darwin (chairman) presiding. In moving the adoption of the report and accounts (an abstract of which appeared in our issue of Nov. 25), the chairman said that these were for eleven months' trading instead of the usual one year, as this enabled the company more easily to meet the requirements of the Finance Act, 1921, the most important provisions of which Act, with regard to their company, were those relating to the revaluation of the stock at the beginning of the year. To enable them to make a claim, not only had they to revalue the stock at Sept. 30, 1920, on the basis of prices ruling at Aug. 31, 1921, but they also had to take and value stocks on hand at Aug. 31, 1921, and have their accounts prepared at that date. Much labour was, therefore, saved by the earlier closing of accounts. The total difference in the valuation of the commencing stocks at prices ruling at Sept. 30, 1920, and at those ruling on Aug. 31, 1921, was £407 149, on which figure the rebate was calculated. Over the period of seven years ended Sept. 30, 1920, during which excess profits duty was in force, the firm were assessed in a total sum of £435 603, of which only £32 587 now remains unpaid. As against this, and arising out of the above-mentioned revaluation, they were in a position to reclaim duty in a sum approximating to £224 000 gross, or to £156 752 after allowing for income tax thereon, a figure which has been taken to the credit of the profit and loss account. The claim for a refund of excess profits duty in so far as taken into the accounts, contained a figure in connection with the Persian stocks upon which no doubt exists; but it excluded a claim which they hoped to make for a further sum of £43 000. In France the subject of war tax on profits was engaging the attention of all industries, especially in regard to the settlement of the amount payable on the profits made during the final period of the incidence of the tax. Amended accounts and declarations had for this purpose been prepared, under the supervision of the firm's accountants in Paris, and submitted to the Fiscal Authorities at Versailles. It was estimated that of the total liability to duty, which stood at 863 964 frs. before the amended accounts were presented, only 130 985 frs. would be payable, leaving a sum of 732 978 frs. to be written back. As against this there was a probable loss of 437 000 frs. arising out of a deposit which it was necessary to make in order to ensure coal supplies during the war. In setting the refund of the war tax against the probable loss of this deposit, the credit difference would be, approximately, £5 000, which sum has been left out of the accounts, pending final settlement.

The turnover at Silvertown for the eleven months from Oct. 1, 1920, to Aug. 31, 1921, was only 50 per cent. of that of the preceding year, this reduction being due to the general slackness of trade, which reduced both the quantity of deliveries and the prices obtainable. The only shop showing an increased turnover was the golf ball shop, where the turnover for the eleven months was 43 per cent. greater than for the twelve preceding months. The rubber department shops, the telegraph shop, the instrument shop, and the battery departments had turnovers which were more than half as much as in the preceding year, whilst in all other manufacturing shops the turnover was less than half.

It is stated that the READING ELECTRIC SUPPLY COMPANY will shortly offer for subscription £100 000 in 7½ per cent. debentures at 95.

THE MARCONI INTERNATIONAL MARINE COMMUNICATION COMPANY announce an interim dividend of 5 per cent., less income tax, upon the issued capital of the company, payable to shareholders registered on Dec. 1, and to holders of share warrants to bearer.

An extraordinary general meeting of the VERA CRUZ TELEPHONE CONSTRUCTION SYNDICATE will be held at 13-14, Blomfield-street, London Wall, on Friday, Dec. 16, to pass a resolution to authorise the directors to sell or otherwise dispose of the assets of the company.

The profit of the BRITISH VACUUM CLEANER COMPANY for the year to Sept. 30 was £2 359, less depreciation of plant, premises, &c., £1 350, leaving £1 009, plus £582 brought in, making £1 591. The directors have placed £1 000 to reserve (making a total of £3 250), carrying forward £591.

THE STOCK EXCHANGE Committee have specially allowed dealings in £1 500 000 7 per cent. mortgage debenture stock of the British Thomson-Houston Company and £400 000 7½ per cent. mortgage debenture stock of the Midland Counties Electric Supply Company.

THE DIRECTORS of the WESTERN TELEGRAPH COMPANY have declared the first quarterly interim dividend of 5s. per share, free of income tax, for the year ending June 30, 1922, payable to shareholders registered on Dec. 6, 1921, being at the rate of 10 per cent. per annum. The transfer books are closed from the 6th to the 13th inst.

A meeting of the second mortgage debenture stockholders of the NEWCASTLE ELECTRIC SUPPLY COMPANY, LTD., is to be held to-day (Friday), at Winchester House, Old Broad-street, E.C., for the purpose of increasing, as from Sept. 1 last, the rate of interest on the stock from the present rate of 5 per cent. per annum to 6 per cent. per annum, and for authorising an additional £1 500 000 of stock, making the total authorised amount £2 000 000.

THE DIRECTORS of the CASTNER-KELLNER ALKALI COMPANY have declared a final dividend of 5 per cent. actual, making 13 per cent. for the year, against 22 per cent. in the previous year. The net profit of the company for the year ended Sept. 30, after allowing for various charges, including corporation tax, was

£155 085, plus £48 152 brought in, making £201 217, of which debenture interest absorbs £7 511.

The accounts of CLAUD HAMILTON, LTD., show, after writing off depreciation, paying the preference dividend, and transferring £6 210 to general reserve, a balance of £17 245 to be carried forward, subject to E.P.D. and corporation tax. No dividend is recommended on the ordinary shares, but the directors propose to capitalise £3 000 of the general reserve fund and distribute this among ordinary shareholders as fully-paid bonus shares in proportion of one for every ten shares held.

The total receipts for 1920 of GREENOCK and PORT GLASGOW TRAMWAYS COMPANY were £84 518. After providing for all expenses, including mortgage interest, amount payable under agreements, and setting aside £6 000 for renewals, there was a surplus of £3 937, plus £216 brought forward. The directors propose to place to sinking fund for loan redemption £2 000, to reserve £1 743, leaving £410 to be carried forward. They regret that the result does not admit of the payment of any dividend.

The directors' report of the WIRELESS PRESS, LTD., states that the net profit for the year ended Sept. 30, after allocating £290 to reduction of copyright account, amounts to £73, which, together with the previous year's balance of £693, it is proposed to carry forward. The copyright account has also been credited with the amount of the reserve account, namely, £450. In agreement with Marconi's Wireless Telegraph Company, the company's service of foreign news by wireless was discontinued on April 2 last.

With regard to the announcement by M. Blakstad in Norway that the Tyse Power Company will take possession of the ALBY UNITED CARBIDE COMPANY's factories at Odda, and put them up for sale in January, the directors of the Alby Company state that, following the purchase by an English syndicate from M. Blakstad of the control of the Tyse Company, proposals were made by Mr. A. E. Barton for the formation of a company to develop the Claude ammonia process, but they fell through owing to financial difficulties. The directors have taken steps to protect the interests of the shareholders.

The first report of the TELEPHONE MANUFACTURING COMPANY (1920), covering a period of nineteen months to May 31, 1921, states that the company acquired the business of the Telephone Manufacturing Company as from Oct. 31, 1919, and shares of eight installation companies in Great Britain as from Dec. 31, 1919. The profits totalled £45 831, plus dividends from the installation companies, (£52 173), making £98 004. The directors have placed to investment reserve all profits accrued on the installation companies to date as from which shares were purchased, £32 053; to general reserve, proportion of net manufacturing profits earned prior to date of incorporation, which directors propose to utilise in writing down preliminary expenses, £12 454; leaving available £53 496. A dividend of 2s. per share, less tax, is proposed, carrying forward, subject to excess profits duty and corporation tax, £24 796. No figures are included in the above for five new British companies in Bristol, South Wales, Liverpool, Newcastle, and Sheffield, the whole of the shares in which are held by the company. These companies have been in operation since about June, 1920, and it is estimated considerable profits have already been made. At the general meeting held subsequently, Viscount Chetwynd was elected chairman of the company, and Sir John Rees was also elected to the Board. The company last week made an issue of £300 000 guaranteed 8 per cent. cumulative income bonds. The bonds, which are to be issued at 96 per cent., will be repayable in or before 1935 at £102 per cent.

Prices of Metals, Chemicals, &c.

		TUESDAY, DEC. 6.		
Copper—		Price.	Inc.	Dec.
• Best selected	per ton	£68 0 0	—	10s.
Electro Wirebars ..	„	£77 0 0	—	—
H.C. wire, basis	per lb.	0s. 11½d.	—	—
Sheet	„	0s. 10½d.	—	—
Phosphor Bronze Wire (Telephone)—				
Phosphor-bronze				
wire, basis	„	1s. 3½d.	—	—
Brass 60/40—				
Red, basis	„	0s. 7½d.	—	—
Sheet, basis	„	0s. 10½d.	—	—
Wire, basis	„	0s. 11½d.	—	—
Pig Iron—				
Cleveland Warrants	per ton	£5 5 0	—	10s.
Galvanised steel				
wire, basis 8 SWG ..	„	£22 0 0	—	—
Lead Pig—				
English	„	£26 10 0	—	10s.
Foreign or Colonial ..	„	£25 7 6	—	10s.
Tin—				
Ingot	per lb.	167 2 6	£3 10 0	—
Wire, basis	per lb.	2s. 3d.	½d.	—
Sal ammoniac.—Per cwt. 65s.-60s.				
Sulphur (Flowers).—Ton £13.				
„ (Roll-Drumming).—Per ton				
£13.				
Sulphuric Acid (Pyrites, 168°).—				
Per ton, £9 17s. 6d.				

Rubber.—Para line, 1s. 2½d.; plantation 1st latex, 11½d. to 11½d. lb. The metal prices are supplied by British Insulated & Helsby Cable, Ltd.

Arrangements for the Week.

FRIDAY, Dec. 9th (to-day).

PHYSICAL SOCIETY.

5 p.m. At the Imperial College of Science, London, S.W. Papers on "The Average Range of B-Rays in Different Metals," by Messrs. G. A. Sutherland and L. Clark; "On the Sensitivity of Ballistic Galvanometers," by Prof. E. Wilson; "The Determination of the Damping Decrement of a Tuning Fork," by Prof. R. L. Jones; and "The Estimation of the Radium Content of Radio-active Luminous Compounds," by Dr. E. A. Owen.

JUNIOR INSTITUTION OF ENGINEERS.

7.30 p.m. At Royal United Service Institution, Whitehall, London, S.W. Presidential address by Mr. C. H. Wordingham, C.B.E.

INSTITUTION OF ELECTRICAL ENGINEERS. (IRISH CENTRE.)

8 p.m. At the Royal College of Science, Upper Merrion-street, Dublin, Paper on "Electric Vehicles, their Design, Construction and Potentialities," by Mr. F. E. Walker.

SATURDAY, Dec. 10th.

BIRMINGHAM AND DISTRICT ELECTRIC CLUB.

7 p.m. At the Grand Hotel, Colmore-row, Birmingham. Annual General Meeting.

MONDAY, Dec. 12th.

INSTITUTION OF ELECTRICAL ENGINEERS.

(LIVERPOOL SUB-CENTRE OF THE NORTH-WESTERN CENTRE.)

7 p.m. At the University, Brownlow-street, Liverpool. Lecture on "Single and Three-Phase Commutator Motors with Shunt and Series Characteristics," by Prof. S. P. Smith.

TUESDAY, Dec. 13th.

NATIONAL ASSOCIATION OF SUPERVISING ELECTRICIANS.

6.45 p.m. At St. Bride Institute, Bride-lane, London, E.C. Paper on "Artificial Heating in Relation to Human Needs," by Mr. J. W. Beauchamp.

INSTITUTION OF ELECTRICAL ENGINEERS. (EAST MIDLAND SUB-CENTRE.)

6.45 p.m. At the Technical College, Loughborough. Paper on "Whirling of Shafts," by Prof. C. H. Bullied.

INSTITUTION OF ELECTRICAL ENGINEERS. (NORTH-WESTERN CENTRE.)

7 p.m. At the Engineers' Club, Manchester. Informal meeting. Discussion on "Supply of Power Station Auxiliaries."

INSTITUTION OF ELECTRICAL ENGINEERS. (SCOTTISH CENTRE.)

7.30 p.m. At 207, Bath-street, Glasgow. Paper on "The Cyc-Arc Process of Automatic Electric Welding," by Messrs. L. J. Steele and H. Martin.

ILLUMINATING ENGINEERING SOCIETY.

8 p.m. At the Society of Arts, John-street, London, W.C. Discussion on "Progress in Gas Lighting in Relation to Illuminating Engineering," opened by Mr. W. J. Sandeman.

FARADAY SOCIETY.

8.15 p.m. At the Chemical Society, Burlington House, London, W. Address on "The Structure of Gaseous Molecules," by Prof. A. O. Rankine.

WEDNESDAY, Dec. 14th.

ASSOCIATION OF ENGINEERS-IN-CHARGE.

7.30 p.m. At St. Bride Institute, Bride-lane, London, E.C. Paper on "Utilisation of Exhaust Gases from Internal Combustion Engines," by Major W. Gregson.

LIVERPOOL ENGINEERING SOCIETY.

8 p.m. At the Royal Institution, Colquhoun-street, Liverpool. Paper on "Mechanical Cargo Handling," by Mr. G. Rae.

THURSDAY, Dec. 15th.

INSTITUTION OF ELECTRICAL ENGINEERS.

6 p.m. At Savoy-place, London, W.C. Paper on "Induction-Type Synchronous Motors," by Mr. L. H. A. Carr.

FRIDAY, Dec. 16th.

INSTITUTION OF MECHANICAL ENGINEERS.

6 p.m. At Storey's Gate, St. James's Park, London, S.W. Papers on "Conveying and Elevating Machinery," by Mr. G. Mitchell, and "Discharge of Grain Cargoes in the Port of London by Pneumatic Elevators," by Mr. R. E. Knight.

JUNIOR INSTITUTION OF ENGINEERS.

7.30 p.m. At Caxton Hall, London, S.W. Paper on "Notes on Searchlight Construction and Operation," by Mr. A. J. Simpson.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

7.30 p.m. At the Literary and Philosophical Society, Newcastle-on-Tyne. Paper on "Railway Electrification," by Sir Vincent L. Raven, K.B.E.

BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION.

8 p.m. At the Chartered Institute of Patent Agents, London, W.C. Conference on "Salesmanship in Relation to Electric Power-driven Machinery in the Home." Speaker, Mr. E. R. Morton.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Partnerships Dissolved.

CAPEWELL, David Abbott, and GOSSAGE, Rolf Bernard Henry, electrical engineers, 176, Alcester-road, Moseley, Birmingham, under the style of the Moseley Installation Company by mutual consent as from Nov. 19, 1921. Debts received and paid by R. B. H. Gossage.

COZENS, Samuel George, GROSE, Richard, and COOMBS, Edward George, electrical engineers and contractors, Ormonde House, No. 63, Queen Victoria-street, London, under the style of S. G. Cozens & Company, by mutual consent as from Oct. 1, 1921. Debts received and paid by S. G. Cozens and E. G. Coombs, who will continue the business.

EASTWOOD, Lewis, WINCHURCH, Lizzie, and DAY, George Arthur, art metal workers, transport contractors, and electricians, Stafford-street, Birmingham, under the style of the Charnern Manufacturing Company and Lewis Eastwood & Company, as from Nov. 25, 1921, by mutual consent so far as regards G. A. Day. Debts received or paid by L. Eastwood and L. Winchurch, who will continue the business.

LOWNDES, Eric, and STEVENS, Edward John, electrical and mechanical engineers, &c., Trafford-park Garage, Manchester, under the style of Lowndes & Stevens, by mutual consent as from Nov. 23, 1921. Debts received and paid by E. J. Stevens, who will continue the business.

Bankruptcy Information.

BENNETT, William, Back Sitwell-street, Derby, electrical contractor. First meeting, Dec. 7, 11.30 a.m., Official Receiver's Offices, 4, Castle-place, Nottingham. Public examination, Dec. 20, 11 a.m., Court House, 20, St. Peter's-churchyard, Derby.

RAWSTHORNE, Thomas, 67a, Paradise-street, West Bromwich, co. Stafford, electrical engineer. Receiving order, Nov. 21. Debtor's petition. First meeting, Dec. 9, 11.30 a.m., Official Receiver's Office, Ruskin-chambers, 191, Corporation-street, Birmingham. Public examination, Dec. 14, 11.30 a.m., Law Courts, Lombard-street West, West Bromwich.

SMITH, J. & SON, 1, Central-street, London, E.C. 1, electrical engineers. Receiving order, Nov. 24. Creditor's petition. First meeting, Dec. 7, 11 a.m., Bankruptcy-buildings, Carey-street, London, W.C. 2. Public examination, Feb. 7, 11 a.m., Bankruptcy-buildings, Carey-street, London, W.C. 2.

WILLIAMS, John Glynn, 4, Blaenau-street, Duffryn Cymmer, Port Talbot, Glamorgan, electrical engineer. Receiving order, Nov. 30. Debtor's petition.

Notice of Intended Dividends.

DOUGHERTY, Samuel Horace, 106, Kensington, Liverpool, late 36, Renshaw-street, Liverpool, under the style of the Mersey Electric Company, electrical engineer. Last day for receiving proofs, Dec. 9. Trustee, Herbert W. Bowler, 30, North John-street, Liverpool.

DOWNIE, Charles Philip Manners (trading as Philip Downie), 355a, Westborough-road, and 88, Ronald Park-avenue, Southend-on-Sea, electrical engineer and factor. Last day for receiving proofs, Dec. 14. Trustee, Thomas Gourlay, 29, Russell-square, London, W.C. 1.

HYDE, Thomas, 180, London-road, Croydon, Surrey, electrician. Last day for receiving proofs, Dec. 19. Trustee, Thomas Gourlay, 29, Russell-square, W.C. 1.

Notices of Dividends.

GEE, G. H., 10, Front-street, Annfield Plain, co. Durham, electrician. Amount per £, 2s., first and final, payable Dec. 7, Official Receiver's Office, Pearl-buildings, 4, Northumberland-street, Newcastle-upon-Tyne.

HARRISON, John (described in receiving order as Harrison & Son), 93, Princes-street, London-road, Southend-on-Sea, Essex, electrical engineer. Amount per £, 3jd., first and final, payable Dec. 9, 29, Russell-square, London, W.C. 1.

Winding-up Petition.

ALLIES ELECTRIC LAMP REPAIRING COMPANY, LTD. A petition for the winding-up of the company has been presented by Leopold Kessler, a creditor, and is directed to be heard at the Royal Courts of Justice, on Dec. 13. Hiscott, Troughton & Grubbe, 5, Stone-buildings, Lincoln's Inn, London, W.C., solicitors for the petitioner.

Companies Winding-up Voluntarily.

AQUA ELECTRIC COMPANY, LTD. (for reconstruction) R. Manners, 14, Hanover-square, W., appointed liquidator, and authorised to enter into an agreement with new company of same name.

ELECTRICAL & ENGINEERING DEVELOPMENT, LTD. D. J. Longden, 67, Broxash-road, London, S.W. 11, appointed

liquidator, and authorised to enter into an agreement with Electrical Utilities, Ltd.

PREMIER ACCUMULATOR COMPANY, LTD. (in voluntary liquidation). Meeting of creditors at the offices of the company in Cattle Market-road, Northampton, on Wednesday, Dec. 14, at 11 a.m. Note.—The liquidation of the company is for the purpose of reconstruction [as the Premier Accumulator Company (1921), Ltd.].

Edinburgh Gazette.

The firm of THE ALBERT MOTOR COMPANY, carrying on business as motor, mechanical, and electrical engineers, at 21, Prince Albert-street, Strathbungo, Glasgow, has been dissolved as July 16, 1921, by mutual consent, by the retiral of David Faulds M'Killop, one of the partners. The business will be continued by Charles David Munro and William Anderson Bowie, under the same name.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

ELLIS, Albert, 12, Shipley Fields-road, Frizinghall, Bradford, electrical contractor. £20 10s. 5d. Oct. 19.

WARWICK & WALKER, 107, Church-road, Birkenhead, electrical engineers. £18 5s. 6d. Oct. 10.

Bills of Sale.

[The undermentioned information is from the Official Registry. It includes Bills of Sale registered under the Act of 1882 and under the Act of 1878. Both kinds require registration every five years. Up to the date the information was obtained it was registered as given below; but payment may have been made in some of the cases, although no notice had been entered on the Register.]

GEE, Harold, 17, Belmont-road, New Brighton, electrical contractor. Nov. 24. £50.

ROGERS, John Joseph, 12, Windsor-terrace, Baneswell, Newport, electrical engineer. Nov. 23. £100.

Receiverships.

JOHNSON, BURLEY & MARTIN, LTD. T. M. Daffern, of Economic-chambers, Little Park-street, Coventry, appointed receiver and manager on Nov. 19, 1921, under powers contained in deb. dated Feb. 18, 1907.

Bankruptcy Proceedings.

PHONOPORE CONSTRUCTION COMPANY, THE, LTD., The Phonopore Works, Scotts Works, Southall, Middlesex. The first meeting of creditors was held on Dec. 5, at 29, Russell-square, London, W.C. 1. The Official Receiver reported that the company was formed in March, 1916, with the object of carrying on business as manufacturers of telephone instruments. The company carried on business until June, 1917, when its works were taken over by the War Office, and it then practically ceased to do any trade until January, 1919, when the War Office gave back possession of the premises. Later, a sum of £1 500 was awarded in respect of compensation, and he (the Official Receiver) understood there was a question of a further payment due to the company. A representative on behalf of the Crown said the War Office had three claims against the company, one of which was for £2750. Mr. F. R. W. Robinson said the company still had a claim against the Crown for over £3,000, of which £700 was in respect of the balance of the award granted by the Royal Commission, and the remainder was for re-instatement. The Official Receiver, continuing, said debentures were issued, the holders of which were Mr. F. R. W. Robinson, Mrs. Robinson (his wife), and Mr. F. R. H. Robinson (son). Mr. F. R. W. Robinson was appointed receiver by Mrs. Robinson under her first debenture, and he was now in possession of the company's assets. The statement of affairs had not been lodged, but the creditors were stated to amount to £2500. The company's failure was stated to have been due to the occupation by the War Department of the company's premises, loss of goodwill, and general depression in trade. Asked if he had any proposal to make to the creditors on behalf of the company, Mr. Robinson said he was in touch with several people, and he was doing his best. He was willing to give up his own debentures for £2,000, and rank as an ordinary creditor, if a working agreement was arrived at. The creditors decided that no application be made to the Court to appoint a liquidator, other than the Official Receiver. A committee of inspection was nominated.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by MESSRS. MEYER, ELLIS & CO., Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.

COMPLETE SPECIFICATIONS.

- 140 055 TAIT PIERCE MANUFACTURING Co. Magnetic chucks. (5.11.14.)
 141 505 THERMOS ARTICLES. Electric heating resistances. (16/1.15.)
 151 351 GERRARD J. Electric current generator for high voltage ignition and lighting. (16/9.19.)
 152 625 ARTERIOLOGIC CRYPTOGRAPH. Production of cipher documents especially adapted for telegraphic despatch. (10/10.19.)
 153 065 TEN BOMER A. Electric wall plugs. (23/7.19.)
 154 836 MASCHINEN FABRIK OBERLIN. Homopolar inductor alternator. (28/11.19.)
 160 833 ART. GUY. BROWN. DOWRY ET CIR. Process for suppressing the higher harmonic currents in the secondary circuits of transformers feeding polyphase metal vapour rectifiers. (1/4.20.)
 162 241 HERMANN. P. Method of manufacture of laminated magnetic masses provided with vanes for electric machines. (4/4.19.) (Divided Application on 142 928.)
 165 402 SCINTILLA. Wire-clamping terminal for low-voltage installations. (24/6.20.)
 167 427 MACNEUR, A. C. Telegraphic telltale instruments. (9/11.20.)
 167 436 KIER, A., & MILLIKEN, R. C. Bonding blocks for metal-covered electric wiring. (18/1.21.)
 167 437 SOC. DUTEN DOUBLET ET CIR. Magnets. (25/2.20.)
 167 497 BEVAN, A. M. E. Means for heating rooms and the like (Divided Application on 142 928.)
 167 590 BULTEMAN, A. F. E. Electric insulators of the built-up or compound type. (2/3.20.)
 167 592 W. J. K. ENGLISH MANUFACTURING Co., LTD., & CROW, W. Electric indicators. (1/4.20.)
 167 598 SODEN, J. K. Electric table-heaters. (9/4.20.)
 167 597 IMBERY, A. Electric resistance furnaces. (30/4.20.)
 167 599 NOLAN, J. Electric immersion heaters. (30/4.20.)
 167 542 SPANER, M., TUCKER, H., & PLATZ, M. J. Air-cooled electric motors. (4/5.20.)
 167 543 HALL, J. Remote control circuit breakers and the like. (4/5.20.)
 167 544 ALUMINUM WORKS, LTD., & SANTIAGO, M. C. Moulds for use in casting pipes and other similar hollow articles in aluminum and aluminum alloys. (4/5.20.)
 167 545 BRITISH THOMSON-HOUSTON Co., LTD., & RALPH, G. J. Electric furnaces. (5/5.20.)
 167 549 CUNNINGHAM, E. Electric switches. (7/7.21.)
 167 552 MARSHALL, W. R. Sparking-plugs. (6/5.20.)
 167 558 GORDELEW, F. H. Means for amplifying the sounds of the receivers of telephonic or like instruments. (7/5.20.) (Cognate Application 13 857.20.)
 167 560 BRITISH THOMSON-HOUSTON Co. (General Electric Co.). Systems of electric ship propulsion. (7/5.20.)
 167 561 BRITISH THOMSON-HOUSTON Co. (General Electric Co.). Electric discharge devices. (7/5.20.)
 167 567 BRITISH THOMSON-HOUSTON Co. (General Electric Co.). High frequency electric signalling systems. (8/5.20.)
 167 568 POUCHAIN, A. Positive electrodes for electric accumulators. (8/11.20.)
 167 577 POUCHAIN, A. Positive electrodes of electric accumulators. (10/5.20.)
 167 580 NAPIER. Device for testing and facilitating adjustment of ignition coils and sparking plugs. (11/5.20.)
 167 584 MACROBIE, A. K., & SHEARING, G. Thermionic valve transmitting circuits for wireless telegraphy and telephony. (11/5.20.)

APPLICATIONS FOR PATENTS

- 17 396 BAKER. Commutators or distributors for electric ignition system.
 17 399 SOC. FRANCAISE RADIO-ELECTRIQUE. Electro-magnetic wave-receiving attachment. (3/11.16, France.)
 17 405 HUGHES & PERKS. Day and night electric way indicators.
 17 413 HIGGS. Brush-holders for electric machines.
 17 449 PRENTICE. Electric lamp holders.
 17 457 YOUNG. Electric transmitter microphones.
 17 463 WHITLOCK. Globe holders for electric lights.
 17 493 HARRIS & SHAW. Adjustable device for conveying electric current, &c.
 17 506 KOLBE. Arrangement of electrodes for fusing electrolytic substances.
 17 513 PICE. High-frequency electrical apparatus.
 17 518 MELLERSH & JACKSON (Soedes Etablissements Gaumont). Control system for motors.
 17 525 TWISS. Switches.
 17 536 DAVIDSON & WATTHOUSE. Electric heaters.
 17 537 PILKINGTON. Electrical transmitter microphones.
 17 576 MACINTYRE. Telegraphic apparatus for transmitting messages, &c.
 17 593 LUNDBERG & PEGO. Switches.
 17 595 & 17 592 MANNING-SMITH. Electric magnets.
 17 594 CORNELIUS. Electric rotating furnaces.
 17 597 BARBOUR & MARTIN. Electric measuring and indicating instruments.
 17 600 TURKLAND. Magnetic locks for electric lamps for mines, &c.
 17 604 IGRANIC ELECTRIC Co. (Cutler-Hammer Mfg. Co.). Electric motors.
 17 608 B. T.-H. Co. (G. E. Co.). Switch boxes.
 17 615 METROPOLITAN-VICKERS ELECTRICAL Co. Electric protective systems. (9/10.20, U.S.)
 17 618 MAGRE & REINER. Electric bells. (28/6.20, Austria.)
 17 621 POWELL & SMITH. Electrically braking motor vehicles.
 17 632 NEALE. Electro-magnets.
 17 634 WHITE, JESSEY & Co. Variable speed gear of electric drilling machines.
 17 646 APPELEY. Insulated bars for coupling up electric switches.
 17 642 CORMOR LAMP WORKS, LTD., & ORANGE. Metal filament lamps.
 17 643 METROPOLITAN-VICKERS ELECTRICAL Co. & FLETCHER. Induction motors.
 17 644 TINGEY. High frequency amplifiers.
 17 645 WILSON. Thermoelectric temperature controlling appliances for electric heaters.
 17 648 PAGITT. Electric apparatus for explosive motors. (17/8.20, U.S.)
 17 642 HAYNES & RAMAGE. Utilizing small electric forces to control larger forces.
 17 642 B. T.-H. Co. (G. E. Co.). Electro-magnetic switches.
 17 727 BAYERISCHE ELEKTRICITÄTS-INDUSTRIE, ROTT & Co. Cut-out. (15/7.20, Germany.)
 17 736 PREMIER ELECTRIC WELDING Co. & PATERSON. Electrodes for electric welding.
 17 749 FAYE-BULLE. Electric apparatus for sending out time, &c. June 30, 1921.
 17 765 SMITH. Storage batteries.
 17 784 DE VOS. Accumulators.
 17 785 WORDSWORTH. Electrically-operated switches.
 17 798 WEEKES. Electric heating elements.
 17 801 JACKSON. Commutators or distributors.
 17 802 TWISS. Insulators.
 17 811 B. T.-H. Co. (G. E. Co.). Electric conductors.
 17 812 B. T.-H. Co. (G. E. Co.). Speed regulating mechanism for electric machines.
 17 815 MANCINI. Utiliser for ambient and natural electro-magnetic energy derived from any luminous source.
 17 820 MIDGLEY. Electric machines.
 17 822 SOADARI. Electric furnaces.
 17 839 RADIO-COMMUNICATION Co. & SCOTT-TAGGART. Negative resistance devices for electro-magnetic wave systems, &c.
 17 844 METROPOLITAN-VICKERS ELECTRICAL Co. Protective apparatus for electric systems. (8/9.20, U.S.)
 17 856 WALTHO. Switches forming part of incandescent lamp fittings.
 17 859 RAILING & ANGOLD. Oscillating gear for electric fans, &c.
 17 870 CUPPLEDITCH & STOTT. Means for handling loads on electrically-driven trucks.
 17 895 MIDLAND ELECTRIC MFG. Co. & BARBER. Switches.
 17 924 POLAK (Maschinen Akt-Ges. Seebach-Zürich). Switchgear.
 17 931 ROUTIN. Electrical apparatus for indicating and repeating movements at a distance.
 17 933 SCINTILLA. Electric starting and igniting apparatus. (1/7.20, Switzerland.)
 17 936 JONES. Electric generators and motors.
 17 932 CURRY. Electric measuring instruments.
 17 943 B. T.-H. Co. (G. E. Co.). Protective devices for electric circuits.
 17 944 B. T.-H. Co. (G. E. Co.). Electric conductors, and method for insulating same.
 17 947 CLARKE'S NEO-ELECTRIC DEVICES, LTD. Telephone call-boxes, &c.
 17 958 LENAGHAN. Electro-magnetic and polarized relays.
 17 959 CREED & Co., LTD., & LENAGHAN. Telephone switch banks.
 17 960 CREED & Co., LTD., & LENAGHAN. Automatic telephone systems.
 17 997 CALLENDER'S CABLE & CONSTRUCTION Co. & URMSTON. Manufacture of electric cables.
 17 998 CALLENDER'S CABLE & CONSTRUCTION Co. & KAY. Switchgear.
 18 007 HOLME & Co., ADAMSON & BROOKE. Control of crane motors, &c.
 18 017 B. S. T. ELECTRIC FITTINGS, Co. & THOMPSON, BARNETT & SAUNDERS. Supports for electric light holders.
 18 032 NEGROMANTI. Electric heated clothing. (18/12.20, Italy.)
 18 037 BARBOUR & MARTIN. Electric instruments and relays.
 18 044 BERGDOHN. Process of treating light rays, cathode rays, &c. (3/7.20, Austria.)
 18 067 SUTHERLAND, LTD., & COOKE. Switches.
 18 075 MACULAY. Cable fuse boxes.
 18 080 HOSIE. Electric cables and insulators.
 18 082 GARRARD, WILSON & RAILING. Electric protective apparatus.
 18 086 TWISS. Masts for supporting overhead transmission lines, &c.
 18 091 SLARK & STEELE. Electric immersion heater.
 18 093 NIMMOLOOP NEDERLANDSCHE THEERMO-TELEFON MATH-SCHAPPI. Long distance telephony. (5/7.20, Germany.)
 18 097 KRUPP (F.) Akt.-Ges. Transmission dynamometers. (10/11.20, Germany.)
 18 103 RUSSELL. Electric supply services for dwelling houses.
 18 109 WEBB. Cathodes for electrolyzers.
 18 112 MORGAN CRUCIBLE Co. & BROWN. Electric current collectors.
 18 122 AUTOMATIC TELEPHONE MFG. Co. & KNIGHT. Telephone systems. (3/7.20, U.S.)
 18 125 NEWTON. Dynamo electric machines.
 18 126 LODGE FUME Co. Metallbank und Metallurgische Ges.). Cleaning discharge electrodes in apparatus for electric precipitation of particles from gaseous effluents.
 18 127 LODGE FUME Co. (Metallbank und Metallurgische Ges.). Mechanically rectifying polyphase current.
 18 138 TRENCH. Safety spring accumulator case.
 18 141 PRESTON & WILKINSON. Supports for electric lamps.
 18 216 B. T.-H. Co. (G. E. Co.). Electric induction apparatus.
 18 217 B. T.-H. Co. (Gie. Francaise Thomson-Houston). Electric machines.
 18 218 B. T.-H. Co. & MARTIN. Electric machines.
 18 219 DAVIS. Electric equipment of aircraft.
 18 226 METROPOLITAN-VICKERS ELECTRICAL Co. Induction motors.
 18 227 METROPOLITAN-VICKERS ELECTRICAL Co. Transformers, reactance coils, &c. (30/7.20, U.S.)
 18 236 TAYLOR. Electric transmission.
 18 241 BREAREY. Means for controlling feed or traverse of material in electric welding machines.
 18 248 PARSONS. Electric indicator movements.
 18 277 BAYLEY. Combined electric cable retractor and grip.
 18 295 SIEMENS BROS. & Co. & CHRISTIAN. Telephone circuits.
 18 296 SIEMENS BROS. & Co., COLLYER & PETITROY. Hunting arrangements in telephone system.
 18 297 CALLENDER'S CABLE & CONSTRUCTION Co., BEECROFT & BOOTHROYD. Clamps for electric junction boxes for bonding metallic sheathed wires, &c.
 18 298 CALLENDER'S CABLE & CONSTRUCTION Co. & BURCHALL. Electric wires or cables.
 18 342 CREED & Co. Keyboard perforators for punched tape for automatic telegraphy.
 18 349 METROPOLITAN-VICKERS ELECTRICAL Co. Commutator machines. (30/7.20, U.S.)
 18 358 NOUVEL. Distant control device for electric circuits. (12/8.20, France.)
 18 363 KOHLMAYER. Storage batteries.
 18 364 KOHLMAYER. Battery boxes or containers.
 18 372 MANN. Accumulators.
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Notes of the Week.

London's Capital Station.

LONDON is to have a capital electricity supply station. And though the Commissioners' decision may require a little explaining to the naturally and designedly obtuse, after all that has been said on the contrary side, we think they have taken the right course. Indeed, their findings on the inquiry into the proposals put forward for the reorganisation of electricity supply in London and the Home Counties exhibit not only tact but a desire to weld all that was good in the various schemes (and the differences between these schemes were at no time great) into a still better whole. As will be seen from the full account which we give on another page of this issue, the District is to remain much the same as was originally determined, and a Joint Electricity Authority of twenty-seven members, including a Chairman and representatives of both company and municipal undertakings, the London and other County Councils, and the Railway Companies is to be established.

Cheaper Current the Object.

BUT it is on the technical side, as we have already hinted, that most interest is to be found. The estimates of the various promoters are generally accepted, as are the methods of meeting the demands until 1926 by extending certain existing stations. The Commissioners then take their own line. They point out that after 1926 it will be more economical to build a 200 000 kW capital station than to continue to develop existing stations or to distribute the extra generating plant required between new capital stations and existing stations. To do this will involve no more capital expenditure than the first proposal and considerably less than the second, while it will reduce the

annual cost of supplying electricity to the authorised distributors' bus bars from 1.147d. to 0.978d. per unit, a saving worth having. Transmission losses and coal consumption will also be reduced. The new station will be erected on the famous Barking site.

The Purchase Clause to Go?

POLITICALLY the Commissioners see no difficulty in pooling engineering resources now existing under different ownerships and under different financial conditions. We hope their optimism will be justified. This is the more likely as they almost warmly recommend an abolition of the hated purchase clause. The Commissioners' decision, indeed, takes us a long step forward. Though it is perhaps too much to say that we have yet emerged from the slough which has so long prevented progress in the electricity supply of London, given that community of interests and endeavour which was so conspicuous during the inquiry, and to which the Commissioners pay just tribute, there is no reason why real advance should be delayed.

Reparation—The Institution Acts.

WE are glad to see that the Institution of Electrical Engineers have lost no time in putting their views on the payment of German reparations in kind before the Government. In a letter to the PRIME MINISTER, which we publish on another page of this issue, Mr. HIGHFIELD calls attention to the fact that the adoption of such a proposal would mean an increase in the unemployment of labour, both skilled and unskilled, and for obvious reasons would not lead to a cheaper service than with equipment of British manufacture. In addition, the prestige of British goods would be diminished and the country would before long be left dependent for electrical services upon German industry. Not the least harmful of the results of this

policy would be the discouragement of embryo electrical engineers, a class of skilled workers which the war showed to be of vital importance to the country's well-being. In a word, to allow the Germans to build our power stations for us would ruin the British electrical industry without doing anyone any good except our late enemies. As to the accuracy of this presentation of the case there can be no two views among electrical engineers. But there will also be a general feeling of gratification that the Institution has moved so promptly on so vital a matter and has commenced its career in a wider field by so just a representation of the views of the whole industry.

Electrical Opinion Firm.

INDEED, the unanimity not only of the Institution, but of the electrical industry as a whole, on this question is very impressive. The Conference of the Joint Industrial Councils of the Electricity Supply and Contracting Industries and of the Associations of Electrical Manufacturers and Wholesalers and of the British Electrical Development Association which recently waited on Sir ALFRED MOND to discuss the subject of unemployment have again met to deal with reparations, and have memorialised the PRIME MINISTER on the disastrous effects to the electrical industry of the proposals. This memorial is the more interesting as it indicates the opinion of the Labour section of electrical workers on a policy which must vitally affect their interests. A copy of this memorial has been sent to every Member of Parliament with an explanatory note. In addition, the electrical section of the Federation of British Industries have lost no time in giving their views on the proposals, with the result that the new President of the Federation, Colonel O. C. ARMSTRONG, has written to the CHANCELLOR OF THE EXCHEQUER pointing out that the views of Sir PETER RYLANDS were only his personal views and not those of the Federation as a body, while both the B.E.A.M.A. and the Cable Makers' Association are moving to get the proposals laid before the Board of Trade Committee on Electric Power Supply. Such a representation of the opinion held by electrical engineers of all kinds on this matter should remove any doubt that may exist in Government circles as to the practicability and, indeed, the possibility of going any further with this scheme—except burying it and as quickly as possible forgetting all about it.

Hydro-Electric Power and Building Construction.

THE work of increasing Bradford's water supply by building an additional reservoir is interesting to electrical engineers in two ways. Not only are the various ropeways, cranes, and other machinery necessary for the construction work to be operated electrically, but the energy necessary for these purposes is to be supplied from one of the existing reservoirs by a special pipe line. But this hydro-electric scheme, as the article which we publish on another page of this issue shows, is no temporary job, for during the constructional work and after it is finished the plant will be used not only for power purposes, but for supplying the village where the workmen are to be accommodated with lighting and amusement in the shape of a picture theatre. We hope, moreover, that the uses of electricity at Scar House village will be still further developed without delay. Situated as this small colony will be in the remote fastnesses of the Yorkshire Moors, with only very inadequate road and rail facilities, and far from industrial areas, the fuel problem would in ordinary circumstances be difficult to solve, and then only solvable at great expense. With

hydro-electric power at their doors all these problems automatically vanish, and the most modern methods of heating, cooking, and lighting become available in the most rural of districts. Bradford has never been behindhand in the development of electrical applications. The Waterworks Committee and Vickers, Ltd., are jointly to be congratulated on their latest electrical enterprise, which we feel sure will be crowned with success.

Taxation and Trade Recovery.

OPINION is steadily crystallising on the view that if the trade of the country is to recover with the least possible delay taxation must be reduced to a level which will once more provide a margin for industrial expansion. In order that this reduction may take place it is obvious that the national expenditure must fall. This is not possible to any great degree, say some, for the cost of the war must be met somehow, and this will be necessary even if the Germans pay their reparation debt in full. While admitting the force of this, we fail to see the necessity for allowing war-time expenditure to be continued in peace, when there is every indication that what is needed more than anything else is universal economy of the most rigid kind. The problem has been rightly presented from this point of view by LORD INCHCAPE, a member of Sir ERIC GEDDES' Economy Committee. Reduced expenditure, he indicated, is necessary if we are to remain solvent, and dreams of a new earth must therefore fade before the stern reality that there is no money to pay for schemes for universal improvement. We have, in fact, reached the limit of taxation. It must be the duty of us all to see that it is cut down without delay and thereafter imposed in such a way as to cause a minimum of harm to industry.

A Welcome Change of View.

THERE is some little hope that the Government are beginning to recognise the necessity for a change in their financial policy. Sir ERIC GEDDES' Committee has, we are told, found that expenditure can be reduced in departments where a few months ago, we were informed, not one farthing less of revenue could be accepted. Sir ROBERT HORNE is tempering the wind to those who are in debt for their excess profits duty. Local authorities, who, as Mr. W. L. HICHENS has pointed out, are as great sinners as the Government in prodigality, are adopting a saner outlook, and Labour is at last beginning to realise that their salvation lies in greater productiveness. Improvement may then be realised in a short time. This being so, it is with a certain opportuneness that the British Institute and National Council of Social Service have issued a manifesto expressing the hope that if heavy cuts on public social services are inevitable they should be made where they are least harmful, and that there is even now an economy which is extravagance. This is very true, especially where expenditure on education and scientific research are concerned (to take two examples only), but it is unfortunately on such items as these that the economy axe first falls. We hope that this occasion will be an exception. The war should have taught us that money spent on such services is well spent.

An Institution and its Presidents.

ONE of the greatest successes of the Junior Institution of Engineers is to be found in its uniformly successful choice of Presidents. It throws its net wide and secures eminent man after eminent man, but by either luck or judgment it also ensures that the eminent man chosen is one who can

and does say something to which it is worth listening. Perhaps, after all, this success is in part due to the reaction of the spirit of the Society on its President. For in a Society where even the oldest are juniors in intention, and where the infallibility of youth is always in the ascendant even among the oldest, it is wise in the presidential pronouncement to throw off pretence and bombastic subterfuge, and say what you mean as directly as you can. From the electrical point of view no better man could have been chosen for this purpose than Mr. C. H. WORDINGHAM, who is a man of definite opinions and knows how to state them interestingly. Moreover, he has the well-being of the electrical industry at heart. We are not surprised therefore to find that his address to the Junior Institution, which lost nothing in its delivery, summarises the present problems of the electrical engineer for the benefit of a wider circle, and indicates in no uncertain way that while the electrical industry can help engineering, engineering can also help the electrical industry; and that the two together are a living force for progress.

The Fear of the Expert.

BUT Mr. WORDINGHAM's most important point was one upon which too much insistence cannot be placed at the present time. For while during the war engineers were accepted at their real value, the old myth is once again arising that engineers are unsuitable for administrative work. In other words, it is the old, old disease for which the cure is so difficult, expertophobia, the fear of the expert, the dread and mistrust of anyone who really knows how to carry out his work. True, it has been said that the amateur has made England what it is, but that is a statement which in these days has a double meaning, of which the full implication might well be realised. That the engineer should have full administrative command is true in the factory and is doubly true, as Mr. WORDINGHAM very justly points out, in the research laboratory. For though the heads of such a laboratory may be mainly concerned in organisation, yet it is organisation that can only be successfully effected by one having scientific and technical knowledge. With their new realisation of their political power this is a point to which engineers might well pay attention.

The Wrong Sort of Criticism.

IN reply to critics we have often argued that to discuss the defects of electrical apparatus in the columns of a technical journal is not only not to be deplored, but is eminently a wise course. Where, it may well be asked, if not in such pages as ours, can information be collected that will not only be of general assistance to the electrical industry at the moment, but by its publication allow improvements to be obtained with the least possible delay? Electrical engineers, it may be confidently asserted, need not be afraid of their mistakes, for they are a sign of growth. Moreover, the lessons they teach must be learnt if we are to advance at all. It is another matter, however, when an engineer goes out of his way to tabulate adverse opinions on electrical cooking and heating apparatus torn from their context in the pages of various technical journals to prove that "electric cooking is a luxury for a limited few for whom reduced rates cannot be justified in social justice," and that the "electric heating of houses would be a gross waste rather than a conservation of fuel resources." Yet this is what has been done by a Mr. SAMUEL WYEN, of New York. As a matter of fact, such a production has its uses. It erects a case against electric

cooking which appears formidable, but which can in reality be easily demolished. It is so exaggerated that it at once produces in the reader's mind an instant sense of reaction. It is not at all the sort of compilation which serves any useful purpose.

Thoughts on the Christmas Season.

THOUGH this is not Trafalgar Day, but the Christmas season, we hope that every electrical engineer is about to do his duty; for at a time of year when the giving of presents is the rule and a choice of gifts suitable to personal idiosyncrasies a difficulty, everyone connected with the electrical industry should be relieved, his task being so easy. Whether it be a maiden aunt who has to be squared, or a lady whose relationship, though not so close, is more interesting who has to be placated, the solution is the same. Half a gross (more or less) of electric irons (at the usual trade rates) will almost do the trick, and if we add a toaster or two and a curling tongs heater or so, not only is anxiety removed, but comfort is introduced into many a home where at present it is an ideal rather than an actuality. Christmastide provides an excellent chance, not only for preaching but for practising the electrical gospel, a chance which we hope will be seized with both hands.

Future of Light Railways.

THE end of this month will see the passing of the Light Railway Commissioners and the whole of the powers and duties of the Commissioners will then be transferred to the Minister of Transport. While this may or may not be included under the heading of post-war reforms, the change will at least close a chapter in the history of the chequered career of light railways in this country, and will, we hope, inaugurate a new and more prosperous era for this useful means of transport. That the Light Railways Acts have failed to realise the expectations of engineers is an admitted fact, but under the circumstances it is a fact at which nobody can be surprised.

Reasons for the Failure.

There are several reasons for this failure. In the first place, the procedure under the Acts of 1896 and 1912, though a great advance upon that previously available, was cumbersome and costly. In the next place, any scheme which threatened the slightest competition with a railway had no chance of receiving official sanction. In addition, the conditions laid down by the Treasury for State assistance were too rigid, and, in consequence, only about one-fifth of the million pounds set aside by the 1896 Act has up to date been advanced to light railway companies. The opposition of the landowners and the difficulty of securing the support of local authorities also had an adverse effect. If, therefore, there had been anything else than slow progress in light railway development it would have been almost a miracle.

Alterations in Procedure.

What chances are there for improvement? If we examine the case we find that in future applications will be made direct to the Minister of Transport, and thus the dual procedure involved in the application for an order to the Light Railway Commissioners and its subsequent submission for departmental confirmation will disappear. When, however, the Minister is of opinion that the proposals of the promoters ought to be submitted to Parliament he may make a provisional Order and then submit the proposals to Parliament by bringing in a Bill for the confirmation of the Order.

These alterations will certainly simplify matters, and they should also lead to expedition and economy. It is now proposed to encourage light railway undertakings by the grant of special facilities both by the State and by the larger railway companies, a very different policy from what has been usual hitherto. Requests for financial assistance from the State are to be considered on their merits and without reference to the conditions hitherto imposed by the Treasury in making advances under the Act of 1896. This is the right policy, for if railway companies could be induced to look upon light railways as feeders to their systems of transport rather than as competitors we believe that much more rapid progress would be made. At all events, light railway Orders and amending Orders are to contain a provision enabling a railway company to acquire a light railway undertaking which is not of the nature of a tramway, so that closer working arrangements may be expected between the two systems. In these days of combination this may lead to some advance being made.

Extension of Powers of Minister.

Unlike the Light Railway Commissioners, there is no limitation upon the duration of the powers of the Minister of Transport, who can also apply to Light Railway Orders the modifications authorised by the Development and Road Improvements Act, 1909, in regard to the purchase of land. In addition, where the Minister agrees to make an advance for the purposes of a light railway the Order may also contain provision for the limitation of the assessment of the light railway to the local rates, such as might have been made under the principal Act of 1896.

Future Policy.

In this connection attention may be drawn to an important report that has been issued by the Light Railways (Investigation) Committee on the future working of existing light railways and the policy which should be adopted in order to encourage this form of transport. The report which was presented to Sir ERIC GEDDES in July bears evidence of a very careful and thorough investigation of the facts. Some of the Committee's recommendations have already been introduced into Part V. of the Railways Act, 1921, but in view of the general interest of the subject, we print elsewhere a summary of the conclusions and recommendations.

Conditions of Financial Assistance.

The Committee think that the Minister of Transport should have some voice in the design of any light railway which receives assistance from public funds, and where this assistance takes the form of subscriptions to share capital the State or local authority so subscribing should possess the ordinary rights of shareholders. Hitherto a State loan or grant has been made dependent upon a local authority making a similar grant, but only on rare occasions have promoters been able to comply with this condition. In future, however, the Minister will have a wider discretionary power, and he may make a free grant or lend money under Section 17 of the Ministry of Transport Act, 1919. The Committee evidently think that this power is not wide enough, and they appear to contemplate cases where the Minister (or a local authority) may apply for ordinary or preference shares in a light railway company, and that when this is so they should be able to appoint a director or directors and vote at meetings of the shareholders, etc. This would be a great departure from our customary practice, but it may be said, in passing, that similar powers are exercised in some Continental

countries where light railways have reached a much higher stage of development than in this country.

Local Authorities Guarantee of Interest.

By Section 71 of the Railways Act an Order may authorise the council of any county, borough or district to guarantee the interest or dividends on any loan or share capital of a light railway company, but as the procedure of the Borough Funds Acts, 1872 and 1903, apply, the Council must have the authority of the ratepayers before giving such a guarantee. We believe that this form of assistance will be much more useful than that hitherto given, and it will probably enable promoters to raise share capital on easier terms.

Cheaper Methods of Construction.

A number of the Committee's recommendations relate to the construction and operation of light railways, and we believe that their adoption would give a fillip to this form of transport, but further legislation will be needed to give effect to some of them. We agree that a new conception of the character and functions of a light railway is necessary. It must, in fact, be recognised that light railways differ essentially from main lines and depend for success upon the adoption of different standards of construction and operation. As a preliminary to this change it is essential to recognise that a lower standard of speed must be adopted in order that fencing, signalling, and other equipment may be avoided.

Electric Traction.

The committee do not deal very fully with systems of traction, but no doubt an increasing number of lines will adopt electric traction, more especially when the electric supply industry has been reorganised and when electrical energy can be obtained from joint electricity authorities or super-power stations at a moderate rate. It is a point which the electrical industry would do well to watch.

Fifty Years of Electricity.*

Prof. FLEMING's latest work is a book for which electrical engineers have been waiting and, having now obtained, will read with both eagerness and benefit. We may be forgiven for saying that we found the introductory chapter on electrical engineering before 1870 the most interesting, as it marches so closely with the lines of our own development. Here in some forty-nine pages Prof. FLEMING lays down the history of the very genesis of the industry on both the strong and weak current sides. He has included an amount of information which is often only vaguely and partially known to the majority of electrical engineers, and in so doing has provided a panorama of the work of the early pioneers and its influence on subsequent progress.

Pioneers and the Industry.

Prof. FLEMING at the very beginning of his book makes a point of the effect which the magnetic properties of iron have had not only on purely electrical developments, but on the history of civilisation generally. It is a point which cannot be too heavily stressed; but, apart from the application of this property of iron bounteously provided by Nature, emphasis must also be laid on how the large amount of other work, conducted by early pioneers with the sole desire of increasing knowledge, has

* "Fifty Years of Electricity." By J. A. Fleming, M.A., D.Sc., F.R.S. (London: The Wireless Press, Ltd., pp. viii, 372. 36s. net.)

been turned to use and service in the industrial world in a way of which they could have had no conception and for which they have received less credit than they deserve.

In referring to the story of how the murderer Tawell was arrested by means of the electric telegraph, Prof. FLEMING remarks that this unexpected use of a new invention is said to have greatly stimulated popular interest in the electric telegraph. The information given in Prof. FLEMING's book will, we feel sure, in its turn, stimulate a popular no less than a technical interest in the possibilities of the use of electricity for all kinds of purposes. If it does no more than this it will have amply fulfilled its object.

Fifty Years of Telegraphy and Telephony.

Following the introduction, a survey of telegraph and telephone development from 1870 to 1920 is given. The matter is dealt with in, as far as possible, non-technical language, and is amply illustrated in a way that makes the explanations clear. This portion of the book, however, suffers to some extent from inevitable restriction on space, and this is especially the case in the descriptions that are given of the printing telegraph. We notice, for instance, that no mention is made of the Western Electric Company's printing telegraph or of certain other American systems, which have received a wide application. Prof. FLEMING trespasses on somewhat dangerous ground when he categorically ascribes the invention of the telephone to Dr. ALEXANDER GRAHAM BELL. This may necessitate explanations, especially as it reduces to an unimportant position the pioneer work of HUGHES. Experience more and more leads us to the opinion that it is unwise to try to label inventions with particular names, for, especially in electrical development, there are and probably always will be, so many workers conducting investigations on converging lines that it is hard to say that the result is due to any one among them to the exclusion of others.

The Development of Generating Machinery.

In Chapter 2 a very clear and most interesting account is given of the development of dynamos, alternators, transformers and motors from 1870 to 1920, and the description is rendered the more interesting by illustrations of certain of the old machines. Prof. FLEMING has not made the mistake of allowing himself to be drawn away from the essentials, and the result is a chapter which can be absorbed with interest not only by the technical, but by non-technical readers.

Progress in Lighting.

The third chapter deals with electric lamps and arc lighting and places on record in a succinct fashion the little known history of both the arc lamp and the incandescent lamp, besides giving some interesting information about certain of the early electricity meters. It also contains a few paragraphs on the subject of wiring, and here we notice with some surprise that no mention is made of the various systems of surface wiring which are now on the market and which, for reasons of economy, are likely to receive increasing application in future. From the popular point of view, at least, this is an important omission. Adequate space is given to the subject of the newer but little known lamps, such as the neon lamp and that due to Mr MACFARLANE MOORE.

Other Uses.

The fourth chapter deals with electric heating and cooking and pays, we are glad to see, an adequate tribute to the work of JOULE. In dealing with the subject of heating we are, for various reasons, often inclined to give undue prominence to what may be called the domestic side of the

subject. Prof. FLEMING, however, puts the matter in its right proportion by devoting considerable space to the industrial uses, such as furnaces and welding.

Chapter 5 deals with the design and construction of plant for electricity supply purposes, and is made the more interesting by an excellent historical survey and photographs. In this chapter the subject of electric traction is dealt with from both the economic and technical points of view.

Chapter 6 deals with electric theory and measurements, and is, perhaps, the one that is most likely to be skipped by the non-technical reader. For the technical reader, on the other hand, it will provide the most interesting matter, for it must never be forgotten that the electrical industry has, since the very beginning, been based on a scientific system of measurements, and that on this broad basis has been built a good deal of its subsequent success.

Wireless Telegraphy and Telephony.

Considering Prof. FLEMING's own work in the electrical field, it is, perhaps, somewhat strange that the twin subjects of wireless telegraphy and telephony are relegated to the last chapter, but perhaps this has been done on the principle of keeping the best wine till the last. The chapter forms a comprehensive study in some forty pages of the developments which have taken place in this branch of electric technology during the few years since the time, in fact, when it emerged from the laboratory into the industrial world. Criticism here is neither necessary nor just.

The Influence of Theory on Practice.

In an epilogue Prof. FLEMING makes a most important point—the influence that pure scientific investigation may have on subsequent industrial developments. As he says: "Those who could have peeped into the laboratories of the Royal Institution in the time past of 1831 and seen FARADAY busy with his magnets, copper wire, and discs and iron bars might have wondered that so much time and intelligence were not better bestowed. Yet these epoch-making experiments have rendered imperishable service to humanity." The corollary is that such geniuses as FARADAY should be encouraged—not discouraged—in their work by the abundant establishment of research fellowships and professorships, which will free them from giving their time to the distracting bread-winning labours during their tenure.

Wanted—an Electrical History.

We have said enough to show that this book is well worth reading, and we may, therefore, be permitted to register one criticism—that is, that the book is very much more a chronicle than a history. If we take any great historical work, FROUDE's "Henry VIII.," for instance, we find not that it is a mere catalogue of events, but that events have been polished and fitted into a central narrative of men and deeds by the genius of the historian, so that finally a human philosophy is involved—a philosophy which is history. In this regard Prof. FLEMING's work fails, perhaps because it is intended to do so. But a real history of electrical engineering is wanted, and we can think of no better person than Prof. FLEMING to write it, especially as this present work must form a basis for any larger exercise of that kind.

No praise is too great for the printing and general make-up of the book, or for the excellence of the illustrations. We could wish, however, that the bibliography and the index had both been more extensive. These are points to which publishers of technical books might pay much greater heed, as they so very largely enhance the value of the work.

Three-Phase Four-Wire Meters.

By G. W. STUBBINGS, A.M.I.E.E., A.Inst.P.

From a theoretical standpoint the measurement of power in a four-wire system requires three wattmeter elements. As meters for this purpose containing only two wattmeter elements are in common use, it may be useful to set out briefly the principles of such instruments, and to enquire into the possible extent of the inaccuracy caused by a departure from such strict requirements.

If i_1, i_2, i_3 are the instantaneous values of the currents in the three lines of a four-wire system, and v_1, v_2 and v_3 are the instantaneous values of the pressure between these lines and the neutral, then the total power in the circuit at any instant is given by:

$$i_1 v_1 + i_2 v_2 + i_3 v_3.$$

If v_1, v_2 and v_3 are sine functions of the time, and can be represented by a system of equal and symmetrically-spaced vectors, then the instantaneous sum of v_1, v_2 and v_3 is known to be zero, and

$$v_3 = -(v_1 + v_2).$$

Substituting this value of v_3 in the original expression, the instantaneous power is:

$$v_1(i_1 - i_2) + v_2(i_3 - i_2).$$

From this result it appears that, provided that the voltage star is symmetrical, the power in a three-phase four-wire circuit can be integrated by a two-element meter, these elements being excited by two star voltages, and by resultant currents each equal to the instantaneous difference of the currents in the line to which the pressure connection is made, and that in the third line which supplies no voltage coil.

Integrating Meter for Four-Wire Circuits.

Assuming the current and voltage are sine functions of the time, it is easy to show in a different way that a meter constructed on these lines will integrate the true power in a four-wire circuit if the voltage system is balanced.

If the pressure coils are connected to lines a and c , and the

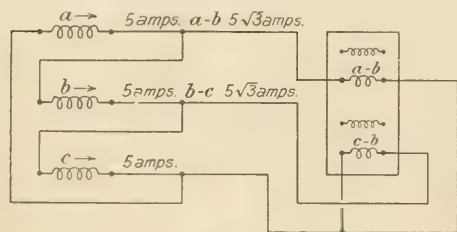


FIG. 1.

current in line b is taken into each meter element, the exciting voltages are:

$$V \sin pt \text{ and } V \sin (pt + 240^\circ).$$

The currents in the three lines are:

$$I_a \sin (pt - \phi_a)$$

$$I_b \sin (pt + 120 - \phi_b)$$

and

$$I_c \sin (pt + 240 - \phi_c).$$

The power indicated by the meter is:

$$\begin{aligned} & V \sin pt \{ I_a \sin (pt - \phi_a) - I_b \sin (pt + 120 - \phi_b) \} \\ & + V \sin (pt + 240) \{ I_c \sin (pt + 240 - \phi_c) - I_b \sin (pt + 120 - \phi_b) \} \\ & = I_a V \cos \phi_a + I_c V \cos \phi_c - I_b V \cos (120 - \phi_b) + \cos (120 + \phi_b) \\ & = I_a V \cos \phi_a + I_c V \cos \phi_c + I_b V \cos \phi_b \end{aligned}$$

where i_a, i_b, i_c and v are virtual values.

Four-Wire Meters Without Series Transformers.

Four-wire meters without series transformers have a double series winding in each element, these two windings being in opposition in each element. Meters with current transformers either have double series coils, or, having single

windings, are supplied by the correct resultant current from a system of current transformers, the secondaries of which are connected in delta. The diagram of connections for this method is given in Fig. 1, and the corresponding vector diagram in Fig. 2. From these diagrams it is seen that at full load the series coils carry a current equal to $5\sqrt{3}$ or 8.6 A. The relative configuration of the current and voltage

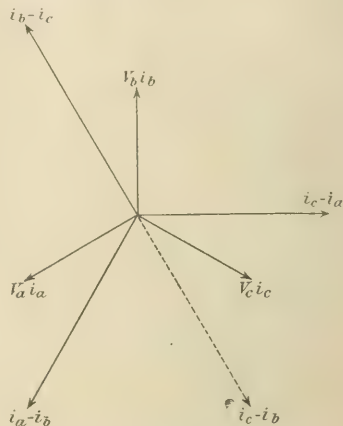


FIG. 2.

vectors is similar to that for a three-wire meter in which the current and voltage vectors are reversed in position.

From these diagrams it is also clear that the current in line b can be considered as being combined with a voltage which is the vector sum of v_a and v_c reversed, this being equal to v_b in a symmetrical system.

Theoretical Inaccuracies in Practice.

The assumption of a symmetrical voltage star, although approximately representing actual conditions, is not strictly accurate, and it will be useful to look briefly into the question of the inaccuracy caused by such deviations as are likely to be met with in actual practice. As a balanced load will cause no distortion of the voltage star, it is sufficient to consider the effect of the out-of-balance currents the resultant of which flows in the neutral conductor. The easiest case to consider is that of a balanced non-inductive load on two phases, and an excess current in the third phase. The out-of-balance current will cause a drop in the line carrying the current, and, owing to the drop in the neutral, will shift the position of the star point at the metering position. The resulting distortion of the voltage system when the excess current is carried by the line to which no potential connection is made, is shown in Fig. 3. The current in this line should be combined with the voltage $o'b'$ for correct power measurement, but in the meter this current is combined with the vector $V_a + V_c$ reversed. If v_b be the drop $b'b'$ in line b , v_n be the drop in the neutral, and V be the star voltage when the out-of-balance is removed, then $o'b'$ is $V - (v_n + v_b)$ and the vector $(v_n + v_b)$ is equal to $V + 2v_n$. The percentage error of registration for phase b is

$$\frac{(v_n + 2v_b) \times 100}{V}$$

If the section of the neutral is one half of that of the line wires, the percentage error is:

$$\frac{7v_n}{V} \times 100.$$

A Practical Example.

As an actual example of what might occur in practice, consider the case of a balanced load of 30 A per phase, with

an out-of-balance excess current of 20 A in line *b*, fed through 500 yds. of 0.15 four-core cable, with a 0.075 neutral, the voltage being 230. The drop in the line conductor due to the 20 A is 1.7 V and the error of registration for this

phase is $\frac{7 \times 1.7 \times 100}{230}$, or 5.2 per cent. The error of registration of the total load will be 2.4 per cent.

If the excess out-of-balance current is on one of the phases *a* or *c* to which a potential connection is made, the effect of the distortion of the voltage system is shown in Fig. 4. In addition to the difference in the magnitude of V_a and $V_a + V_c$, there is now a phase error. It is easily seen from the geometry of the diagram that the phase displacement of the resultant of V_a and V_c from normal due to the out-of-balance current is approximately:

$$\sin^{-1} \frac{3}{2} \cdot \frac{2c}{2c + c} = \frac{1}{1} \cdot \frac{1}{1}$$

or approximately:

$$57.3 \times \frac{3}{2} \cdot \frac{2c}{2c + c} = \frac{1}{1} \text{ deg.}$$

The phase displacement of V_a due to the out-of-balance is approximately:

$$\sin^{-1} \frac{3}{2} \cdot \frac{c}{2c + c} = \frac{1}{1} \cdot \frac{1}{1}$$

or

$$57.3 \times \frac{3}{2} \cdot \frac{c}{2c + c} = \frac{1}{1} \text{ deg.}$$

The total phase angle between the actual voltage V_a and the reversed resultant of V_a and V_c is therefore

$$57.3 \times \frac{\sqrt{3}}{2} (3c + c) = \frac{1}{1} \text{ deg.}$$

Assuming a drop of $\frac{1}{2}$ per cent. in line *c*, the phase angle would be

$$57.3 \times \frac{3}{2} \cdot \frac{3.5}{100} = \frac{1}{100}, \text{ or } 1.7 \text{ deg.}$$

This phase error is, of course, of negligible importance for non-inductive loads, but the error might be of importance in

The percentage error of registration of the energy in phase *b* is therefore

$$\frac{3c + c}{2c} \times 100$$

or one half that found for the case when the excess out-of-balance was in line *b*.

Referring to the conditions previously considered, it is found that with the out-of-balance in line *c*, the percentage error of registration in phase *b* is 2.6 per cent., the load being

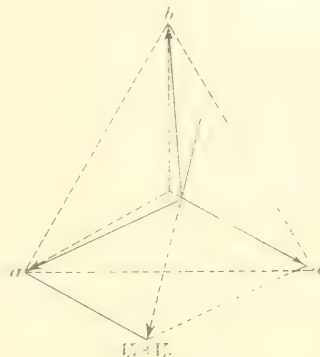


FIG. 4

non-inductive, and the overall inaccuracy will be 0.7 per cent. In this case, therefore, the error is almost negligibly small.

The foregoing enquiry would seem to show that for ordinary four-wire circuits, where the out-of-balance currents normally met with are relatively small, the two-element meter gives a sufficient degree of accuracy. Where, however, large out-of-balance currents are to be anticipated on circuits of low-power factor, either a three-element meter, or three-single-phase meters are desirable.

New Safety Lamp Regulations.

In consequence of the rapid extension of the use of electric safety lamps, new regulations have been drafted by the MINES DEPARTMENT of the Board of Trade in order to secure efficiency, and to fix responsibility for the maintenance of this apparatus upon the colliery management. Hitherto all safety lamps in mines have been approved by the Department after official tests, but colliery managers have not been restricted in regard to the purchase of batteries and spare parts. In the proposed draft regulations, it is laid down that before a colliery management uses in a safety lamp any part that has not been obtained from the approved maker of the lamp, the management shall itself submit the lamp, fitted with such part, for approval by the Mines Department, and take over the responsibility for the lamp being "fit" which formerly rested on the lamp-maker.

The integral parts of a lamp are: the outer case, the whole of the accumulator, the bulb, the detachable part (if any) of the outer case, and such other parts as are named in the specification.

The makers of all approved types of electric safety lamp shall inspect, gauge, or test before issue in such manner as may be prescribed all lamps, and all integral parts of lamps bearing their name or trade mark.

Opposition to the Regulations.

These conditions have aroused considerable opposition from the colliery managers, their main objection being that it will confer a monopoly upon the lamp makers, and thus tend to increase the price of lamps; that it will prevent them from introducing new and improved types of lamps and batteries, and that the practice of managers buying batteries and spare parts direct from the manufacturers and fitting them to the lamps requires no change. We have every sympathy with the desire of the Mines Department to ensure that all electric safety lamps are perfectly safe, and we are inclined to think that managers are unduly alarmed over the matter. The new rules are still under consideration, and they will, probably, undergo some revision before they are finally approved. We suggest that if the battery and the fittings be standardised and approved officially, they could then be fitted by some competent person, not necessarily the lamp maker; but a certain degree of responsibility must of necessity rest upon the management of collieries for the use of safe and efficient lamps. It is almost impossible to be too careful in the employment of electric lamps and the work of fitting spare parts, and the supervision of the lamps should be entrusted to some skilled person, who would be responsible for the proper execution of the work.

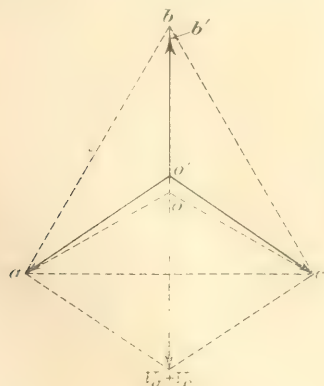


FIG. 3.

the case of a badly-balanced load of low-power factor, as a phase angle of 1.7 deg. at 0.8 power factor gives an error of 2.4 per cent. The investigation of such a case is complicated by the fact that the pressure drops in the mains would no longer be in phase with the star voltages.

It is seen also from Fig. 4 that the magnitude of the resultant of V_a and V_c is equal to

$$V \sqrt{2c + c}$$

The magnitude of V_a is $V + \frac{1}{2}v_c$.

Hydro-Electric Power as an Aid to Construction.

An interesting application of hydro-electric power to constructional operations, such as those involved in building a waterworks, is seen in the Scar House scheme of the Bradford Corporation. This scheme is an extension of storage reservoirs in the Nidd Valley, from which the city derives its water, and includes the building of a large masonry dam. In order to provide the necessary energy to run the cranes, blondins, crushing plant, and other constructional machinery, Mr. Lewis Mitchell, waterworks engineer to the Bradford Corporation, conceived the idea of utilising the water flowing from the existing Angram reservoir to operate a hydro-electric plant for supplying the necessary electrical energy. In this way coal will be saved, and power which would otherwise run to waste be utilised. In addition to this a village has been constructed for the accommodation of the navvies, who will be directly employed by the Bradford Corporation. This village, including the cinema, will, of course, be electrically lighted, and we hope will also be supplied with electrical energy for "other uses."

VICKERS, LTD. secured the contract for carrying out this work in November, 1920, and the following details of the technical plant, which was formally opened last week by Alderman A. Gadie, chairman of the Bradford Waterworks Committee, have been supplied by them.

Water Turbines.

The generating plant at the hydro electric station, which is situated about a mile down the Nidd from the Angram dam, consists of two Francis

79 per cent.; $\frac{1}{2}$ load, 76 per cent. On the tests recently carried out, the efficiency of the turbine at full load worked out at 86·5 per cent.

Governing Arrangements.

The turbines are governed by two Picard Pictet patent oil-pressure governors, which work each in conjunction with a relief valve; that is to say, each turbine has its own governor and its own relief-valve. This is necessary owing to the long length of the pipe line. The result of this arrangement is that, if the load is suddenly thrown off, the relief valve, which operates very quickly, begins to open before the governor commences to close the turbine gates. The relief valve then closes very slowly, taking 80 to 100 secs. as

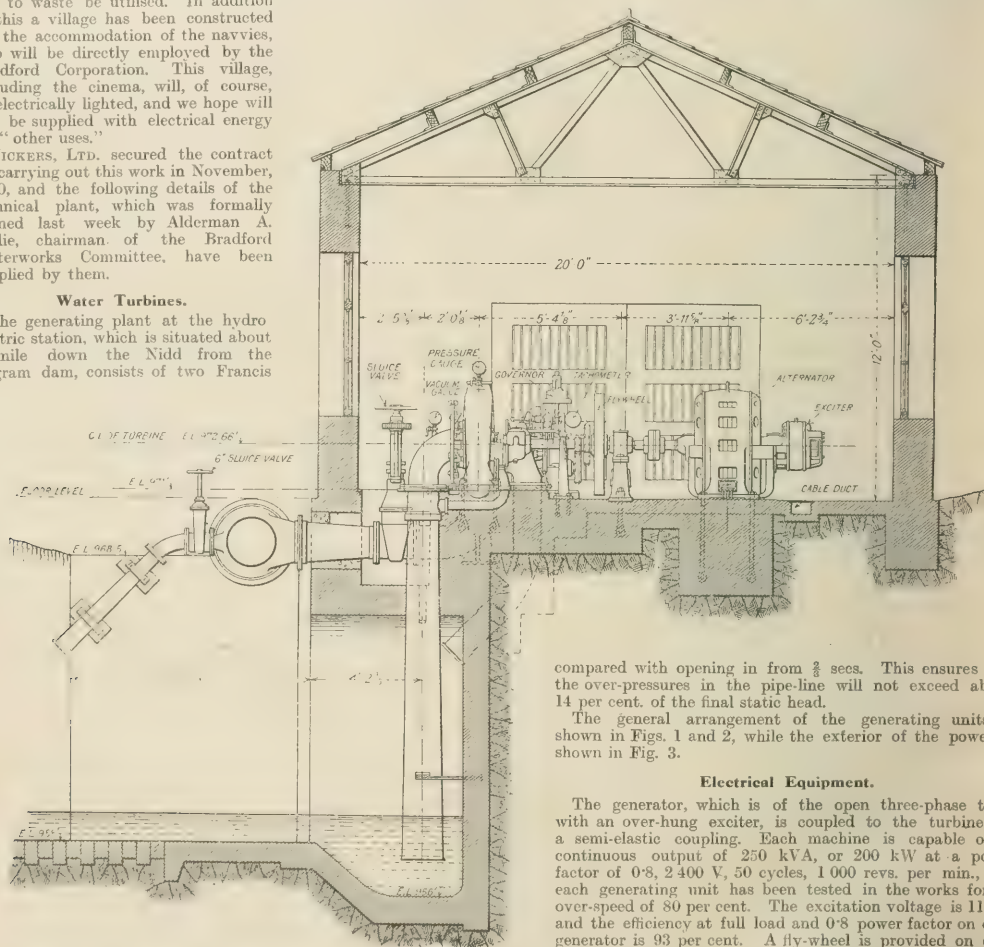


FIG. 1. CROSS SECTIONAL ELEVATION OF POWER HOUSE AND MACHINERY.

turbines made at the Vickers Naval Construction Works, Barrow-in-Furness, to the designs of the Ateliers des Charnilles S.A., Geneva. Each turbine is designed for the following running conditions: Nett head, 168 ft.; output, 295 B.H.P.; discharge, 19·5 cub. ft. per sec.; speed, 1,000 revs. per min. Owing, however, to the possible variations in level in the Angram reservoir, the plant is also capable of working under a head of 207 ft., with the same output and a correspondingly reduced discharge, and under a head of 148 ft. with correspondingly reduced output. The guaranteed efficiency under a nett head of 168 ft. was as follows, subject to a variation of plus or minus 2 per cent. Full load, 295 B.H.P., 79 per cent.; $\frac{1}{2}$ load, 80 per cent.; $\frac{1}{4}$ load,

compared with opening in from $\frac{1}{2}$ secs. This ensures that the over-pressures in the pipe-line will not exceed about 14 per cent. of the final static head.

The general arrangement of the generating units is shown in Figs. 1 and 2, while the exterior of the power is shown in Fig. 3.

Electrical Equipment.

The generator, which is of the open three-phase type, with an over-hung exciter, is coupled to the turbine by a semi-elastic coupling. Each machine is capable of a continuous output of 250 kVA, or 200 kW at a power factor of 0·8, 2,400 V, 50 cycles, 1,000 revs. per min., and each generating unit has been tested in the works for an over-speed of 80 per cent. The excitation voltage is 110 V, and the efficiency at full load and 0·8 power factor on each generator is 93 per cent. A fly-wheel is provided on each generating unit in order to avoid the expensive alternator which would be necessary were the whole of the fly-wheel effect required in the rotating part of the alternators.

The current is conveyed to the switchboard by single-core rubber insulated 3,300 V Glover's cables. The six-panel switchboard was supplied by the Metropolitan-Vickers Electrical Company, and comprises a synchronising bracket, exciter cubicle (controlling the two exciters), two generator cubicles, and two feeder cubicles (each of which is capable of dealing with the full output of the station), and finally a voltage regulator and lighting cubicle. The lighting in the power house is supplied by a 0·5 kVA single-phase transformer. The general arrangement of these cubicles in relation to the apparatus on the two outgoing feeders, comprising isolating links, choking coils and lightning arresters, is in accordance with the best modern practice.

Sub-Stations

There will eventually be four sub-stations, two of which, Nos. 1 and 4, are duplicates of each other as far as equipment is concerned. Each of these two sub-stations contains four 50 kVA, 2200-440 V 3-phase transformers. These transformers are star/star connected, oil immersed in corrugated sheet-iron tanks of the self-cooled type. Each of these sub-stations will also contain the necessary isolating links, lightning arresters and choking coils on both the high and low tension sides. As regards switchgear, on the h.t. side there are four 50 kVA transformer cubicles, while on the l.t. side there is a three-panel switchboard, two panels of which will each control two 50 kVA transformers, the third panel dealing with one 50 kVA and one 200 kVA feeder.

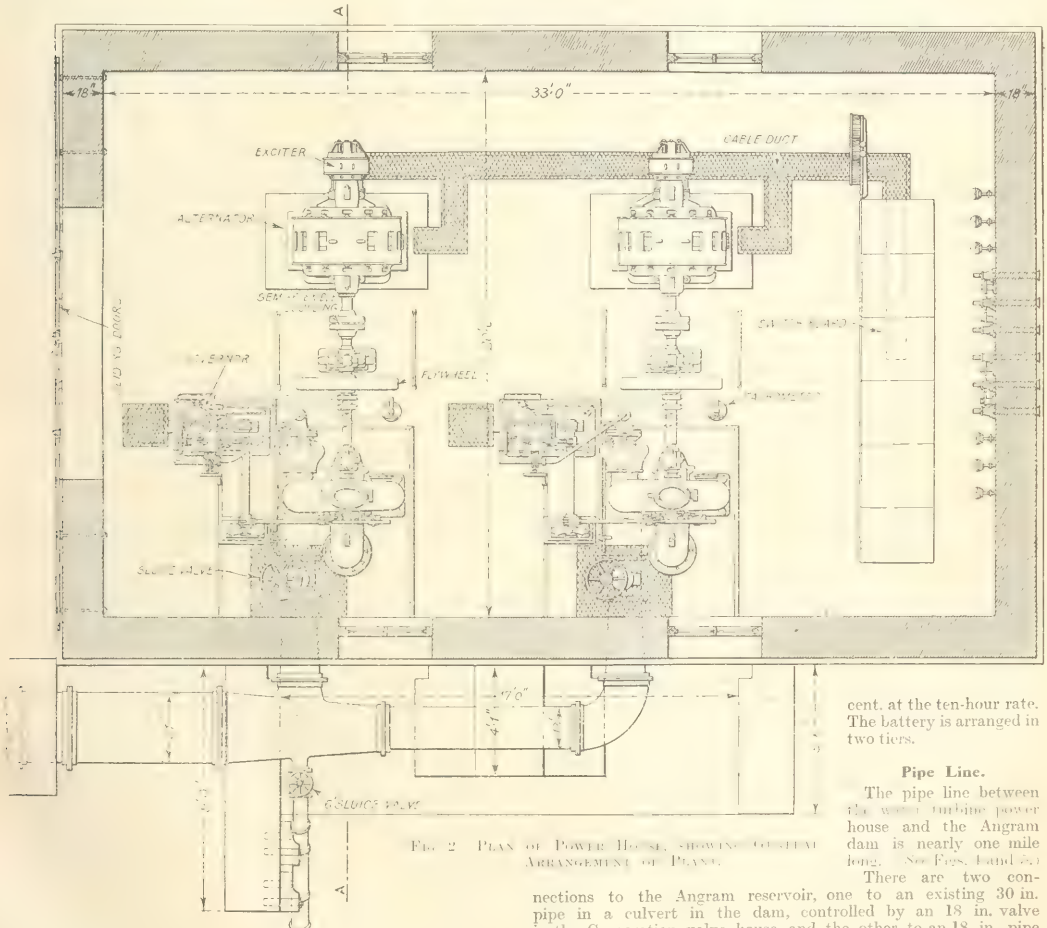
Sub-Station No. 2.

Of the other sub-stations, sub-station No. 2 is placed near the Corporation offices at the railway end of the new dam site; and, as

at 110 V direct current. The sub-station comprises the following equipment: The high-tension line is brought in to a cubicle similar to those in the other sub-stations, which controls a 25 kVA transformer. This transformer is used for feeding a 20 kW motor generator, which can either charge the battery or supply current for lighting direct. As a stand-by, and for use when the water turbine plant is not running, a 20 kW generator, belt driven by a 35 h.p. Vickers-Petter semi-Diesel engine, with an electric starter and compressed air apparatus, and designed to run on crude oil, is provided.

Battery Room

As an annexe of this sub-station, there is a battery room containing a Chloride battery of 60 cells in glass boxes. The battery when fully charged will be capable of giving a discharge of 979 Ah at the ten-hour rate. The ampere hour efficiency of the battery is 90 per cent. at all rates, while the watt-hour efficiency is 75 per



cent. at the ten-hour rate. The battery is arranged in two tiers.

Pipe Line.

The pipe line between the water turbine power house and the Angram dam is nearly one mile long. (See Figs. 4 and 5.)

There are two connections to the Angram reservoir, one to an existing 30 in. pipe in a culvert in the dam, controlled by an 18 in. valve in the Corporation valve house, and the other to an 18 in. pipe just down stream of the Corporation's measuring weir below the dam, controlled by another 18 in. valve. From the Corporation's cast iron 30 in. pipe inside the dam 30 in. bore steel pipes $\frac{1}{16}$ in. thick have been installed down to the point where the other 18 in. pipe joins. An air valve is provided to free any air which may collect in the pipe, and for the escape of air when the pipe is being filled. This valve also prevents the formation of a vacuum in the pipe line if the latter is emptied too quickly. The 30 in. diameter pipe is approximately 312 ft. long. Following this there is a section approximately 1484 ft. long of 35 in. bore pipe $\frac{1}{8}$ in. thick. This again is followed by a section approximately 1488 ft. long of 33 in. bore pipe 0.2 in. thick, while the final length is approximately 1491 ft. long of 31 in. bore pipe $\frac{1}{4}$ in. thick. The total length of

it has to supply the workshops and blondins, &c., as well as a certain proportion of the cranes on the dam, it contains five 50 kVA transformers and five high tension transformer cubicles. The low tension switchboard consists of four panels, two of which each control two 50 kVA transformers, while the third deals with one 50 kVA transformer and one 100 kVA feeder, and the fourth panel with two 200 kVA feeders.

Sub-Station No. 3.

Sub-station No. 3 is situated at the back of the Corporation village, and is of a different character from the others, being intended solely for lighting. To meet the requirements of the Bradford Corporation Waterworks engineers on the site, this is effected

the pipe line is 4 775 ft., and the pipes are of the mild steel welded type with flanges riveted on.

Constructional Details

Concrete anchor blocks, anchoring rings and expansion joints at the necessary points are provided, and the pipe line is supported where necessary on rubble masonry piers and concrete saddles, free movement being ensured by inserting tough brown paper served with black lead and tallow between the pipe and the concrete



FIG. 4. VIEW OF POWER HOUSE

saddles. In its course to the power house the pipe line follows approximately the path of the River Nidd, which it crosses five times, temporary wooden bridges being erected at the crossings. The pipes are coated both outside and inside with hot tar asphalt before despatch from the works, and after erection on site they were painted with special Cuirass Products paint.

Just before entering the power house a small 2 in. drain valve is provided in the bottom of the pipe line to drain the last section if it should ever be required to empty this completely. In case



FIG. 5. VIEW OF PIPE LINE FROM THE TOP OF THE ANGRAM DAM

the power house is shut down completely for any reason a 6 in. discharge valve is provided connected by a tapered pipe to a 15 in. pipe discharging into the river. This is necessary in order that the water supply to Bradford, which goes through the turbines, may not be shut off.

Transmission Lines.

The transmission lines—a large portion of the material for which supplied by Swiss Electric Transmission—are of simple character, wooden poles of the "A" and "H" type being used. The wires are of stranded copper with a continuous earth wire.

Suitable cradles and triangular guards are provided where either roads or railways are crossed. The lines have been designed liberally, and are strongly guyed and supported owing to the heavy wind and weather conditions which frequently obtain at the head of the Nidd Valley. This is also necessary because it is desired to use to the utmost the available power.

Isolating switches are provided on each terminal pole at the various sub-stations and on each of the two terminal poles at the



FIG. 5. VIEW OF PIPE LINE LOOKING TOWARDS ANGRAM DAM

power station, so that any section or building may be completely isolated.

These isolating switches are operated from the ground level, and the connections between the actual line wires and the apparatus inside the buildings are made by insulated wires specially designed to resist weather conditions, which are carried down the poles to the isolating switches upon reel insulators, and are supported between the poles and the buildings by raw hide suspenders hanging from stranded steel wire.

Water-Power Resources.

The final report of the WATER-POWER RESOURCES COMMITTEE, of which Sir John Snell is chairman, has come to hand as we go to press. The report establishes the *prima facie* presumption that some 210 000 kW of water power can be developed in Great Britain continuously night and day throughout the year at an economic rate, while in Ireland a continuous output of 113 000 kW could be obtained. In Great Britain the potential electrical output thus obtainable is equal to about 40 per cent. of the total output in the year 1917-18 from the 410 British public electricity supply and electric tramway and railway undertakings operated by steam power, a supply which involved a consumption of nearly three million tons of coal per annum.

The bulk of the larger British water powers are situated in the Scottish Highlands, and the utilisation of this power might do much to arrest the depopulation of the Highlands. In Wales the larger water powers are already being developed to some extent by the North Wales Power & Traction Company, and while in England the main sources of water power are small, much more might be done to utilise them by installing modern turbines and improving the sites.

Controlling Haphazard Development.

The haphazard harnessing of the country's water power might, however, lead to a partial development which would prejudice the ultimate complete utilisation of available resources, and the Committee, therefore, consider that provision should be made for the ultimate acquisition by the State of all the future water-power undertakings, and they propose a system of terminable licences for limiting the tenures of the undertakings of water-power developments.

More Work for the Electricity Commissioners.

It is suggested that either the Board of Trade or the Electricity Commissioners should be specifically charged with the duty of supervising the development of the country's water power, and that, as suggested in the Third Interim Report, a Technical Committee should deal with the question of tidal power. The report, which can be obtained from the Stationery Office, is unanimous, except that Mr. E. A. Sandford Fawcett signs the report with the reservation that it is unnecessary to set up a commission. Mr. W. A. Tait takes the same view, and also refers to the dissentient report he made at the time of the issue of the Third Interim Report of the Committee.

The Alexanderson System for Long-Distance Radio Communication.*

(Continued from page 733.)

Earth Connection.

The earth connection is made to a network of wires and zinc plates buried in the ground round the station. There are also sixteen parallel copper conductors laid underneath the antenna and buried 1 ft. in the ground; these extend the entire length of the antenna and are spaced somewhat as shown in Fig. 9. It was found that the inner wires carried the

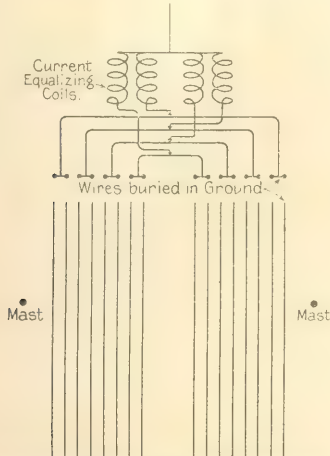


FIG. 9.—SCHEMATIC DIAGRAM OF EARTH-WIRE SYSTEM AT THE NEW BRUNSWICK STATION.

greater proportion of current, since they offered less impedance than the outer wires, and in order to equalise the currents in the wires, equalising-coils were inserted, as shown in Fig. 8, in the earth connection at each of the five tuning points outside the station. The addition of the equalising-coils reduced the equivalent antenna resistance from 0.9 to 0.7 O.

A still better distribution of the earth currents was obtained by installing a counterpoise, or "capacitive ground," consisting of copper wires arranged as in Fig. 10, and erected a few feet above the ground. This was connected to the lower end of each tuning-coil, as shown in Fig. 11, the earth-connection being made to a tapping, which was adjusted so that about half the current through the down leads flowed into the earth-wires and half into the counterpoise. The equivalent circuit of the multiple-tuned antenna with counterpoise is illustrated in Fig. 12. The addition of the counterpoise further reduced the equivalent antenna resistance to 0.5 O, made up approximately as follows:—Radiation resistance, 0.07 O; Tuning-coils and insulation, 0.10 O; earth resistance, 0.33 O; total multiple resistance, 0.50 O.

It is considered probable that the design and construction of the earthing system for the multiple antenna may be considerably simplified in future high-power installations, and yet provide a total antenna resistance lower than that obtained at the New Brunswick station.

It is claimed that the multiple-tuned antenna gives the same signal audibility with a lower and less expensive structure, and at the same time with less power, than an ordinary antenna with a single tuning inductance.

Radiation Efficiency.

The radiation efficiency of the New Brunswick multiple-tuned antenna, at 13 600 m. wave-length, is 14 per cent., as against 2.6 per cent. for a corresponding antenna with a single earth; at 8 000 m. wave-length the radiation efficiency is 33 per cent., and at 2 500 m., 70 per cent. Although the radiation efficiency of all types of antenna decreases with increase of wave-length, the smaller absorption at the longer wave-lengths

offsets this decrease, and efficient wave-lengths for transoceanic communication have been found to lie between 10 000 and 20 000 m. A point to be noted is that the New Brunswick antenna had a minimum wave-length of 8 000 m. as a single antenna, whereas it can be operated as a multiple antenna at 2 000 m. wave-length, *i.e.*, at a wave-length comparable with its own length of 1 500 m., and this suggests the possibility of effective directional radiation, which has not hitherto been possible. As described in its simplest form, the multiple antenna is adjusted so that the radiation from each of the individual oscillators is in phase. But the phase displacement of the oscillations of the individual radiators may be regulated by tuning, and at the same time radiators may be constructed having a length of one wave-length or more. Alexanderson predicts with confidence that directive radiation on a large scale will not only prove practical, but will be the most effective method of radiation.

For future and more powerful stations, antennae have been designed four miles long. It is calculated that such an antenna, with multiple tuning, would be equivalent to four antennae like the New Brunswick antenna connected in multiple, that the earth resistance would be one quarter of the multiple-tuned resistance of the New Brunswick antenna, and the radiation efficiency, with long wave-length, as much as 50 per cent. or more, instead of the few per cent. which has been common up to the present time.

The Barrage Receiver.

The barrage receiver is the name given to a circuit for balancing out interferences, so called because it was devised during the war with the object of preventing Transatlantic reception in France from being interfered with by the offensive barrage of an enemy radio station. Two long, horizontal antenna wires (A_1 , A_2 , Fig. 13) are used, in line with each

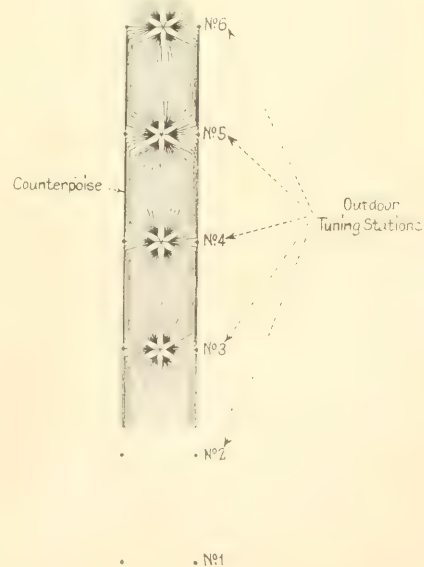


FIG. 10.—PLAN VIEW OF COUNTERPOISE AT NEW BRUNSWICK STATION.

other and running out in opposite directions from the receiving station; the length of each is preferably about one-quarter of the wave-length to be received. Each antenna is coupled through coils to a phase-shifting device consisting of two stationary coils connected in parallel, and a rotatable secondary coil; a condenser in series with one of the

* Based on articles by Mr. E. F. W. Alexanderson and others in the "General Electric Review."

fixed coils produces a phase difference between the currents which flow in the two coils, and by turning the secondary coil the E.M.F. induced in it may be made to assume any desired phase relation with the primary voltage. The two secondary coils are connected in series to a receiving set of the ordinary kind. Now, any interfering wave, coming from a direction different from that of the source of the signals

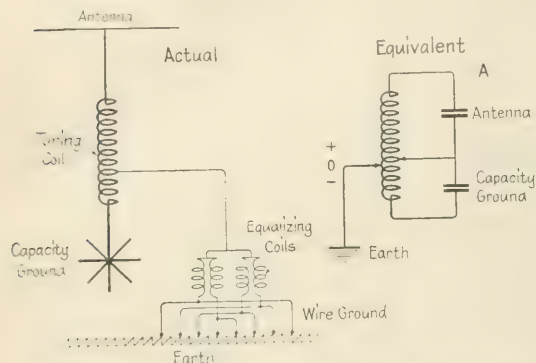


FIG. 11. SCHEMATIC DIAGRAM OF ANTENNA TO EARTH CONNECTIONS OF THE MULTIPLE-TUNED ANTENNA.

it is desired to receive, will produce currents in the two antennae having a phase relation different from that between the currents produced by the desired signal. By suitably adjusting the secondaries of the two "phase-rotators," and also the coupling between the coils, it is possible to neutralise the interfering currents in the two antennae, but not the desired signals. A signal originating in any direction whatever may be neutralised in this way. By the use of a double set of phase-rotators, interfering signals coming from two different directions may be neutralised simultaneously, and this principle may be carried still further if desired.

Arrangement of Receiver Wires.

It was originally intended to mount the antenna wires for the barrage receiver on poles, but, at the suggestion of Commander A. Hoyt Taylor, the easier procedure was adopted of laying the wires on the ground, and this arrangement has proved entirely satisfactory. In the first barrage receivers installed, the antennae consists of two insulated wires laid on the ground a distance of two miles in each direction from the receiving station. Antennae of this kind are aperiodic, which makes them much easier to balance than if they were tuned; the phase-shifting devices are also aperiodic, so that the E.M.F.'s in the aperiodic antennae are balanced before they have a chance to create oscillating currents. The adjustment is very easy to perform, even by an inexperienced operator, and is perfectly stable after it has been made. This form of antenna has, moreover, a unidirectional characteristic, as

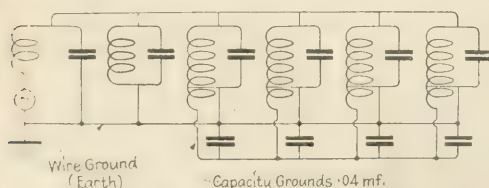


FIG. 12. EQUIVALENT CIRCUIT MULTIPLE-TUNED ANTENNA, NEW BRUNSWICK TRANSFORMING RADIO STATION.

shown in Fig. 14, which also illustrates the bidirectional characteristic of the loop antenna and the non-directional characteristic of the ordinary elevated antenna.

Experimental Barrage Receiving Set.

An experimental barrage receiving set was operated for several months of the summer and autumn of 1918, about three miles from the transmitting station at New Brunswick, N.J. The New Brunswick wave is 13 600 m., and the Carnarvon wave is 14 200 m.; yet the barrage receiver could be adjusted

so that the transmitted wave not only did not interfere with the Carnarvon signals, but the New Brunswick signals could be made entirely inaudible. It was even found possible to receive signals from San Diego, California, right in line with the transmitting station, without great reduction in intensity. The transmitting station, being at a comparatively short distance, its wave-front was considerably curved, so that it produced currents in the two receiving antennae having a phase-relation different considerably from that between the currents produced by the San Diego signals. Although the barrage receiver was devised primarily with the object of cutting out interference from another station, such as the associated transmitting station, it was found incidentally that interference by static and strays could be materially reduced by proper adjustment, and solid copy could be obtained at times when the signals were practically unreadable with ordinary methods.

Duplex Radio-Telephony.

On Feb. 22, 1919, Mr. Daniels, Secretary of the U.S. Navy Department, at his desk in Washington, picked up his telephone and spoke a few words of greeting to President Wilson, then 800 miles at sea on the U.S.S. "George Washington." Mr. Daniels' voice was carried over the regular trunk line from Washington to New Brunswick, N.J., where the telephone line current, through the agency of valve amplifiers and finally of the magnetic amplifier, modulated the output of the Alexanderson alternator, the radiators from the New Brunswick antenna being modulated accordingly. Previously, the operators on the "George Washington" had heard New Brunswick's radiophone while the ship was lying at anchor in Brest harbour.

In April, 1919, a valve transmitting set of about 4 kW was installed on the "George Washington," thus enabling speech in both directions, the circuits being so arranged, both on the ship and at New Brunswick, that no switch of any kind had to be manipulated in order to change over from sending to

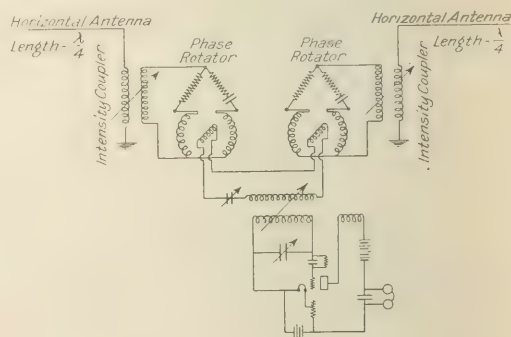


FIG. 13. DIAGRAM OF THE BARRAGE RECEIVER.

receiving, both transmitter and receiver remaining in action the whole time, as in the case of an ordinary line telephone. With the usual arrangement of wireless telephone, a switch has to be used to change from sending to receiving, or vice-versa, and this does not conduce to the satisfactory interchange of ideas; both parties are apt to say "Hello!" simultaneously, then wait for an answer simultaneously, then say "Hello!" again, and finally give it up in despair. It can, therefore, be said that one of the most important problems from the point of view of making radio-telephony practical and useful for the general public is to devise a simple method of duplex operation, whereby the speaker is able to hear the voice of the other party.

The New Brunswick Circuits.

At New Brunswick the circuits were as shown in Fig. 15. The receiving station was at Belmar, four miles from New Brunswick, far enough away to enable the receiving instrument to differentiate between the 1 800 m. wave coming from the "George Washington" and the 8 000 or 13 600 m. wave which was used for the radio-telephonic transmission from New Brunswick. It will be observed that the receiving and transmitting stations are both connected in series to an ordinary telephone exchange line, so that a party speaking from Washington or anywhere else on the land telephone system could hear the incoming radiophone speech over the same wires which transmit his own speech to New Brunswick. A curious property of the circuit is that the speech and signals picked up

Commissioners' Report on London Electricity Supply.

The decision of the Electricity Commissioners on the schemes submitted at the enquiry into the LONDON and HOME COUNTIES ELECTRICITY DISTRICT, held in June and July last, was issued on Wednesday.

In the opinion of the Commissioners it would be short sighted to establish a smaller District than that provisionally determined, notwithstanding that there may be little immediate advantage for some of the undertakers included in the outlying portions. The Electricity District must be such as will be most conducive to economy in the supply of electricity, and delimitation cannot be influenced by the desire of one county to be wholly included or wholly excluded merely in order to preserve its area intact. For the same reasons the Commissioners cannot consent to the proposed exclusion of the North Metropolitan Electric Supply Company and the Metropolitan Electric Supply Company so far as the latter's bulk area is concerned, but an Order will be drafted so as not to interfere with the rights of these two companies and for the delegation to them of the supply powers of the Joint Authority in their respective areas, subject to the submission by the companies within a period of two years of proposals for securing a supply in any undeveloped areas where there is a reasonable prospect of such supply being remunerative.

Alterations to the District.

The Commissioners have therefore decided to confirm the provisionally determined District, subject to the following minor fringe amendments. In Essex, the inclusion of the whole of the rural districts of Billericay, Epping, and Ongar; in the County of Hertford, the inclusion of the detached part of the parish of High Wych in the rural district of Hadham; in the County of Buckingham, the inclusion of the parishes of Penn, Coleshill, and Amersham in the rural district of Amersham; in the County of Surrey, the inclusion of the parishes of Shalford and St. Martha in the rural district of Hambleton, and the parish of Artington and part of the parish of Compton in the rural district of Guildford; in the County of Berks, the exclusion of the parishes of Sunninghill and Sunningdale in the rural district of Windsor.

Constitution of the Joint Electricity Authority.

The Commissioners are unable to accept the scheme of the Poplar Borough Council, and a Joint Electricity Authority will be established on the lines proposed in the scheme promoted by the London County Council and the Conference of Local Authorities. This Joint Electricity Authority will consist of twenty-seven members made up as follows: Eight representatives of local authorities (authorised undertakers), eight representatives of companies (authorised undertakers), of the latter group six will represent the London companies, one the power companies, and one the outside London companies, six representatives of the London County Council, one of the railway companies, and three for the other county councils on their own behalf and on behalf of the urban and rural districts not owning undertakings. The chairman, if elected from outside the body, will make the total as above.

The Economics of a Capital Station.

The Commissioners concur generally in the technical proposals for dealing with the electrical requirements of the area during the first stage of development, which terminates about 1925-1926. On the proposals for dealing with the second stage the Commissioners, however, differ from the promoters, who propose to continue the development of certain existing "group" stations and to instal in them a further 199,000 kW of generating plant, bringing the plant installed in "group" and other stations about the year 1930 to a total of 832,600 kW. An alternative proposal provided for the installation of 645,000 kW of generating plant in capital stations and the reduction of the 557,000 kW of plant installed in the group stations to 232,600 kW, thus involving the discarding of 324,400 kW of plant long before the end of its economic life. This alternative involved a new capital expenditure of £23,855,000. The Commissioners have come to the conclusion that a better way is to instal 199,000 kW of generating plant in a capital station or stations, while retaining the "group" stations during the development of the second stage. This will need no more new capital than the extension of the "group" stations, and enable electricity to be delivered at the busbars of authorised distributors at 0.978d. per unit as against 1.147d. per unit under the technical scheme, as well as providing all the advantages derivable from the capital station, such as availability for large railway or other bulk requirements at favourable rates. Such a modified combination of existing stations with a new capital station will also minimise the outlay upon the costs of transmission from the capital station, and will make the fullest use of the capital invested in existing stations. It will lessen the estimated coal consumption by 10 per cent. and reduce the average cost of electricity to authorised distributors by 15 per

cent. These savings will be additional to the substantial savings outlined in the technical scheme as compared with existing conditions.

The Barking Site Approved.

The Commissioners have concluded that the Barking site should be utilised for the construction of the first capital station, and are therefore prepared to give their consent to the County of London Electric Supply Company beginning immediately the construction of a 100,000 kW station on the understanding that at any time before August, 1926, the company may be called upon to sell this station to a Joint Electricity Authority upon terms to be prescribed by the Commissioners. The proposals of certain railway companies to proceed with the electrification of their suburban lines constitutes a further reason for the re-organisation of the supply in the area and the establishment of a capital station without delay.

Control and Purchase.

With regard to the various proposals for the acquisition or control of generating stations, the Commissioners are of opinion that, of the stations owned by power companies, only six or seven of the principal company suppliers and a like number of the local authorities' stations will ultimately survive as generating stations, and these more particularly are the stations which should vest in the Joint Authority. The remainder of the existing stations, of which about fifty will be gradually closed down, can be incorporated in the scheme of re-organisation under an appropriate system of control by the Joint Authority.

There being a far reaching measure of agreement on the question of purchase between the London County Council, the Conference of Local Authorities and the Associated Companies, it should be possible to settle terms of agreement for transfer of electricity stations on a basis equitable to both local authorities and companies, and without, at the same time, being burdensome to the Joint Authority or adverse to the interests of the consumers of electricity. The Commissioners also press on principle for an extension of tenure of the distribution powers of the supply companies as part of a settlement.

Financial Proposals.

As regards finance, the authorised undertakers should find the funds for all extensions of generating plants at their stations while such stations remain in their possession, and for any inter-connecting mains required before the Joint Authority is in a position to act.

The capital monies necessary for the construction of additional interconnecting mains and the erection of capital stations should be raised by the Joint Authority under powers of borrowing to be conferred by further legislation.

The Commissioners will proceed to draft an Order embodying their decisions, which will provide for the inclusion of the details of a modified technical scheme to be undertaken by the Joint Authority, and in framing the details of the scheme the Commissioners propose to consult with the engineering advisers of the principal undertakings concerned.

The Electrical Industry and Reparations.

We have received from the Institution of Electrical Engineers a copy of a letter dated December 9th, 1921, which has been addressed to the Prime Minister on the subject of German Reparations in kind. This letter being of outstanding interest to the electrical industry we reproduce it in full below. We have inserted the sub-headings.

The Right Honourable David Lloyd George, O.M., P.C., &c.,
First Lord of the Treasury,
The Treasury,
Whitehall, S.W.1

German Reparations in Kind.

SIR.—The Council of the Institution of Electrical Engineers have had their attention directed to certain public declarations and press communications proposing that the German Reparations Indemnity should be partly provided by the construction in this country of generating stations and the carrying out of railway electrification by German contractors; and having appointed a Committee to report to them thereon, desire to put before the Government their considered view on these proposals as follows:—

On the general principle of reparations in kind they have to remind the Government that at the present time when unemployment is so extensive any reparations in kind should be of such a

nature that they do not compete with any productions in this country involving employment on a great scale of labour both skilled and unskilled.

German Power Stations and Cheaper Service.

With regard to the proposals that large electric power stations should be erected and that railway electrification should be undertaken by German contractors, they desire to make the following observations. It is possible that the proposals for the acceptance of German plant on account of reparations may have arisen from a hasty impression that such action would confer benefits on this country in the form of cheaper transport and power. But if such plant is to stand as a contribution towards reparations its value must be debited to the undertakings using it. In no other way can such value be put to the credit of national indebtedness. There is, therefore, no good reason to suppose that the use of German plant obtained in that way would result in the users of it being able to give a cheaper service than with new equipment of British manufacture.

Additional Unemployment the Result.

There are, however, other considerations which my Council desire to urge. The Electrical Industry in this country is at the present time suffering from a grave lack of employment in all branches, but nevertheless many works are being run in the expectation of a trade revival. Should it be decided to accept German machinery on a large scale, there is no doubt that a large additional amount of unemployment would immediately result, and that both the work people and technical staffs at present being kept together would be disbanded. Moreover, the effect of the acceptance for the public service of this country of electrical machinery of German manufacture would be a world-wide advertisement for such goods, and would fatally diminish the present prestige of British electrical goods with most serious effects on our export markets.

A Discouragement to Technology.

The experience of the war showed the necessity of this country having a large number of highly skilled and trained electrical engineers available, and the members of the Institution of Electrical Engineers were called upon during the war to undertake work for the national forces requiring the highest skill.

A proposal which would have the effect of crippling many of the most important electrical manufacturing concerns and leaving this country dependent for electrical services upon German industry would result in discouraging the training of electrical engineers for what, in war time, is a vital necessity.

Disastrous Consequences of the Idea.

In view of the points briefly set out above, the Council of the Institution of Electrical Engineers, representing all branches of the Electrical Industry, desire to urge most strongly on H.M. Government the disastrous consequences which would ensue to the industry if electrical construction in this country on an extensive scale is entrusted to German manufacturers. Any possible immediate advantage anticipated by the proposers of the scheme of reparation could not offset the ruin of those industries in this country which are engaged in the manufacture of steam turbine plant and heavy electrical machinery, both of which had their sole origin in British science and inventiveness.

The Council of the Institution trust that in view of the discussions which have been published, H.M. Government will remove the great uncertainty which has been created in the industry by an immediate statement that such proposals will not be entertained. If, however, proposals of the kind should be considered by the Government, my Council ask that they should be given an opportunity of being heard by yourself or the Chancellor of the Exchequer before any action is taken.

I am, Sir,

Your obedient servant,

J. S. HIGHFIELD,

President.

Conference of Joint Industrial Councils Protest.

The Conference of Joint Industrial Councils of the Electricity Supply and Contracting Industries and of the Associations of Electrical Manufacturers and Wholesalers and the B.E.D.A., which recently waited on Sir Alfred Mond to deal with unemployment, have met to consider the reparations question, especially in view of the assurance which Sir Alfred Mond gave the deputation, that the Government were very desirous to assist as far as possible the reopening of activity in electrical work.

The Conference viewed with great alarm the proposals to carry out the construction of electric generating stations and electrification of railways by placing the works in German hands and accepting the construction as part of the reparation payments, and resolved:

- (1) To call the attention of the Government to the irreparable injury which would be done to the British Electrical Industry now and in the future if any such proposals were seriously entertained, and which, if put into effect, would result in the closing down of important electrical works in this country and consequent increase of unemployment.
- (2) To use all legitimate efforts in the Press and in our constituent bodies to oppose to the uttermost the principle of acceptance by the Government of reparation payments in the manner suggested.

The Conference further invited the Government to make an immediate and unequivocal statement that acceptance of reparation payments by handing over such public service works to German contractors will not be entertained.

Correspondence.

A PSEUDO-ENGINEERING SOCIETY.—A CRITICISM.

To the Editor of 'THE ELECTRICIAN'

SIR,—I have had drawn to my notice an article evidently written by yourself, entitled "A Pseudo-Engineering Society," Vol. LXXXVII, No. 2263, p. 401, col. 2, of the date of Sept. 30th, 1921.

I do not know your motives in publishing the article in question, and we are not adverse to fair criticism and remarks, but we do most strongly object to the passage as follows:

and it is something akin to a misrepresentation of an honorable term to use the word "engineer" in the title of a Society which is primarily intended for political propaganda.

This passage has done us considerable harm, and trouble, and on advice we are assured the above constitutes a libel pure and simple, inasmuch as the entire passage is malicious and wrong.

I enclose you a copy of a letter written appreciating our services during the great railway strike of 1919.* And there are scores of other proofs of bona-fide corroboration of the immense services of this society in engineering, and the assistance of engineers; in fact, "John Bull" warmly appreciated, early in 1920, the services that this society was rendering to ex-Service engineers, and others, re the unemployment question.

The executive council therefore have instructed me to inform you that unless you publish an apology and contradiction of the passage alluded, they will immediately instruct the Society solicitors to take action for libel.

We do not wish to appear mercenary, but it is necessary to show our members and the public the truth.—Yours, &c.,

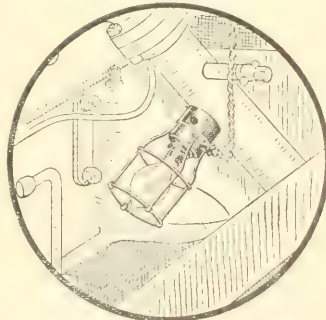
Sheffield, Dec. 10th.

CHARLES FROBISHER

Secretary, The British Society of Engineers.

The "Kendrick" Inspection Lamp.

A novel portable electric hand lamp has been placed upon the market by the NEAL, MACNEIL CONSTRUCTION COMPANY, LTD. Apart from the usual wire guard for the protection of the lamp, it embodies in the lamp-holder a strong magnet which enables it to be placed and firmly held in any position, so that the light from the lamp can be thrown where required. The magnet is composed of a steel cup with a central pole, around which is wound the coil, finally



THE "KENDRICK" INSPECTION LAMP.

being sealed by an aluminium plate. When it is required to move the lamp the circuit can be broken by pressing a small button at the side of the holder. It is a very useful accessory for machine shops, garages, warehouses, &c., and it is already largely used by several well-known makers of machine tools. Two sizes are made, viz., 6 or 12 V for motor-car use, and 100 to 120 or 200 to 250 V for workshops, &c. The current consumption of both sizes is only 0.18 A. Full particulars may be obtained from the manufacturers.

* The enclosure is a letter from Mr. J. H. Follows, general superintendent of the Midland Railway, expressing his warmest thanks for assistance given by the Society or its Secretary—it is not clear which during the railway strike. Ed. E.

Future of Light Railways.

In the report of the Light Railways (Investigation) Committee, which has just been published, there are a number of recommendations regarding the construction and operation of light railways, the extent to which assistance should be given by the State and local authorities to new schemes, &c. In view of the importance of the subject we give a summary of the more important of the Committee's conclusions.

Recommendations.

The Minister of Transport should have some voice with regard to the design of any light railway which receives assistance in future from public funds; and, where this assistance is rendered in the shape of subscriptions to share capital, the State or the local authority so subscribing should possess the ordinary rights of shareholders.

Where it is proposed to acquire land compulsorily for light railway purposes, the rules for the assessment of compensation which are contained in Clause 2 of the Acquisition of Land (Assessment of Compensation) Act, 1919, should be made to apply. Promoters should have power to acquire an easement only, where such would be sufficient.

The principle of betterment should be more widely recognised, and the application thereof should not necessarily be limited to the owner of the property which is to be compulsorily acquired.

Future policy should aim at encouraging light railway undertakings by the grant of special facilities by the State and by the larger railway companies.

The possibility of exempting light railway companies from the payment of corporation profits tax should be seriously considered, and the revision of the rating of railways should be seriously considered, with particular reference to the incidence of highway rates.

Small undertakings desiring to be classified as "light" railways, and main line companies who may desire certain sections of their undertakings to be so classified, should be able to attain this object without difficulty and with the maximum of expense. The relative procedure should be as simple as possible, and payment of the fee of £50 should no longer be required.

Design and Construction Methods.

Where no connection with a main line is possible, or likely to be required, the choice of the gauge for a new light railway may be determined mainly by considerations of economy in construction and maintenance. Where connection with a main line is proposed, a narrow gauge should not be adopted unless the light railway is to have a lead exceeding twenty miles or is to form part of an existing narrow gauge system which could not advantageously be converted to standard gauge. For narrow gauge lines the dimension of 2 ft. 6 in. should in future be regarded as the standard.

Light railways should be classified in two groups with particular reference to the maximum speed authorised. This maximum should be twenty-five miles per hour for lines in Group I., and fifteen miles per hour (or such lower maximum as may be agreed to by the Minister of Transport) for lines in Group II.

Weights of rail and axle loads permissible should be determined by reference to a sliding scale to be inserted in Appendix VII. to the Requirements with regard to the Opening of Railways, due regard being had to speed, alignment and traffic conditions.

Complete schedules of up-to-date model clauses for insertion in draft light railway orders should be printed and made available for the use of promoters, subject to the proviso that the schedule of Requirements appended to each Order should be left open for settlement on the merits of each case. The Requirements usually specified in this Schedule with regard to signalling, points, and cognate matters could not safely be relaxed in favour of the "higher speed" lines; but on the "lower speed" lines included in Group II. no signals should, as a rule, be required.

Fencing should be provided only where local conditions, including the speed of trains, render it essential; and the protection of level crossings by gates and gatekeepers should be similarly limited.

Where a road and light railway intersect, a bridge should not be provided except where no economy could be effected by the provision of a level crossing.

Traffic Regulations and Facilities.

Station accommodation for passenger traffic should be more strictly limited, and should take the form of a simple shelter, except at important stations. Halts should suffice at wayside places. The station facilities for freight traffic should be more closely adjusted to the requirements.

Where a new light railway is proposed, the question of dispensing with platforms should be considered, especially in the case of a narrow gauge line.

The quantities of rolling stock initially provided for light railways should be more closely adjusted to the traffic requirements. A determined effort should be made to secure economy in respect of rolling stock by a standardisation of types and parts.

Advantage would result from a wider use of railway vehicles on tramway tracks. Provided that suitable regulations are applied, and that local conditions render it practicable, we see no reason why tracks on a public road or street should not be used for this purpose.

Greater economy is desirable in methods of maintenance and

operation and existing facilities for the handling of traffic should be improved, e.g., by the extension of sidings and other working facilities at stations and exchange points.

An application by a railway company for an amending Order empowering it to acquire a light railway should be granted by the Minister only if he is satisfied that the light railway concerned has changed in character and become competitive.

The principle of voluntary "grouping" of light railway undertakings for purposes of management should be extended, and there should be a closer co-operation in matters affecting the design and repair of rolling stock and permanent way material.

Light railways should be emancipated from the influence of the standards by which, at the present time, the cost of labour is determined.

Rates and fares should be determined in each case by reference to the economic circumstances of the particular line concerned. In particular, light railway charges should not be based upon any definite ratio to main line charges.

Light railway companies in Great Britain should be admitted as members of the Clearing House, and possess all the privileges of membership except the power of voting; and they should be represented on all official panels or committees which deal with matters likely to affect such undertakings.

Through rates are advantageous to the public, and their institution brings the light railways into closer contact with the main lines, and thereby tends to facilitate the working and exchange of traffic. They are, therefore, generally desirable, but in particular cases the decision must depend upon local circumstances, especially on the character of the country which the railway traverses.

In assessing the comparative economic values of road motor transport and light railway services, individual cases must be considered on their merits.

Electrical Imports and Exports.

IMPORTS.—The following are official values of electrical machinery, apparatus and material imported into this country (a) during November, 1921, and (b) the aggregate figures from Jan. 1 to Nov. 30, with increase or decrease compared with corresponding periods of 1920:—

Electrical machinery, (a) £46 871 (decrease £95 784), (b) £78 386 (decrease £509 992); telegraph and telephone cables, submarine (a) nil, (b) nil (decrease £50); other than submarine, (a) £2 652 (decrease £6 885), (b) £75 355 (increase £54 826); telegraph and telephone apparatus, (a) £17 389 (decrease £16 845), (b) £296 913 (increase £105 019); other electrical wires and cables, rubber insulated, (a) £6 780 (increase £3 049), (b) £40 397 (increase £11 480); with other insulations, (a) £11 254 (decrease £8 561), (b) £103 300 (decrease £20 023); carbons, (a) £1 215 (decrease £13 830), (b) £90 309 (decrease £44 793); glow lamps, (a) £21 505 (increase £8 813), (b) £239 186 (increase £175 942); arc lamps and electric searchlights, (a) £23 (decrease £3 730), (b) £6 653 (increase £1 114); parts of arc lamps and searchlights (other than carbons), (a) £391 (decrease £1 178), (b) £14 622 (increase £1 666); batteries, (a) £12 285 (decrease £10 233), (b) £114 751 (decrease £2 012); meters and measuring instruments, (a) £2 137 (decrease £10 567), (b) £132 713 (increase £50 242); switchboards, (a) £7 291 (increase £6 100), (b) £23 228 (increase £20 476); electrical goods and apparatus unenumerated, (a) £49 914 (decrease £56 605), (b) £669 640 (decrease £38 566). Total of electrical machinery, apparatus and material, other than uninsulated wire, (a) £179 707 (decrease £206 256), (b) £2 485 453 (decrease £246 899).

EXPORTS.—The exports of electrical machinery, apparatus and material (a) during November, 1921, and (b) from Jan. 1 to Nov. 30, with increase or decrease compared with corresponding periods of 1920, were as follows:—

Electrical machinery, (a) £449 915 (decrease £19 927), (b) £4 431 650 (increase £2 083 283); including railway and tramway motors, (a) £6 373 (increase £3 954), (b) £193 421 (increase £159 079); other generators and motors, (a) £275 553 (increase £59 355), (b) £2 506 324 (increase £1 172 566); and electrical machinery unenumerated, (a) £167 989 (decrease £83 236), (b) £1 731 905 (increase £751 638); telegraph and telephone cables, submarine, (a) £42 028 (decrease £39 581), (b) £2 063 911 (increase £613 266); other than submarine, (a) £110 262 (decrease £20 334), (b) £1 536 709 (increase £621 192); telegraph and telephone apparatus, (a) £184 738 (increase £74 369), (b) £1 862 202 (increase £787 192); other electrical wires and cables, rubber insulated, (a) £45 693 (decrease £144 527), (b) £1 174 751 (decrease £412 093); with other insulations, (a) £161 721 (decrease £36 246), (b) £1 765 360 (increase £68 244); carbons, (a) £5 668 (decrease £6 731), (b) £65 991 (decrease £54 478); glow lamps, (a) £27 257 (decrease £31 826), (b) £418 411 (increase £125 490); arc lamps and searchlights, (a) £447 (decrease £1 097), (b) £12 741 (decrease £4 630); parts of arc lamps and searchlights (other than carbons), (a) £334 (decrease £1 923), (b) £5 924 (decrease £8 020); batteries, (a) £38 186 (decrease £42 371), (b) £639 320 (increase £87 668); meters and measuring instruments, (a) £33 236 (decrease £7 823), (b) £456 738 (increase £90 205); switchboards, (a) £21 839 (increase £1 342), (b) £222 009 (increase £118 837); electrical goods and apparatus unenumerated, (a) £119 486 (decrease £161 455), (b) £1 890 597 (increase £17 637). Total of electrical machinery, material and apparatus, other than uninsulated wire, (a) £1 240 810 (decrease £447 130), (b) £16 746 314 (increase £4 133 843).

Legal Intelligence.

McNaught v. Blackpool Corporation.

At Manchester Assizes last week, before Sir William Finlay, K.C., Commissioner, Mr. A. J. McNaught recovered £676 from Blackpool Corporation as damages for injuries sustained in a collision between trams at Blackpool. Defendants admitted responsibility, and the only question was the amount.

Straughan v. Glasgow Corporation.

In the Court of Session, Edinburgh, recently, Mrs. H. Straughan was awarded £550 damages against the Corporation of Glasgow for injuries sustained in November last. Pursuer had alighted from a tramcar at Uddingston Cross. She was passing round the back of the car when the latter was suddenly reversed and she was knocked down. As a result of her injuries, her left leg had to be amputated.

Wm. Claridge v. Bradford Corporation.

At the West Riding Assizes last week Mr. Wm. Claridge, accountant, sued the Bradford Corporation for damages in respect of injuries sustained in consequence of the negligence of defendants or their servants. On Feb. 3, 1921, plaintiff was returning home in a tramcar, and at Five Lane Ends the car overran the points, crashed into a wall, and overturned. The plaintiff, who was a top-deck passenger, was seriously injured, and, as his right arm and hand were still affected, he was not yet fully equipped to carry on his business. The collar-bone had not properly united and was pressing on one of the nerve centres, thus preventing the full use of the hand. Defendants admitted liability.

Ultimately the jury awarded £22,000 damages, with £223 as special hand. Defendants admitted liability.

Chamberlain & Hookham v. Solar Zahlerwerke.

This case came before the Anglo-German Mixed Arbitral Tribunal on the 9th inst. For the claimants Mr. Douglas Hogg, K.C., said his clients claimed £26,921 and interest. There was no serious dispute as to the amount, but the German company urged that their shares were owned by the English firm, and that when the shareholders in a German company were English the company was not a German company. They also stated that where the shareholders in a German company were in the position of claimants there was no debt. Those propositions were not (said counsel) in accordance with English or German law, or with the provisions of the treaty. Messrs. Chamberlain & Hookham, who were makers of electricity meters, formed, in 1908 (in association with a German firm in Hamburg), a German company, and the respondent company was incorporated. The capital of 50,000 marks was held by three or four shareholders, Mr. John Chamberlain holding 30,000. The German company bought from Chamberlain & Hookham the patent rights in their meters for a number of Continental countries. The price was 49,000 marks, nearly the whole of the paid-up capital. The German company commenced business in Hamburg, its principal business being the assembly and sale of meters made under the English firm's patents. The German company did not at first make very much profit, but in 1914 it was apparently getting large orders and looked like having a prosperous future. In 1912 the whole of the share capital in the German company was owned by Chamberlain & Hookham, and at the outbreak of war there was owing to them the amount claimed. He contended that there could be no doubt that Messrs. Chamberlain & Hookham had the right to say that they had sold goods for which they had not been paid.

The decision will be announced in due course.

Tyrod Company v. Franco-British Electrical Company.

By this action, heard by Mr. Justice Coleridge recently, plaintiffs claimed damages against the defendant company for failure to deliver a certain model which plaintiffs had ordered in July, 1920.

Mr. BARRINGTON WEALE, K.C. (for plaintiffs), said that the chief question was as to what damage plaintiff company had sustained by reason of defendants' failure. Plaintiffs were advertising agents, and were the inventors of an ingenious electrically-operated device, which showed the name of the person they wished to advertise. They had a model made with which they were not quite satisfied, and a friend introduced them to a director of defendant company named Brackensley. They took the model to Mr. Brackensley and told him what they wanted. They said they wanted a model properly made, the details of which they gave, and Mr. Brackensley assured them there would be no difficulty in doing the work. Plaintiffs pointed out that despatch was vital to them. Mr. Brackensley said that they would require the model in six weeks. It was agreed that it should be made within that time, but it was not delivered in time. The defence was that no time was mentioned, and it was left to defendants to do their best and produce the model as soon as they could.

After hearing evidence on both sides, his Lordship said he was satisfied that time was mentioned, but he doubted whether anything more was done than to mention six weeks in a letter. In a letter plaintiff said, "We understand that the model should be ready within six weeks from this day" (July 15), but plaintiffs' original story was that it was to be within six weeks from July 8. He did not think there was a binding contract to deliver within six weeks,

and the question remained as to delivery within six weeks. From the evidence it appeared that a period of from eight to nine weeks would seem to be a reasonable time. Plaintiffs were going to exhibit the model at an exhibition to be held at the White City in November and December, and defendant promised that it should be ready in time. Plaintiffs issued circulars and engaged a stall at the exhibition, and they hoped for good financial results from the exhibition of the model. When the exhibition came along the model was delivered; but there was only alternating current at the White City, and when the model came to be placed in position it was found that the alternating current was useless for working the model. Defendants then suggested a motor generator should be used somewhere where the public would not see it. Plaintiffs, however, and quite rightly, too, would not agree. The consequence was that the exhibition went by without plaintiffs getting the buyers they anticipated. He was of opinion that defendants did not supply within a reasonable time, and he came to the conclusion plaintiffs might have sold fifty at a profit of £5 each. Therefore he gave judgment for plaintiffs for £250, with costs.

Municipal Accounts.

The total receipts of DARLINGTON ELECTRICITY AND LIGHT RAILWAYS COMMITTEE for the year ended March, 1921, were £33,560, against £27,682 in the previous year. Working expenses, however, had increased by £4,879, and capital expenses by £411, which left a net loss of £3,166, against £3,744 last year. The Electricity Department showed a net profit of only £579, against £5,365 in the previous year, but this was only because the charges were not increased when coal and wages costs went up. The average charge per unit for electricity sold in Darlington last year was 1'28d., and this was the lowest average charge made by any electric supply authority in the country. The total working cost per unit was 0'97d.; this, also, with one exception, was the lowest in the country.

The annual accounts of the EAST HAM tramways for the year ended March 31 show the traffic revenue £109,586, plus £979 from other sources, making a total revenue of £110,565, against £95,235 in the previous year. Working costs amounted to £129,912 (£104,385), leaving a gross loss of £14,326 (£9,151). After providing for interest on loans, £7,658 (£5,021) and sinking fund, £11,663 (£7,183), a deficit of £33,647 (£21,355) remained. After placing £300 to special reserve (£300), and allowing £79 for capital expenditure out of revenue, the deficiency at the close of the year amounted to £34,026, against £21,655. At the commencement of the year the authorised borrowing powers amounted to £235,830, to which should be added £8,375 sanctioned during the year in respect of the purchase of equipment for ten new cars, making a total at the end of the year of £244,203. This amount is exclusive of £11,586 originally sanctioned for tramway purposes, but subsequently allocated to the Electricity Undertaking for expenditure on machinery for the joint purposes of the two undertakings. With regard to the redemption of debt, the contribution to sinking fund amounted to £5,564, while a sum of £4,100 was applied in actual repayment of loans otherwise than out of sinking funds, making a total provision for the redemption of debt of £9,664.

The report of MAIDSTONE ELECTRICITY DEPARTMENT for the year ended March 31, shows that the capital expenditure to that date was £214,718, against £144,030 in the previous year. The total revenue was £58,402 (£43,935); total costs, £46,374 (£32,253), leaving a gross profit of £12,028 (£11,672). After payment of capital charges the net result was a loss of £526, against a profit of £1,486 last year. Consumers connected at March 31 numbered 1,367 (1,248); units sold 4,993,740 (4,600,879). The maximum load was 2,270 kW (2,108 kW); load factor, 32.3 per cent. (31.24 per cent.). In his report for the year, the borough electrical engineer (Mr. E. E. Hoadley) states, with reference to the year's loss that, in addition to the general adverse conditions of trade during the year, the plant installed during and just after the war had given a certain amount of trouble, and during the past year had cost considerable sums in making good breakdowns caused by faulty manufacture due to war conditions. On account of this plant being out of commission and less economical plant having to be run, the coal bill was considerably increased. With the various repairs and alterations that have been effected the whole of this plant is now in first-class working order. Constructional work of considerable magnitude has been in hand during the year. A third turbine of 1,500 kW capacity has been installed, with all its attendant arrangements for the supply of the necessary steam for driving it. A supply of three-phase, at extra high pressure (6,600 V), has been given to the outlying parts of the town, and the Cherry Orchard Estate, the Upper Fant district, and Tovil are supplied with alternating current. This alternating current supply will enable the Committee to deal with applications for supplies of greater magnitude and at greater distances than they have hitherto been in a position to do. The whole of Messrs. Reeds, Tovil mill, and Messrs. Allnutt's mill are now driven by alternating current from the mains of the Corporation, and in normal working use about 500 units per hour. During the winter extra high tension mains were laid to Snodland, to the mill of Messrs. Townsend Hook, and the industrial settlements at Preston Hall were supplied en route. Preston Hall has been taking a supply for some time, but, owing to delays in the delivery of certain plant, the undertaking is not yet in a position to supply Messrs. Townsend Hook, nor are they ready to take the supply. During the year a hiring scheme has been inaugurated, and considerable progress has been made. A large number of electric fires, flat irons, and pieces of cooking apparatus are out on hire, and each week sees the number extended.

Electricity Supply.

Street lighting in BUCKENHAM is to remain on the pre-war scale. Hereford Town Council has received sanction to a loan of £8 550 for mains and services.

A new electric lighting scheme for WATERFORD City is being prepared by Mr. Seán McEntee, of Dublin.

MAIDSTONE Town Council has received sanction to a loan of £5 134, for plant for the electricity works.

The Minister of Transport has revoked, as from Dec. 3, the FELTHAM AND DISTRICT ELECTRIC LIGHTING ORDER, 1914, as to the whole of the area of supply.

An arrangement has been made by which the SHROPSHIRE POWER COMPANY will supply electricity to the Callow End and Kempsey districts of the Upton rural area.

SHOREHAM Electric Light Company has secured statutory powers to supply Shoreham-by-Sea urban district, which includes Kingston-by-Sea and the Parish of Lancing.

BARRY District Council have rescinded their former resolution to spend £125 000 on the renovation of the gasworks in order to investigate fully the question of providing a supply of electricity to the town.

LANCASTER Corporation have received sanction to borrow £7 600 for extensions to the electricity works. The Electricity Committee have accepted an offer of the plant of the Caton Engineering Works for £5 800.

CROYDON Electricity Committee is making an experiment with regard to the supply of electricity for lighting and cooking to houses on the Corporation's estate at Norbury for a fixed weekly sum of 1s. 6d.

Successful tests of the new 1 500 kW Brush Ljungstrom turbo-alternator have been made by the BATH Corporation electricity department. This is the first turbine set to be employed at the electricity works.

YORK Town Council has entered into an agreement with the War Department for a supply of electricity to the Government offices in the city for three years. It is estimated that 70 000 units will be taken each year.

ABERDEEN Electricity Committee's claim against the Board of Trade in respect of alleged loss due to interference by the Coal Controller with the supply of coal to the electricity works has been dismissed by the War Compensation Court.

The SCARBOROUGH ELECTRIC SUPPLY COMPANY, LTD., are applying to the Electricity Commissioners for a Special Order to amend the provisions of the SCARBOROUGH CORPORATION ELECTRIC LIGHTING ORDER, 1891, by increasing the maximum charges for current.

Mr. J. H. Clothier, electrical engineer at St. ANNES, reports that applications for electricity supply from LUTHEM area are coming in well, and service mains are being laid as quickly as possible. The Electricity Commissioners have sanctioned a loan of £9 740 for the work.

The cost of an electricity supply for MUMBLE is estimated at £15 000, and 500 consumers would be required to make it pay. Up to the present only sixty-five applications have been received, and fifteen promises, and the Swansea Electricity Committee have deferred consideration for a month.

A HITCH has occurred at BLACKPOOL, which has resulted in the new Corporation houses being without light. The Electrical Engineer desired to erect a corrugated iron transformer chamber on the site in place of a permanent structure on the ground of cost. The Housing Committee rejected the idea.

STAFFORD Electricity Committee recommend the acceptance of the tender of Callender's Cable & Construction Company for supplying and laying 1 000 yds. of low-tension cable in Newport-road; also that the electricity cable in North-street be extended to the Stafford Steam Laundry's premises at an estimated cost of £200.

A loss of £20 000 has been incurred by LINCOLN electrical undertaking in connection with the scheme for taking over St. Swithin's power station. At last week's meeting of the City Council, Mr. J. Smaley protested against the proposal to apply for a further loan of nearly half a million in connection with electrical undertakings.

It has been finally decided to form a company to supply electricity to TEIGNMOUTH. The Quay Company have consented to grant a lease of land on the quay for a term of forty-two years. The directors nominated are Dr. Purves, Messrs. Morgan Giles, F. Harvey, W. R. Parkhouse, A. P. Dell, E. W. Parsons, and G. Rossiter.

Salford Town Council has approved a scheme for an expenditure of £57 500 on the new GENERATING STATION at ABERHOPE. It is intended to keep the present Frederick-road station running until the new station is complete, and eventually make the former the distributing station for the whole district. The Electricity Commissioners have approved the scheme.

The Minister of Transport has revoked, as from Dec. 10, the RIMMISH UFFAN AND RIMMISH RURAL ELECTRIC LIGHTING ORDER, 1910, so far as it relates to Appleton, Grappenhall, Latchford Without, Stockton Heath, Higher and Lower Walton, and Thelwall; and the SHERBORNE ELECTRIC LIGHTING ORDER, 1912, as to the whole area of supply.

BANGOR City Council have accepted the offer of the North Wales Power & Traction Company to supply electricity in bulk to Bangor.

The Council will apply for sanction to borrow £9 000 to cover the estimated expenditure for plant, mains, &c., and a further £2 000 to cover prospective expenditure on distributing mains and services during the next two years.

The connection of the CHESTER electricity supply system with the generating station, H.M. Factory, Queensferry, having been completed, the scheme was formally inaugurated by the Mayor, Ald. W. H. Griffith on Friday last. Connection between the generating plant and the distribution system is made by overhead transmission lines, with the features of which we propose to deal in next week's issue.

Representatives of the three electricity schemes submitted for the AIRE AND CALDER VALLEY meet the Electricity Commissioners in London last week, for the purpose of discussing measures for the effective co-operation of the three bodies concerned, which between them generate all the electricity used in the area. The scheme adopted by the Commissioners is not dissimilar from that proposed by the Leeds Corporation.

At a meeting of DOVER Electricity Committee on Monday, it was reported that the revenue return for the year ended Sept. 30 showed an increase of £660 on the corresponding quarter of 1920. The Electricity Commissioners have sanctioned the following loans: for mains and services, £4 000 (repayable in twenty-five years); for the extension to St. Margaret's and the South Foreland lighthouse, £3 600 (for twenty-five years); transformers, &c., £400 (for twenty years).

The London County Council has agreed to lend £2 000 to HACKNEY Borough Council for the electric lighting of the roads across Hackney Marsh. The amount, which includes £1 664 for cable work and switchgear, and £336 for posts and lanterns, is to be repaid within twenty years. The Borough Electrical Engineer reports that by means of direct labour and the use of the Borough Council's own transport system a saving of £1 548 has been effected in the last six months in dealing with the disposal of clinker and boiler ashes.

The Slough and Datchet Electric Supply Company have intimated to BURNHAM Parish Council that they do not at present see their way to extend their cable to Burnham. The Council have, therefore, decided to write to the Local Government Board to see what steps could be taken through the Slough and Datchet Company acquiring the rights of supply and refusing to use them. It was agreed to give notice to the company of the action they were going to take.

Mr. W. T. KERR, electrical engineer to Hereford City Council, has arranged to form a company to purchase the BEACHELY power station and to run a transmission line from Chepstow up to Lydney, and to erect a ring-main in the Forest of Dean, coupling the transmission line from Hereford to Lydbrook to the same, thus connecting two power stations and ensuring a continuity of supply. The Electricity Commissioners are prepared to grant the company a Special Order for the area.

The recommendation contained in the annual report of SOUTHPORT Electrical Engineer that orders should be placed now for new plant to be ready for 1923, was criticised at last week's meeting of the Council. The chairman, however, pointed out that the engineer was thoroughly overhauling the undertaking, especially in regard to the plant capacity. A further report was being prepared, and if any new plant in the shape of a stand-by were needed a recommendation would be brought forward. The annual report was "received," but not approved as was at first proposed.

New Schemes and Mains Extensions.

WORTHING Town Council are to apply to the Electricity Commissioners for permission to borrow £17 000 for additional plant for the electricity undertaking for next winter.

Sanction has been received by HEREFORD City Council for a loan of £8 550 (including £2 000 prospective expenditure) for new mains and services, repayable in twenty-five years.

J. & P. COATS, LTD., have received permission from the local Dean of Court to erect a power station, consisting of a power-house 150 ft. by 65 ft., a boiler-house 90 ft. by 55 ft., and a pump-house 52 ft. by 36 ft.

LANGHOLM Lighting Committee has been instructed by the Council to inquire and report as to an electricity scheme for the town. The subject was being investigated in 1914, but had to be abandoned on account of the war.

The recommendation of RATHMINES and RATHGAR Lighting Committee to extend the electricity undertaking by the installation of a 750 kW steam turbine, at an estimated cost of £30 000, was adopted at a meeting of the Urban Council last week.

Candidates for vacancies on the BANFF Town Council were "heckled" last week concerning the proposed electricity scheme for Banff and Macduff, which is estimated at £20 000. It is a vexed local question whether the scheme should be proceeded with before a new town hall is acquired.

CHESTER Corporation are applying to the Electricity Commissioners for a Special Order to extend the area of supply under the Chester Electric Lighting Order, 1890, so as to include the Hoole Urban District and parts of the Chester and Tarvin Rural Districts, &c.

EAST GRINSTEAD Urban Council are making progress with the electric lighting scheme, and specifications for the works have been ordered, these to comprise adaptation of the brewery buildings and

alterations to the refuse destructor building, for the purpose of the generating station.

FRASERBURGH Town Council have referred to the Streets Committee proposals for an electric lighting scheme, one of which (T. C. Smith, Ltd., Aberdeen) is for £8,000, which would cover the cost of cable and mains, but not the cost of fittings for street lighting, &c. Another proposal (from Macnochie Bros., Kinnaird) is also being discussed.

SEAHAM HARBOUR Urban District Council are considering the advisability of supplying electricity for public and private consumption, and Mr. Dawson Martin, A.M.I.E.E., has been called in to give his views on the matter. The Council are to get together further particulars, and, if necessary, a public meeting will be held to get the support of the public in regard to the scheme.

Satisfactory arrangements have been reached by TORQUAY and NEWTON ABBOT Councils with regard to electricity supply for their respective districts. Newton Abbot will purchase the local electricity from Edmundsons Electricity Corporation, but it is understood that Torquay will be responsible for some of the capital. The works will be extended so that electricity supply in bulk will be furnished in Torquay. Newton will be supplied with current at 10d. per unit, the same as Torquay, which is a reduction of 2d. on the present charge.

Alteration of Charges.

NORTHALLERTON ELECTRIC LIGHT & POWER COMPANY has reduced the charge for public lighting from 7s. 6d. to 7s. 3d. per lamp per 100 hours.

WEST BROMWICH Town Council have adopted the recommendation of the Electricity Committee to reduce the price of current used for power by 12½ per cent.

DUMFRIES Electricity Supply Company, Ltd., have applied for an Order to charge 1s. per unit, with a minimum payment of 15s. for each of the winter quarters, and 10s. for the summer quarters.

SALFORD Town Council has decided to reduce the price of electricity by 15 per cent. as from Jan. 1. The new charges will be 75 per cent. above pre-war rates for lighting, and 100 per cent. for power, heating and bulk supply.

Owing to the high price charged for gas, WICKLOW is preparing a scheme for supplying the town with electricity. The boycott of the gas supply by tradesmen and private users, which commenced on the 28th ult., still continues.

The price of electricity in LIVERPOOL, for both lighting and power purposes, is to be reduced early in the New Year. Negotiations are in progress for the transfer of the BOOTLE Corporation's electricity undertaking to the Liverpool Corporation.

SCARBOROUGH Electric Supply Company is seeking powers from the Electricity Commissioners for an order enabling them to charge (1) in respect of the two winter quarters for any amount up to 15 units 15s., for each unit over 15 units 1s.; (2) in respect of the summer quarters, up to 10 units 10s., and for each unit over 10 units 1s.

EXMOUTH Urban Council have refused the application of the Electric Supply Co-operation for a revision of the agreement made with the Council. The maximum rate of charge authorised at present is 8d. per unit, and the company maintain that they cannot continue to meet the demand for additional supplies unless they are in a position to increase their plant and extend the mains.

Electric Traction.

GLASGOW Corporation has decided to purchase the Airdrie and Coatbridge tramway undertaking at £82,000.

SALFORD Tramways Committee has recommended the Council that trolley boys should no longer be employed on its cars.

The proposal to run trams through Prince's and Sefton Parks was rejected at a meeting of LIVERPOOL City Council last week by 55 to 50 votes.

GLASGOW Corporation have approved, without any discussion, Part II. of the Corporation Order dealing with the extension of the tramway system, &c.

WARWICK Corporation have complained to LEAMINGTON of the noisy tramscars between the two towns, and suggest that the two Corporations make joint representation to Board of Trade.

BELFAST Tramways Committee have promised to consider the question of obtaining legislation to lay tramways in the Dufferin-road for the accommodation of the workers in Workman, Clark & Company's yard, and for the extension of the Queen's-road tramway to the Deep Water Wharf.

A conference of all the municipal tramway authorities of the country, convened by the Municipal Tramways Association, last week passed a resolution in favour of a FORTY-EIGHT HOUR WORKING WEEK, and supporting the suggestion of its representatives on the N.I.C., that the terms of the agreement of March, 1919, be revised.

BRIGHTON Town Council are again considering the advisability of reducing the tramway fares. Since the introduction of the minimum charge of 2d., there has been a persistent falling-off in traffic each week. The total receipts for the last nine months only amount to £4,000. Penny fares have been revived on the motor-bus routes.

Mr. A. R. Fearnley, of Sheffield, who advised BLACKBURN Corporation on their tramway undertaking, states that the whole concern is in first-class condition, and that the rolling stock is probably

not beaten by any tramway in the country. He suggests minor alterations, and recommends there should be through running cars between various routes.

Northfield's opposition to the Birmingham City Council's proposal to WIDEN THE BRISTOL-ROAD and construct lines of tramways is very strong. There are 1,438 signatures to a petition against the scheme, and this petition sets forth an alternative scheme which would leave the Bristol-road undisfigured, and, it is claimed, would offer many material advantages.

BIRKENHEAD Tramways Committee is appealing to the Town Council to abandon an unemployed relief scheme already sanctioned for the reconstruction of the tramway track, at a cost of £100,000. Since the approval of the scheme the Committee has discovered that the borrowed money must be repaid in eight years, and it is considered that the annual expenditure would be too great for the ratepayers.

Mr. A. R. Fearnley, general manager of Sheffield tramways, has submitted a report on his examination of CHESTER tramway system, in which he states that there is no reason why the undertaking should not continue for the next seven or eight years to give a satisfactory service without any great expenditure. The work which requires putting in hand could, he states, be met out of existing renewals, which in March last amounted to £17,539.

At the instance of the Streatham Ratepayers' Association, the need for an extension of the City & South London Railway has been considered by the WANDSWORTH Borough Council Highways Committee, who recommend that the company be asked to extend the present terminus at Clapham Common by a line to Tooting, Streatham, and Southfields, and that a communication be addressed to the Ministry of Transport urging the desirability of these extensions being carried out.

The question of extending the BRADFORD City tramways from the terminus at Bailiff Bridge to BRIGHOUSE is being discussed, but no decision has yet been reached. At present Brighouse is being served by the Halifax Corporation. The Brighouse and Hipperholme authorities have a right of purchase, which expires in February next, and they have expressed their desire to purchase on arbitration terms the metals and overhead equipment between Brighouse and Bailiff Bridge, with a view of eventually transferring them to the Bradford Corporation so that the latter could run a through service from Bradford to Brighouse.

TORRINGTON Rural Council have re-affirmed their decision of a few years ago to advance £12,000 towards the cost of constructing the TORRINGTON-HALWELL LIGHT RAILWAY, though it was only by the casting vote of the chairman that the offer was re-affirmed. A meeting is being called by Devon County Council Finance Committee of all the local authorities interested in the project. Torrington Town Council are expected to support the scheme, but Barnstaple Employment Committee are disappointed with the replies so far received from the various Councils in North Devon. As the result of a meeting at Okehampton several hundred pounds were promised by private investors.

The ISLINGTON Borough Council proposes to borrow £8,237 for the purchase of four 2½ ton electric dust vans and the necessary charging apparatus. Of this amount £6,100 is for the vans, and the London County Council will lend it for five years, but a period of fifteen years is allowed for repaying £2,137 required for the charging plant. It will be recollected that in March last the Borough Council borrowed £57,110 for eleven mechanically-propelled vehicles for street watering and refuse collecting, together with the requisite charging plant and garage accommodation; and it is now stated that, as the result of the experience gained, one motor replaces two horse-drawn vehicles for dust collection, and four horse-drawn vehicles for street-watering purposes. A reduction of costs has been effected by the use of motor vehicles. The new vans will be fitted with storage batteries capable of running thirty miles per charge on level roads, and the charging station will contain two 40 kW motor generators.

Business Items, &c.

HIGGS BROS. announce that they are opening an office at 3, York-street, Manchester, in addition to their Birmingham and London offices.

MESSRS. J. H. HAWKINS and C. M. HALLAHAN have opened an electrical department in connection with their business at 58, High-street, Aylesbury.

The address of the SOUTH AFRICAN INSTITUTE OF ELECTRICAL ENGINEERS is now 94, Cullinan-building, Simmonds and Main Streets, Johannesburg.

The YORKSHIRE ELECTRIC POWER COMPANY's head office has been removed to 36 and 37, Park-place, Leeds. Telephones, 24 578 Leeds. Telegrams, Yepower, Leeds.

Spensers, Ltd., has now become the SPENSER LIGHT COMPANY, 6, London-street, Paddington, W. 2. The partners are Messrs. H. Ellwell Smith and Kenneth Smith.

HUBBER & SON announce that the business of the late Mr. Frank Hubber, electrical engineer, of 85 and 86, South-street, Exeter, will be continued by them, with Mr. Walter H. Hubber as manager.

W. H. ALLEN, SONS & COMPANY, LTD., Queen's Engineering Works, Bedford, have appointed Mr. HARRY ASTBURY, A.M.I.E.E., of Empire House, 159, Great Charles-street, Birmingham, as their representative for the Birmingham district.

Personal and Appointments.

Mr. W. DAVEN has been elected president of the Birmingham and District Electric Club for the ensuing year.

PROF. H. B. DIXON has intimated his intention to retire from the Sir Samuel Hall Chair of Chemistry at Manchester University at the end of the present session.

The marriage took place at Cambridge, on Saturday, of Mr. W. L. BRYAN, Professor of Physics in the University of Manchester, and Miss Alice Hopkinson, of Cambridge.

Mr. H. F. CARLILL, assistant secretary of the Power, Transport and Economic Department of the Board of Trade, has succeeded Mr. J. G. WILLIS, C.B., as inspector-general in bankruptcy.

The list of successful candidates who passed the October examination for the A.M.I.E.E. shows that eight passed the whole examination, and two passed Part II. only. Thirty-seven officers for the Royal Engineers passed the entire examination, thirteen passed in Part II., and five in Part I.

Mr. W. BROWN, late resident engineer of the North Metropolitan Electric Power Company at Barnet, has been appointed H.M. Electrical Inspector of Factories, with headquarters at Leeds. Capt. R. M. MOSERLEY, of St. Albans, has been appointed to succeed Mr. Brown at Barnet.

The King has approved the granting of the following Honours on the termination of the post-war work of the Ministry of Transport: *Baronetcy*: Sir Robert Francis DUNNELL (Secretary of the North-Eastern Railway Company), who acted as Secretary and Solicitor to the Ministry during the war. *Knighthood*: Mr. Henry A. H. Steward (Principal Light Railway Commissioner).

M. GEORGES CLAUDE, the inventor of the Claude process of synthetic ammonia, has been awarded the Prix le Conte of 50 000 frs. (£1 000) by the French Academy of Science. He has, however, refused to accept the reward, and has requested the Academy to devote 25 000 frs. to the Société de Secours des Amis des Sciences and 25 000 frs. to the research laboratories of the College of France.

We announced last week that Mr. D. H. DAVIES, manager of the Heywood Corporation Electricity and Tramways Department, who had been appointed assistant general manager of the Chesterfield Corporation Electricity, Tramways and Motor-bus Department, had decided to remain at Heywood at an increased salary. According to a writer in the "Yorkshire Telegraph and Star," Mr. Davies has decided after all to go to Chesterfield.

HACKNEY BOROUGH COUNCIL have appointed Coun. C. W. JACKSON (chairman of the Electricity Committee), Ald. H. MORRISON, Coun. G. A. HASMER, and Mr. L. L. ROBINSON (Borough Electrical Engineer) as representatives of the Council on the Conference of Local Authorities owning Electricity Undertakings in Greater London. They have also appointed Coun. JACKSON, Aldermen S. BEVEN, and W. J. T. THOMAS, and Mr. L. L. ROBINSON as their representatives on the Wages Conference of local authorities.

Members of the ELLIOTT CRICKET CLUB (Elliott Bros. (London), Ltd.), held their annual dinner on Saturday evening at the Sydney Arms, Lewisham. In the absence, through illness, of the president, Mr. L. W. SMITH, the chair was occupied by Mr. R. O. SMITH, a vice-president of the club. During the evening the Friendly Team prizes were presented by Mr. R. O. SMITH. The Batting Prize (a Phillip Mead bat, presented by Mr. L. W. SMITH), had been won by Mr. H. MITCHELL, while the Bowling Prize (a ball, suitably inscribed and mounted, presented by Mr. R. LAWLER), had been won by Mr. D. S. GREIG. A musical programme followed.

Wireless and Telegraph Notes.

CHINA has adhered to the International Telegraph Convention.

To enable CHILE to correspond with the principal European and American stations, the Government is accelerating the installation of wireless stations in various parts of the republic.

A Reuter's message from Washington states that the Subcommittee on Drafting has adopted the tentative plan presented by Mr. Root for dealing with the question of WIRELESS INSTALLATIONS IN CHINA.

Addressing some 200 students of the Applied Sciences Department of Birmingham University last week, Senator MARCONI said he thought that shortly it would be necessary to separate wireless telegraphy from general electrical engineering, and to found a CHAIR OF WIRELESS TELEGRAPHY.

Messages from the P.O. station at LEAFIELD, working on low power pending the completion of the corresponding station in Egypt, are being received in Australia. According to a message from Sydney, the morning newspapers in Australia are publishing news dispatched from Leafield which has been picked up by the Perth Wireless Station.

The two schemes for DIRECT WIRELESS communication between AUSTRALIA and GREAT BRITAIN have been referred to the Special Committee of the Senate and the House of Representatives, and Mr. Hughes has been authorised to sign the agreement, subject to the report of the Committee, without further reference to Parliament.

The first SWEDISH wireless telegraph station for navigation was officially opened at Vingra, off Gothenburg, on Nov. 15. Three other similar stations are being planned. The Swedish Government have approved proposals, made by the Swedish Pilotage Board, for

co-operation between countries on the North Sea and the Baltic in regard to ice signalling by wireless.

The agreement between the UNITED STATES and JAPAN as to the island of Yap includes the following terms:—

The United States will have free access to Yap for cable landing on an equality with Japan and other nations. The United States and its nationals will enjoy the same rights as Japan in regard to radio communication, but as long as Japan maintains an adequate radio station on Yap the right of the United States to build a station is suspended. There is to be no censorship of cables or radio communications, and Japan agrees to exercise the power of expropriation to help the United States to get property for cable stations and other purposes if the United States is unable to secure it otherwise.

Institution Notes.

Mr. J. S. Highfield addressed the members of the LIVERPOOL SUB-CENTRE of the INSTITUTION of ELECTRICAL ENGINEERS on Monday, and outlined the advantages gained by the Institution from the grant of the Royal Charter. He also pointed out the great use that centres and sub-centres could be in guiding the Council in their efforts to keep the Institution flag flying. A lecture by Dr. S. P. SMITH on "Single and Three Phase Commutator Motors, with Shunt and Series Characteristics" followed.

We are glad to learn that, after allowing for interest on the purchase price of £85 000, amortisation of lease, maintenance, &c., the monthly accounts of the ENGINEERS' CLUB show a satisfactory and increasing net profit. The Committee points out that many things have still to be done before the club approaches the ideal of comfort at which they are aiming. Members can help towards this end by subscribing to the Club debentures, which are issued in multiples of £25, and bear interest of 7 per cent., free of income tax. These debentures are redeemable at twelve months' notice at 102 per cent.

Senator MARCONI delivered his presidential address to the members of the BIRMINGHAM and MIDLAND INSTITUTE at the Town Hall last Friday. There was a crowded attendance. Recent developments and experiments which he had lately been engaged upon on board his yacht the "Elettra," with new apparatus, led him, he said, to anticipate that it would be possible in the near future to achieve commercial Transatlantic wireless telephony with much less than 1000 H.P., because the new apparatus sifted out, as it were, the transmitted signals, which were of regular wave lengths, from the other natural disturbances, which consisted of all kinds of irregular impulses and waves, and which, arising in the atmosphere or elsewhere, also affected the receiving apparatus. Much greater progress had been made than was realised in the utilisation of wireless telephony for industrial needs, although, he regretted to say, that its practical application was taking place in countries other than England.

Educational.

An appeal for £250 000 has been issued by the UNIVERSITY COLLEGE of SOUTH WALES and MONMOUTHSHIRE.

The ROYAL TECHNICAL COLLEGE, GLASGOW, have issued their annual report on the 125th session. Over 1300 students enrolled for the electrical engineering classes, and 51803 hours were worked. Preliminary experiments with the new oscillograph recently purchased for the department are said to have given interesting results, and additional apparatus for use in conjunction with the oscillograph has been made in the department, with the object of facilitating the obtaining of records of transient phenomena. Mr. J. F. E. FARRELL and Mr. G. SHEARER have been appointed assistants in this department in succession to Mr. O. M. SALZMANN and Mr. J. CARNEGIE. Mr. H. S. N. SHARP has been appointed an additional assistant.

Exhibition Notes.

At the forthcoming BRITISH EMPIRE EXHIBITION awards (divided into five grades) will be given to exhibits of special merit in electrical, mechanical, mining and metallurgical plant and machinery, and also for town planning, lighting, heating and ventilation, &c.

Owing to a fall in prices since the original estimates for the building of the BRITISH TRADE SHIP, the Board have reduced the cost of space by 33½ per cent. This reduction also applies to the cost of sending a representative of the firm on tour in the ship itself. The reduction will be retrospective. The terms for exhibiting are reduced from between £2 100 and £1 350 for stalls, to £1 400 and £900 respectively. The cost of showcases and counter cases is similarly reduced to an average charge of about £400.

Obituary.

The death took place on Monday, at Anerley, London, of Mr. G. W. TALBOT, Postmaster-General and Director of Telegraphs, Birmingham.

We regret to announce the death of Mr. JOHN GIBSON, which occurred very suddenly on Friday last in London from cerebral hemorrhage. In earlier days Mr. Gibson was connected with ERNEST SCOTT & MOUNTAIN, Newcastle-upon-Tyne, and HOLDEN & BROOKE, Manchester, but for the last fifteen or sixteen years he was prominently associated with the supply business of the METROPOLITAN-VICKERS ELECTRICAL COMPANY, and was a director of the "Cosmos" Lamp Company.

Tariff and Custom Changes.

Exemption from so much of the Customs duty leviable thereon as is in excess of the duty leviable on machinery under Part 3 of the Second Schedule to the INDIAN TARIFF ACT is now granted in the case of switchboards (if for use on high-pressure circuits); oil switches and oil circuit breakers; motor starters and controllers (except in connection with any kind of road vehicle, lifts, &c.); regulators and rheostats; transformers, static converters, and static condensers of 3 kVA capacity or over.

The arrangements for the repayment of the levy under the GERMAN REPARATION (RECOVERY) ACT have been amended. The rate of exchange at which the levy on goods invoiced in German currency is payable to the Commissioners of Customs and Excise is that prevailing at the date of the importing ship's report. The German Government will pay to the exporter (in German currency) the value of the reparation levy, and they will make re-imbursement in respect of all United Kingdom Customs' receipts for levies paid since the Act came into force (i.e., all levies paid on goods imported into the United Kingdom either before or after May 12, 1921). The firm named on the Customs' receipt as the consignor should transmit the receipt in original to the Peace Treaty Account Department Company (Limited), Am Weidendamm 14, Berlin, N.W. VII., together with a written statement containing particulars of the country of issue, date of receipt, total value of consignment, nature of goods, consignee and desired method of payment.

The following items show the increased PREFERENCE for BRITISH goods under the new tariff provisionally adopted by the New Zealand Parliament on Nov. 3. Electric lamps of all sorts formerly paid 10 per cent. British and 20 per cent. foreign. The new rates on incandescent bulbs are 1d. per bulb (foreign 2d.) on bulbs not exceeding a power consumption of 1 W.; 3d. per bulb (foreign 6d.) on bulbs from 1 to 70 W.; 6d. per bulb (foreign 1s.) from 70 to 150 W.; and proportionate rates for higher power consumption. Electric lamps not elsewhere included (not peculiar to surgical use) still to pay 10 per cent. if British, but the foreign rate is increased to 30 per cent. Electric generators, motors, and transformers now pay 10 per cent. (foreign 20 per cent.), while switchgear, controllers, and other unenumerated appliances pay 20 per cent. (foreign 30 per cent.). In view of the extensive development of water power in the Dominion machinery or appliances required for the generation of electricity will be free from June 1 next, while foreign will pay 10 per cent. Electric transformers, motors, starters, switchgear, electric furnaces for chemical purposes or for treating metals, and various other specified electric appliances of British make will also be free from June 1.

Foreign Notes.

GERMANY is stated to be doing good business in electrical material with China. Among the many orders obtained is a telephone installation at Tsinanfu.

Work on the TATA hydro-electric scheme, near Poona, has again been postponed, owing to the continuance of the passive resistance tactics of the inhabitants.

The SWEDISH GENERAL ELECTRIC COMPANY has obtained a concession for the erection of a factory for the manufacture of electrical material in Taroslov, Russia.

ROME Municipal Council has approved a project for utilising the famous waterfalls at Tivoli for generating electricity. It is said that this will result in the destruction of the falls.

On Dec. 29 the JAPANESE INDUSTRIAL MISSION will study the Underground Railway System, and on Jan. 2 will pay a visit of inspection to Paddington Station and the Swindon Works of the Great Western Railway.

Successful tests have been carried out on the Ljungstrom Steam Turbine Company's TURBO-CONDENSER LOCOMOTIVE in Sweden. A speed of 90 kilometres per hour was attained with a heavy train. It is claimed that the new locomotive effects a saving of 50 per cent. in fuel.

The ALABAMA POWER COMPANY has obtained a lease of the Government 60 000 kW plant at Sheffield (Alabama) for one year. On Nov. 10 the company's system carried 100 200 kW, producing 1 650 000 kWh. Operation on the Government plant is expected to start early this month.

A number of HYDRO-ELECTRIC CONCERNS have formed a group for the purpose of establishing a great system for the distribution of electricity in the south-east of FRANCE and the Massif Central. The group has taken the name of Société de Transport d'Énergie du Centre, and has its headquarters at Saint Etienne.

The A. E. G. (Allgemeine Elektrizitäts Gesellschaft) has shared in the boom of the German electrical industries. The company has secured the controlling interest in seven other big concerns. The capital, fully paid, is now 850 000 000 marks, and the profit on the year's trading was 247 720 753 marks, the dividend on the ordinary shares being 16 per cent.

DUTCH ELECTRIC LAMP manufacture is holding its own, for although the export of such lamps shows a decrease this year the decline is less than that in most articles. Actually, the exportation of these lamps forms the largest item of manufactured goods exported from the Netherlands, and for the first seven months of 1921 reached a value of 4 320 473 dollars. (U.S. Consular Report.)

In the town of Titiribi, in COLOMBIA, where the famous gold and silver mines of "Lancudo" are situated, a new hydro-electric plant has been installed for lighting and power. The equipment, the "Columbian Trade Review" states, consists of a Pelton wheel working at a net head of about 300 ft., and capable of driving two alternators 50 kW each, 2 200 V. The current is transformed down to 110 V, the standard used in Colombia for domestic lighting. For this kind of plant there is a growing demand.

The prolonged drought north of the Apennines and the Po valley has had a serious effect on the supply of electrical power in ITALY, which in the north, is drawn chiefly from water-driven turbines. The hours of work have been reduced in many factories, and if the present weather conditions continue the factories will have to close altogether. There is even under consideration the advisability of stopping the electrically-operated railways and returning temporarily to steam traction.

A Tientsin merchant has petitioned the Chinese Ministry of Agriculture and Commerce for approval to form a company for the construction of TRAMWAYS BETWEEN PEKING AND TIENSIN. An electric plant will be installed at Hwailai, and power will be generated from the Yungting River. It is expected that electricity will also be supplied from this source to the factories en route. The Fu Sin Electric Company of Shen Tseh, Kiangsu, and the Changsu Electric Company of Changsu, Kiangsu, have been registered by the Ministry of Communications.

Imperial Notes.

The Electrical Section Committee of the South African Branch of the British Engineering Standards Association recommend the adoption in South Africa of the BRITISH STANDARD ELECTRICAL PRESSURES for new systems and installations.

A meeting of citizens of GRAFTON and SOUTH GRAFTON (N.S.W.) recently passed a resolution expressing regret that the Government cannot at present supply the money for the Nymboida hydro-electric scheme, and asking if the Government would carry it out if the money is loaned, and make provision for local control by the local governing bodies or local boards through the medium of the Grafton and South Grafton Councils.

COMMONWEALTH CABLES, LTD., is the name of a new company in New South Wales, with a nominal capital of £200 000, of which 10 000 £1 deferred shares are to be allotted to the vendors and promoters (Messrs. C. A., W. G. and H. Gibson and J. J. Hughes) as consideration for the transfer of the company of an agreement with the Postmaster-General for the supply of telephone cables. The objects of the company include the manufacture of cables and insulated wires for electrical work. It is stated that the vendors and promoters have already a contract for cable amounting to £217 606.

With the completion of the Chippewa Canal the HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO will have a total investment of \$210 000 000 in plant established or acquired since the cheap power enterprise was begun. The Niagara system is the principal unit, but the Commission now operates fourteen systems in various parts of the Province from Port Arthur to Ottawa and back to Windsor. When the Chippewa and Ranney's Falls power developments are in service, the Commission will, the "Canadian Gazette" states, have in these fourteen systems twenty-three hydro-electric plants, with a total capacity of 1 000 000 h.p., serving every one of the twenty-two cities in the Province except Sault Ste. Marie. The report for the year ended Dec. 31, 1920, shows that the Niagara system has had great success. The total of 125 municipalities in this system had a revenue of \$7 982 614, while the operating expenses were \$6 561 107. After allowing for a depreciation of about \$770 000, the net surplus was over \$660 000, and the accumulated surplus amounted to \$2 726 904.

Forty Years Ago.

(THE ELECTRICIAN, DECEMBER 17, 1881.)

ELECTRICITY v. SMOKE.—Dr. D. J. Lodge was announced to deliver a lecture on the above subject last Thursday night at the London Institution.

ELECTRIC LIGHT IN TRAINS IN FRANCE.—The French are close on our heels with the introduction of the electric light into trains. We hear that a train running between Paris and Soissons, on the 7th of this month, was lit up by the electric light, this being the first experiment of the kind in France.

ELECTRIC LIGHTING AT THE MANSION HOUSE.—Mr. Crompton is getting on with his arrangements for lighting the Egyptian Hall and Saloon in the Mansion House with a combination of his arc and the Swan incandescent lamps, and it is probable that in another week or so the lighting will be begun. The fittings of the chandeliers and lamps have been specially designed for the occasion, and will all be stamped with the City Arms.

LIBRARY OF THE SOCIETY OF TELEGRAPH ENGINEERS.—The energetic librarian of this society has a goodly list of accessions to show, which have been obtained during the past year. He has also prepared an Index to the Journal of the Society, and to the Specifications of Patents, which, writing as we necessarily do before the annual meeting, we trust will be welcomed by the Council and members as they deserve. Such an index is of great importance and value.

Miscellaneous.

The Chamberlain of the Exchequer has decided to allow arrears of EXCESS PROFITS DUTY to be paid by instalments over a period of five years.

S. SAMUEL DAVIDSON, founder and chairman of Davidson & Company, engineers and mounters, and of the Success Engineering Works, Belfast, has left estate valued at £185 818.

The A.E.U. is recommending its members to vote for the agreement on freedom of management and overtime, recently provisionally arrived at with the Engineering and the National Employers' Federations.

A SWISS AGENT at Zurich desires to represent on commission British manufacturers of various metals, including galvanised sheets and ELECTRICAL SHEETS. Particulars from the Department of Overseas Trade. Ref. No. 512.

The salaries of officials of various trade unions have recently been criticised by their members, and we learn that the officials of the London district of the ELECTRICAL TRADES UNION have voluntarily accepted a reduction of 20 per cent.

The Home Secretary has issued draft regulations to ensure the safety of workmen engaged in building operations in which MACHINERY WORKED BY MECHANICAL POWER is used. Objections may be sent to the Factory Department, Home Office.

A British electrical engineer, experienced in the ARGENTINE MARKET, desires to represent on commission British manufacturers of d.c. motors from $\frac{1}{2}$ to 50 H.P., a.c. motors from $\frac{1}{2}$ to 100 H.P., farm lighting, &c., cables and wires, &c. Particulars from the Department of Overseas Trade. Ref. No. 516.

Speaking at a Livery dinner of the Paviers' Company last week, Mr. Deputy Neal said that the Company was taking steps to found a CHAIR OF ENGINEERING at the University of London. It was only a question of time. A grant from the Treasury and the Company's contribution would suffice to establish the Chair.

NEWCASTLE City Council have decided, by forty-five votes to seventeen, to rescind a resolution of February, 1919, fixing the working week of employees at forty-four hours. This affects the tramwaymen, who recently resolved to resist by "every means in their power" any proposal to increase the working week.

In the newly opened steel foundry of Sutherland, Ltd., at BELFAST, the smelting is effected by electricity. Current is supplied from the Corporation mains at 6,000 V, and the furnace has a capacity of 30 cwt. After the opening ceremony, Mr. T. D. Robertson, of Electro-Metals Ltd., which built the furnaces, read an interesting Paper on "Electric Steel."

Invitations to firms to renew their undertakings under the KING'S NATIONAL ROLL for the employment of ex-Service men will shortly be issued by the Local Employment Committees, and renewals for a further period of two years are asked for. According to a new regulation, an employer is entitled to count in his quota any ex-Service man still in his employment who was in receipt of a disability pension at some time or other while employed by him, but who has since ceased to receive the disability pension.

The Boards of Directors of the City & South London, Central London, London Electric, Metropolitan District Railway Companies and of the London General Omnibus Company have decided to recommend the stockholders to vary the division between the companies of the COMMON FUND, established under the London Electric Railway Companies Facilities Act, 1915. In future, the Central London will get 16 instead of 20 per cent., and the London Electric 41 instead of 30 per cent. These revisions take effect from July 1, 1921.

During the year 1920, 11,011 NEW COMPANIES were REGISTERED in the United Kingdom, with a total nominal capital of £593 189 032. Of the total number, 9 581 were registered as private companies. The 1920 figures exceeded those of 1919 by 286 and £180 221 828 respectively, and those of 1920 were considerably larger than those of any year since the Companies Acts, 1862, came into operation. Winding-up proceedings were begun in 3 158 cases, 3 031 voluntary, eight voluntary subject to the supervision of the court, and 119 compulsory, including eight cases not registered under the Companies Act.

A new District Committee, composed of one delegate from each of the ninety-nine London branches of the ELECTRICAL TRADES UNION, has been appointed to succeed the London Committee which was recently suspended by the Executive Council of the Union. This new committee will meet the Executive in a few days, when it is expected the position will be regularised. Mr. Webb, the London secretary, has decided not to answer the charges recently made by the Executive Committee, but he claims that they have an unanswerable case, which will be made known to the members if necessary.

The proposed NAVAL HOLIDAY programme will, if adopted, seriously affect several Swansea industries. Not only will the MANNESMANN TUBE WORKS at Landore be involved, but the nickel and copper works also, to a considerable extent, depend on Admiralty and foreign naval orders. One of the officials of the Mannesmann Tube Company states that the Navy cut will have a very serious effect on the British tube industry. A tremendous amount of tube tonnage is put into warships, and the Landore works, for example, have been engaged at one time on work for the British Navy, and the Japanese, Chilean, and Greek Navies in addition.

Under the name "THE BTFX BOOK" the Business Telephone Directories, Ltd., have issued, with the authority and co-operation of the Post Office, a CLASSIFIED LONDON TELEPHONE DIRECTORY,

containing complete classified lists of commercial and professional subscribers to the Post Office London Telephone Exchange System. A classified list of seaside and country hotels is also included.

The electrical section, which occupies ten pages, and is under fifty-six classified headings, will be particularly appreciated by our readers. The price of the volume is 2s. 6d. (by post 3s. 6d.), but a copy is delivered free to every subscriber to the London Telephone Exchange System.

LICENCES OF RIGHT have been granted to E. C. R. Marks (Sparks, Withington & Company) in connection with patents 115 679 (6 867/17), 117 838 (10 952/17) for "improvements in electrically-operated diaphragm horns"; to J. Y. Johnson (Badische Anilin und Soda Fabrik) for "improvements in means to be employed in the production of long stable electric arcs" (Patent No. 22 715/09); to S. C. Cary, for improvements relating to electric welding (Patent No. 118 138 (11 511/17); to the K.-W. Ignition Company, for improvements to connections or connectors for electric conductors (Patent No. 118 083 (1894/18), and for improvements relating to circuit breakers for ignition systems (Patent No. 118 084 (1895/18); to S. J. Withers (The Hart & Hegeman Manufacturing Company), for improvements in electric snap switches (Patent No. 119 689 (14 557/17).

In an article on the glassware industry in the "Times Trade Supplement," a correspondent points out that German 12 in. opal shades for indirect lighting are on sale in this country at 13s. a dozen, whereas the British labour costs alone are to-day 11s. 3d. to 4s. reduce to 5s. now that the mark hovers round 1000 to the pound. The British price is 60s., included in which are labour costs 20s.; materials, 25s. On the same process of calculation the German 16 in. shade could be sold at 14s. or 15s., whereas the British price is 156s. For fancy decorated shades the London importers' price weeks ago for the foreign article ranged from 12s. to 6s. per dozen, whereas the British labour alone are to-day 11s. 3d. to 4s. according to quality, and we are not able to put on the market anything in this line at less than 13s. 2d. Calculating 360 crowns to the pound, Czechoslovakia can dump here half opal globes at 4s. 6d. per dozen against our price of 7s. 9d.

Books Received.

"Electrodeposition and Electroplating." (Discussion before Faraday Society.) Pp. 83. 10s. 6d.

"Electric Clocks and Chimes." (London: Percival Marshall & Company.) Pp. 159. 3s. 6d. net.

"Betriebsverfahren." By Ludwig Fischer. (Berlin: Carl Heymanns Verlag.) Pp. iv.+59. 8 Marks.

"The French Polisher's Handbook." By "A Practical Man." (London: Percival Marshall & Co.) Pp. 114. 2s.

"Modern Gasworks Practice." By Alwyne T. Meade. (London: Benn Brothers.) Pp. xi.+815. Second edition. 55s.

"Hardening and Tempering Engineers' Tools." By G. Gentry. (London: Percival Marshall & Co.) Pp. 61. 9d. net.

"Applied Calculus." By F. F. P. Bisacre, O.B.E., M.A. (London: Blackie & Son.) Pp. xiv.+446. 10s. 6d. net.

"Common Battery Telephony Simplified." By Walter Atkins. (London: Benn Brothers, Ltd.) 4th Ed. Pp. 139. 8s. 6d.

"A First Book of Applied Electricity." By S. R. Roget, M.A. (London: Macmillan & Company.) Pp. viii.+143. 2s. 6d.

"Directive Wireless Telegraphy." By L. H. Walter, M.A. (London: Sir Isaac Pitman & Sons.) Pp. xi.+124. 2s. 6d. net.

"Radiation from Slow Radium and their Therapeutic Value." By J. B. Kramer. (London: Baillière, Tindall and Cox.) Pp. 102.

"The Framework of Wireless Telegraphy." By R. C. Galletti di Cadilhac. (London: Crosby Lockwood & Son.) Pp. 48. 3s. 6d. net.

"Modern Methods of Welding as Applied to Workshop Practice." By J. H. Davies. (London: Constable & Company.) Pp. xviii.+263. 21s.

"Central Station Rates in Theory and Practice." By H. E. Eisenmenger. (Chicago: F. J. Drake & Company.) Pp. xxv.+382. \$2.50.

"Questions and Solutions in Magnetism and Electricity." By W. J. White. (London: "Electricity.") Pp. 108. Second edition. 2s. 6d. net.

"The Making of Reflecting Surfaces." Discussion between the Physical Society and the Optical Society. (London: The Fleetway Press.) Pp. 44. 5s.

"Alternating Currents." By G. C. Lamb. (Cambridge: University Press.) Part I. Pp. viii.+73. 5s. 6d. net. Part II. Pp. viii.+127. 7s. 6d. net.

"Emission of Electricity from Hot Bodies." By O. W. Richardson, F.R.S. (London: Longmans, Green & Co.) Pp. viii.+320. Second edition. 16s.

"A Catalogue of British Scientific and Technical Books." Prepared by a Committee of the British Science Guild. (London: British Science Guild.) Pp. xviii.+376. 10s. net.

"Modern Electrical Theory Supplementary Chapters." Chapter XV. "Series Spectra." By Norman R. Campbell, Sc.D. (Cambridge: University Press.) Pp. vi.+110. 10s. 6d. net.

"Fuel and Refractory Materials." By A. Humboldt Sexton, F.I.C., F.C.S. Revised and enlarged by W. B. Davidson, D.Sc., Ph.D., F.I.C. (London: Blackie & Son.) Pp. 382. 12s. 6d. net.

"Rays of Positive Electricity and their Application to Chemical Analyses." By Sir J. J. Thomson, O.M., F.R.S. (London: Longmans, Green & Company.) Pp. x.+237. Second edition. 16s. net.

Tenders Invited and Accepted.

UNITED KINGDOM.

WEST DERBY GUARDIANS. Dec. 17. Electric supplies, engine packings, &c. Particulars from the Clerk, Brougham-terrace, Liverpool.

EDINBURGH CORPORATION. Dec. 19.—Five months' supply of insulated cables to the Electricity Department. Specifications from the Engineer, Dewar place, Edinburgh.

SHARDLOW RURAL COUNCIL. Dec. 21.—Electric pumping station and purification works in connection with the Little Eaton sewerage. Specifications from Messrs. Elliott & Brown, Burton-buildings, Parliament-street, Nottingham.

BLACKPOOL CORPORATION. Dec. 23.—One 5 000 kW 3 phase, 50 period, 6 600 V turbo alternator (Sec. 1); one surface condensing plant, complete with auxiliaries (Sec. 2); one 2 000 kW phase and frequency changer, 6 600 V, 3 phase, 50 period to 2 200 V, 1 phase, 83 period, complete with exciter and starting motor.

BRADFORD CORPORATION. Dec. 24.—Rotary converting plant (Contract "R. 207"). Particulars from Mr. T. Roles, City Electrical Engineer and Manager, Electricity Offices, Town Hall, Bradford.

THE VISITING COMMITTEE OF PLYMOUTH MENIAL HOSPITAL. Dec. 24.—One 45/50 B.H.P. gas engine, suction-gas plant, and 30 kW dynamo. Specifications, &c., from the Medical Superintendent, at the Hospital, Blackadon, near Ivybridge.

EDINBURGH CORPORATION. Dec. 27.—Fifty-three electrical equipments for tramways. Forms of tender from the Tramways Manager, 2, St. James-square, Edinburgh.

WEST DERBY GUARDIANS. Dec. 28.—Electric light and power installation (including generating plant), electric lift service, and telephone installation at the Walton Institution. Specifications from Mr. E. B. Bailey, 37, Moorfields, Liverpool.

LONDON COUNTY COUNCIL invite applications from firms, and particularly manufacturers, to be placed on the lists of persons or firms from whom the Council from time to time invite tenders for the supply of electrical and mechanical equipment and spares, &c., required for the Council's tramways. Applications for inclusion in the first lists of goods required must be sent in not later than Dec. 31.

BIRMINGHAM SALVAGE AND STABLES COMMITTEE. Jan. 2, 1922.—Contract No. 1 (a) eight-cell destructor in two units; Contract No. 2, electric garage. Particulars from Mr. J. Jackson, Superintendent, Salvage Department, Council House, Birmingham.

DUNDEE CORPORATION.—Electric lighting of public clocks at Broughty Ferry, Lochee, and St. Peter's. Particulars from the City Architect.

AUSTRALIA.

POSTMASTER-GENERAL'S DEPARTMENT. MELBOURNE.—Jan. 17, 1922.—"Supply and delivery of telegraph instruments, differential galvanometers, keys, relays, sounders, &c., to the stores branch. (Schedule No. 1 718.) Local representation is essential.

VICTORIAN GOVERNMENT RAILWAYS. Jan. 25, 1922.—"Supply and delivery of ten coasting recorders, or, alternatively, ten coasting and service recorders, for electric trains. (Contract No. 34 736.)

CITY ELECTRIC LIGHT COMPANY, LTD., BRISBANE.—Feb. 10, 1922.—"Supply and delivery of six miles of three-core 0.15 by 0.15 by 0.15 paper insulated cable, suitable for 5 500 V, with a non-earthed system. Tenders, accompanied by a preliminary deposit of £100, to the Engineer and Manager, Boundary-street, Brisbane.

POSTMASTER-GENERAL'S DEPARTMENT. MELBOURNE. Feb. 14.—"29½ tons Wheatstone tape of various patterns. (Schedule No. 3.) Local representation is essential.

THE COMMONWEALTH OF AUSTRALIA. Feb. 15.—Telegraph apparatus and parts (Schedule 544). Particulars from Supply Officer, Australia House, Strand, London, W.C. 2.

NEW SOUTH WALES GOVERNMENT RAILWAYS AND TRAMWAYS DEPARTMENT (Electrical Engineer's Branch).—Feb. 22, 1922.—"Supply, delivery, erection and maintenance of one 5 000 kW 50 cycle turbo-alternator with condenser and accessories, at Zarra-street power house, Newcastle. (Contract No. 556.) Tenders, or proper forms and accompanied by a preliminary cash deposit, to the Secretary for Railways, Phillip-street, Sydney, N.S.W. Local representation is essential.

NEW ZEALAND.

POST AND TELEGRAPH DEPARTMENT. Jan. 17.—"25 000 dry cells for telephone work.

BOROUGH COUNCIL OF PALMERSTON NORTH. Original closing date Sept. 24. Extended date not yet decided.—"Service meters: (a) Single-phase, 230 V, 400 5 A, 150 10 A, 50 15 A; three-phase, balanced load, 400 V, 100 10 A, 30 25 A, 15 50 A, 10 75 A, 5 100 A. (b) 19 50 kVA single-phase transformers, with oil, complete; 1 complete winding h. and l. tension, for one leg; spare parts and accessories.

LYTELTON, PUBLIC WORKS TENDERS BOARD OF NEW ZEALAND. Jan. 31.—"Two complete sets of 3 phase automatic oil circuit breakers suitable for 6 600 V, 1 200 A capacity, four sets of disconnecting switches for isolating the oil switches, and one 6 600 V air break lever operated switch for main transformer switches at Lake Coleridge power house. Tenders to the Secretary, Public Works Tenders Board, Government Buildings, Wellington.

* Particulars from the Department of Overseas Trade.

PUBLIC WORKS TENDERS BOARD, WAIKATO POWER SCHEME. March 6.—"Section 45) two 2 500 kW alternators, three-phase, 50 cycle, 5 000 V, at 166½ revs. per min., with a power factor of '8. Excitation at 220 V. (Section 46) two 3 100 H.P. water turbines of the double-runner Francis type to operate the generators mentioned in Section 45. (Section 47) two exciter sets, each consisting of one 200 kW d.c. generator, and one 350 H.P. asynchronous motor, together with a Tirrill regulator. The generator shall have an output of 220 V, with a full-load current of 7 000 A. The motor shall be of 350 H.P., with a power supply of 400 V, three-phase, 60 cycle. The synchronous speed of the sets shall be 750. (Section 48) four Stoney sluice gates for the pits, appertaining to the turbines mentioned in Section 46. Tenders to the Secretary, Public Works Tenders Board, Government Buildings, Wellington.

SOUTH AFRICA.

MUNICIPAL COUNCIL OF JOHANNESBURG. Jan. 4.—"Supply and erection of one two-phase alternating-d.c. 2 000 kW converter, switchgear and spares. The h.t. supply is two phase, 3 000 to 3 300 V per phase, 50 periods, and the converter is to be capable of supplying (a) d.c. three-wire from 460 to 520 V as a shunt-wound machine; and (b) traction supply from 500 to 550 V as a compound-wound machine.

SOUTH AMERICA.

STATE ELECTRICAL POWER STATION, MONTEVIDEO. Dec. 30.—"(a) A group, comprising a four-stroke Diesel engine, coupled to a three-phase alternator, with the following characteristics: 50 cycles, 2 000 2 200 V between phases, 200 kW, and power factor of '8; (b) a group, comprising a four-stroke Diesel engine, coupled to a d.c. generator of 300 kW for a three-wire system of 2 by 230 V. The d.c. generating set must be delivered immediately after the acceptance of the tender. Local representation is essential.

ARGENTINE NATIONAL BOARD OF SANITARY WORKS.—January 19, 1922.—"Plant and accessories for new generating station, including three 4-cycle 375 H.P. Diesel engines, to run on crude petroleum, and three 3-phase alternators, each of 250 kW, 2 200 V between phases, 50 cycles, power factor 0.8.

ARGENTINE MINISTRY OF PUBLIC WORKS. Feb. 21, 1922.—"Nine electric motors, 36 tip waggons, 1 centrifugal pump with electric motor. Specification expected at the Department of Overseas Trade by Dec. 28.

BULGARIA.

BULGARIAN DIRECTION OF POSTS, TELEGRAPHS AND TELEPHONES. Jan. 10, 1922.—Supply of sixty 50-line and fifteen 100-line telephone exchanges. Particulars and drawings may be obtained from the Bulgarian Legation, 3, Queensberry-place, S.W. 7.

WALKER BROS., LTD., of Wigan, have secured the contract of the Great Western Railway Company for new ventilation plant for the Severn Tunnel.

STAFFORD TOWN COUNCIL has accepted the tender of Callenders Cable & Construction Company, Ltd., for 1 000 yards of low-tension cable.

EAST ASHFORD Board of Guardians have accepted the tender of H. S. Tett & Co., for installing the electric light at the workhouse, at £838.

LIVERPOOL Corporation have accepted the tender of the Metropolitan-Vickers Electrical Company for a 500 kW automatic rotary converter.

The METROPOLITAN ASYLUMS BOARD have accepted the tender of C. A. Vandervell & Company for lighting sets for six ten-passenger omnibuses, at £28 1s. 2d. per set.

BIRKENHEAD Corporation have accepted the tender of W. T. Henley's Telegraph Works Company for three miles 0.1 main cable, £987, and two miles of 0.05 main cable, £466.

The tender of H. J. Cash & Company (lowest tender received), at £506, has also been accepted for wiring and fitting Sherington-road School. Four tenders received; highest £466.

CHESTERFIELD Electricity Committee have accepted the tenders of the Claycross Company for an economiser, £811 5s. 6d., and the Lea Recorder Company for a recorder, £146 10s.

BARKING Urban Council have accepted the tenders of Lund Bros. & Company, for electric lighting installation at Special Schools Centre; and the Pirelli-General Cable Works, Ltd., for feeder cable (Longbridge-road).

LEWISHAM (London) Council received three tenders (highest £663) for wiring the council chamber and offices for electric lighting, and the lowest tender (that of A. J. Hewens, at £422 10s.) is recommended for acceptance.

HACKNEY Borough Council have accepted the tender of the Clay Cross Company for the supply of pipes, at £317, in connection with the extension of the power-house at Millfields-road, and that of Blakeborough & Sons for six large valves, at £795, in connection with the same undertaking.

HALIFAX Corporation have accepted the following tenders: Stewarts & Lloyds, tram poles, £13 10s. 6d. and £17 10s. per pole, for medium and heavy poles respectively; Liverpool Electric Cable Company, 6½ miles bronze cable, £11 7s. per mile; Edgar Allen & Company, points and crossings, £4 277.

MANCHESTER Corporation have accepted the following tenders: Hadfields, Ltd., permanent-way points; Bruce, Peebles & Company, two 2 500 kW motor converters and switchgear, one 1 500 kW motor converter and switchgear; Pirelli General Cable Works, Western Electric Company, and Callender's Cable & Construction Company, for cable.

Arrangements for the Week.

Companies' Meetings, Reports, &c.

FRIDAY, Dec. 16th (to-day).

INSTITUTION OF MECHANICAL ENGINEERS.

- 6 p.m. At Storey's gate, St. James's Park, London, S.W. Papers on "Conveying and Elevating Machinery," by Mr. G. Mitchell, and "Discharge of Grain Cargoes in the Port of London Authority," by Mr. R. E. Knight.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

- 7.30 p.m. At the Literary and Philosophical Society, Newcastle-on-Tyne. Paper on "Railway Electrification," by Sir Vincent L. Raven, K.B.E.

JUNIOR INSTITUTION OF ENGINEERS.

- 8 p.m. At Cannon Hall, London, S.W. Paper on "Notes on Searchlight Construction and Operation," by Mr. A. J. Simpson.

BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION.

- 8 p.m. At the Chartered Institute of Patent Agents, Staple Inn-buildings, London, W.C. Conference on "Salesmanship in Relation to Electric Power-driven Machinery in the Home." Speaker, Mr. E. R. Morton.

ELECTRO-HARMONIC SOCIETY.

- 8 p.m. At Cannon-street Hotel, London, E.C. Smoking concert.

SATURDAY, Dec. 17th.

INSTITUTION OF ELECTRICAL ENGINEERS.
(SCOTTISH CENTRE.)

- 7 p.m. At Grosvenor Restaurant, Glasgow. Smoking concert.

MONDAY, Dec. 19th.

INSTITUTION OF MECHANICAL ENGINEERS.
(GRADUATES' SECTION.)

- 7 p.m. At Storey's gate, London, S.W. Paper on "Worm Gearing," by Mr. C. Poole.

WEDNESDAY, Dec. 21st.

INDUSTRIAL LEAGUE AND COUNCIL.

- 7.30 p.m. At Caxton Hall, London, S.W. Lecture on "Trade Boards," by Mr. A. Dalglish.

FRIDAY, Dec. 23rd.

EDINBURGH ELECTRICAL SOCIETY.

- 8 p.m. At Philosophical Institute, 4, Queen-street, Edinburgh. Paper on "Watts on Wheels (Automobiles and Accumulators)," by Mr. E. O. Catford.

Prices of Metals, Chemicals, &c.

TUESDAY, DEC. 13.

Copper—		Price.	Inc.	Dec.
Best selected	per ton	£67 10 0	—	10s.
Electro Wirebars ..		£75 10 0	—	£1 10s.
H.C. wire, basis	per lb.	0s. 11½d.	—	½d.
Sheet		0s. 10½d.	—	—
Phosphor Bronze Wire (Telephone)—				
Phosphor-bronze				
wire, basis	"	1s. 3½d.	—	½d.
Brass 60/40—				
Rod, basis	"	0s. 7½d.	—	—
Sheet, basis	"	0s. 10½d.	—	—
Wire, basis	"	0s. 11½d.	—	—
Pig Iron—				
Cleveland Warrants	per ton	£5 5 0	—	—
Galvanised steel				
wire, basis 8 SWG ..	"	£22 0 0	—	—
Lead Pig—				
English	"	£27 0 0	10s.	—
Foreign or Colonial ..	"	£25 15 0	7s. 6d.	—
Tin				
Ingot		£171 10 0	£3 7 6	—
Wire, basis	per lb.	2s. 3½d.	½d.	—
Antimony		£120 0 0	—	—
Salmoniac.—Per cwt. 65s.-60s.				
Sulphur (Flowers)—Ton 112 10s.				
" (Roll-Brimstone).—Per ton				
£12 10s.				
Sulphuric Acid (Pyrites, 168°).—				
Per ton, £9 17s. 6d.				
Rubber.—Para fine, 1s. 2½d.; plantation 1st latex, 11½d.				

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and rubber prices by W. T. Benley's Telegraph Works Company.

Tube Investments, Ltd.

Mr. ARTHUR CHAMBERLAIN (chairman) presided at the annual meeting of the above company in Birmingham last week. Referring to the present depressed state of industry, and to the fact that the orders the company had on hand were only sufficient to run their plant at about half capacity, the chairman said: "the first and foremost remedy is to forgive every one of our enemies and friends all further payment of war indemnities or debts. If you cannot swallow this pill, I do not mind if you forgive nothing, but postpone everything for say, fifteen years certain. It will not have quite so good an immediate effect, but in the end it will probably come to nearly the same thing. First, no single act would so encourage the world's production; secondly, it would allow us an equal chance with others to make those luxuries which would be called for in exchange for the surplus; thirdly, it would immensely strengthen the debtor nations' exchanges, and thus lessen another of the difficulties we are up against, competing against a depreciated exchange; fourthly, although done from purely selfish motives, it would immensely improve the goodwill of nations one to another, than which nothing is better for international trade on which we are entirely dependent. Having done this, we ought to try and arrange by agreement between Governments, or, if that fails, by an international insurance scheme, for stabilisation of exchanges. They should be agreed for at least a year at a time, possibly more, and it should be possible to insure against the periodic revisions that would be arranged for. Next we shall probably find it necessary to give certain of our old enemies, but new friends, and certain of our Colonies and Allies, credit—a very different matter from the war debts. Another possibly unpalatable, but extremely interesting, fact that emerges is the vital necessity for this country to have Free Trade. . . . Protection is a wall that can be so high that you cannot see over the top to find what is doing in the world. Why should we British manufacturers be afraid of Free Trade? Protection was not the main thing that made Germany, nor was Free Trade on our part the contributing factor. It was something much more creditable to her and much less flattering to us. . . . Another thing to do is to repeal the so-called Safeguarding of Industries Act before it does any more harm. The only real constructive proposal that I have seen so far from a member of the present Government is that, as might be expected of Mr. Churchill, we should develop the colonial-producing facilities. That is a real step in the right direction, and if he is really determined to stop wasting money in Mesopotamia and other places, and to put the money where it will sooner produce wealth, his intentions should receive our hearty support. For the same reasons, the proposals of the Federation of British Industries seem to be all wrong. They are based on the fundamental error that Germany must pay. . . . Finally, I again suggest that, among the things we might refrain from doing, is wasting money."

In conclusion, Mr. Chamberlain expressed his gratification at the promise of the Washington Conference. He said that money spent on armaments was money wasted as far as trade was concerned. Their subsidiary company, Tubes, Ltd., had already received very valuable orders for the battleship construction that had just been passed. Those orders would have been a godsend to them, but, taking the long view, he was sure it was to the interests of the company they should not have those orders to-day.

The dividends recommended were approved, viz., at the rate of 7 per cent., less tax, on the preference shares, and 8 per cent., less tax, on the ordinary shares.

The MACKAY COMPANIES have declared a dividend on the common stock of 1½ per cent.

PINCHIN, JOHNSON & COMPANY have declared an interim dividend of 5 per cent. less tax.

ELECTRO BLEACH & BY-PRODUCTS, LTD., announce an interim dividend of 3½ per cent. on the preference shares.

An interim dividend of 3 per cent., tax free, has been declared by the PARA TELEPHONE COMPANY on the ordinary shares.

PENNSYLVANIA WATER & POWER COMPANY have declared a quarterly dividend of 1½ per cent. on the common stock.

REES ROTURBO MANUFACTURING COMPANY have declared a dividend of 5 per cent. on the preference shares for the year 1917.

The directors of the FALKIRK IRON COMPANY have declared an interim dividend of 5 per cent., less tax, on the ordinary shares.

The issue in New York of \$10,000,000 PACIFIC GAS AND ELECTRIC COMPANY first and refunding 6 per cent. bonds was over-subscribed.

The MONTREAL WATER & POWER COMPANY have declared a dividend of 3½ per cent. for the half-year ended Oct. 31 on the capital stock.

An interim dividend on the ordinary shares at the rate of 5 per cent. for the six months ended September has been declared by WAYGOOD-OTIS.

The directors of the BRAZIL TRACTION, LIGHT & POWER COMPANY have declared a quarterly dividend of 1½ per cent. on the cumulative preference shares.

The READING ELECTRIC SUPPLY COMPANY has been offering for subscription this week £100,000 7½ per cent. first mortgage debenture stock at 95 per cent. The issue was over-subscribed.

A quarterly dividend of 82 per share has been declared by the CONSOLIDATED GAS, ELECTRIC LIGHT AND POWER COMPANY OF BALTIMORE on the common stock.

The GLOBE TELEGRAPH & TRUST COMPANY announces a quarterly dividend of 3s. per share on the preference shares, and 5s. per share net on the ordinary shares.

An extraordinary meeting of the BRITISH URALITE COMPANY (1908) will be held at 8, Old Jewry, E.C., on Dec. 14, to pass a resolution appointing Mr. John Cross a director.

The CANADIAN GENERAL ELECTRIC COMPANY has declared a dividend of 2 per cent. for the quarter ending Dec. 31, on the common stock, payable to shareholders registered Dec. 15.

The \$30 000 000 NEW YORK EDISON COMPANY first lien and refunding mortgage twenty-year 6½ per cent. bonds, offered in New York at 104½ and interest, was immediately over-subscribed.

The EASTERN EXTENSION AUSTRALASIA & CHINA TELEGRAPH COMPANY, LTD., have declared an interim dividend for the three months ended Sept. 30 of 5s. per share, payable, free of income tax.

The directors of the YORKSHIRE (West Riding) Electric Tramways Company have declared a final dividend of 5 per cent., being at the rate of 6 per cent. per annum, on the preference shares, for the half-year ending Dec. 31, less tax.

The LANELLY AND DISTRICT ELECTRIC LIGHTING AND TRACTION COMPANY this week invited public subscription for £125 000 7½ per cent. debenture stock at 94 per cent. The issue was quickly over-subscribed.

The net revenue of the UNITED ELECTRIC TRAMWAYS COMPANY OF CARACAS for the year ended June 30 was £20 585, plus £7 867 brought in. The directors recommend a dividend of 8 per cent., less tax, leaving £14 852 to be carried forward.

ARMSTRONG WHITWORTH DEVELOPMENT COMPANY recommends a dividend at 6 per cent. per annum, less tax, on the preference shares, making 6 per cent. for the year: £5 558 has been written off for the formation expenses; £14 540 is carried forward.

The CHILIAN ELECTRIC TRAMWAY COMPANY and the NATIONAL ELECTRIC POWER COMPANY have concluded negotiations for amalgamation. The capital of the new company will be £12 000 000, of which the greater portion will be found in London.

The net earnings of the VICTORIA FALLS & TRANSVAAL POWER COMPANY, including those of the Rand Mines Power Supply Company, for the quarter ended Sept. 30, amounted to £205 885, before providing for taxation in South Africa and the United Kingdom.

The report of NEW PEGAMOID for eleven months ended Aug. 31, shows, after writing off reserve account and amount brought forward, a loss of £48 074, largely accounted for by the large amount written off stock and forward commitments to bring these to present market value.

The gross receipts of the MANX ELECTRIC RAILWAY COMPANY for the year ended Sept. 30 were £63 708 and expenditure £44 726, leaving £18 982, plus £1 390 brought in. It is proposed to pay a preference share dividend in respect of the year ended Sept. 30, 1916, on Jan. 2 next, carrying forward £916.

The meeting of the holders of 5½ per cent. first mortgage bonds of the BARCELONA TRACTION, LIGHT & POWER COMPANY was held last week at Winchester House to consider and pass resolutions increasing the interest payable on these bonds to 6 per cent., 2 per cent. of such interest to be fixed, and the balance to be dependent upon earnings.

The directors of the ALBY UNITED CARBIDE FACTORIES have decided to wind up the company, in view of recent developments in Norway and the breakdown of negotiations in regard to the Odda factory. The proposal "that the company be wound up by the Court" will be submitted at an extraordinary meeting, to be held at Winchester House, on Dec. 22, at noon.

The profit of VICKERS, LTD., for the year ending Dec. 31, 1920, after allowing for preference dividends for the year (£395 985) amounted to £145 275, which, added to £846 264 brought in, leaves a credit balance of £991 639, which will be carried forward. No dividend is recommended on the ordinary shares in view of necessity of conserving the company's resources.

The annual meeting of CLAUD HAMILTON, LTD. (incorporating Rennie & Prosser, Ltd.), was held in Glasgow on Monday, Mr. Alex. J. Fergusson, presiding, and the report, which was given in our last issue, was adopted. At the extraordinary meeting held afterwards, it was agreed to increase the share capital of the company by 10 000 ordinary shares of £1 each, and the articles of association of the company were altered to permit of the distribution of bonus shares.

The NEWCASTLE-UPON-TYNE ELECTRIC SUPPLY COMPANY offered for subscription this week £750 000 6 per cent. second mortgage debenture stock at 85½ per cent. The issue was over-subscribed. The holders of second mortgage debenture stock approved a resolution last week modifying their rights. The main provisions were that the interest payable on the stock should be increased from 5 per cent. to 6 per cent., and that the authorised amount should be increased from £500 000 to £2 000 000.

The STOCK EXCHANGE COMMITTEE have granted official quotations to 50 000 £1, fully paid, 6½ per cent. A cumulative preference shares of the General Electric Company; 55 025 £1, fully paid, 6 per cent. cumulative convertible first preference shares of the Lancashire Electric Light & Power Company, and £228 460 7½ per cent. debenture stock of the North Metropolitan Electric Power Supply Com-

pany, and have specially allowed dealings in 310 000 £1, fully paid, vendor's shares of the Telephone Manufacturing Company (1920).

The accounts of C. A. VANDERVELL & COMPANY for the year ended March 31 show a loss of £251 280. Stocks have been valued in the balance-sheet at prices prevailing on March 31. The questions of excess profits tax and allowances by the Government on war plant and buildings are not yet settled, but it is anticipated they will be cleared up satisfactorily to the company at an early date. The directors have withdrawn £75 000 which was placed to reserve last year, and have also absorbed £58 281 to be carried forward.

The report of the NAIROBI ELECTRIC POWER & LIGHTING COMPANY for the year ended Dec. 31 states that in previous yearly accounts the local rupee was treated as the equivalent of 1s. 4d. In the accounts now submitted it is translated at 2s. The result, however, of treating the local unit as having a value of 2s. instead of 1s. 4d. is an increase of approximately 50 per cent. in the items appearing on both sides of the revenue account, which must be borne in mind on attempting any comparison with the figures of previous years. The net profit for the year was £3 889, to which is added £2 113 brought forward, and £220 being E.P.D. recovered, making £6 222. Dividends have been paid amounting to 10 per cent. for the year, less tax, being at the same rate as in previous years.

The report of CAPE ELECTRIC TRAMWAYS, LTD., for the year ended June 30, shows a profit of £81 724, and, after providing for debenture interest, redemption of debentures, and taking into account the balance brought forward, a net credit balance of £60 046 remains. The reserve fund has been credited with £18 000, and the directors recommend a dividend of 6 per cent. on the ordinary shares, carrying forward £12 573. Passenger receipts were £397 124, as against £325 085. Capital expenditure was £70 620. After protracted negotiations the Municipality of Cape Town at last came to the decision not to proceed with their proposal for the acquisition of the company's Cape Town system. The concession will therefore run on until 1925, when the Council can again exercise the right of expropriation.

The profits of the CORDOBA LIGHT, POWER & TRACTION COMPANY for the year to March 31 was £123 923, less interest on debenture stock and promissory notes, &c., leaving £54 625, plus £60 015 brought forward, making £114 641. Redemption of debenture stock absorbs £8 432, leaving £106 209. Upon approval of a scheme by the proprietors and by the Court, the sum of £69 300, being five and a half years' arrears of dividend on the preference shares, less tax, will be transferred from this balance, together with £5 300 net from the profits of the half-year to Sept. 30, 1921, being current dividend on preference shares for that period, and appropriated, in accordance with the scheme, to satisfaction of six years' dividend on preference shares to the latter date. This will leave £36 908 available. The scheme provides further for the transfer of £5 000 of this amount to the share capital redemption fund.

In moving the adoption of the report and accounts at the annual meeting of the DELAGOYA BAY DEVELOPMENT CORPORATION, held in London last week, Mr. H. K. Heyland, chairman of the company, said that £9 960 had been spent during the year on additional power-house plant in order to cope with the rapid increase in demand. During the year Mr. W. M. Mordey had been to Lourenço Marques, and after prolonged interviews with the various local authorities, agreement was come to for increase of passenger fares on the tramways, in order to obtain which the Corporation had undertaken the construction of a small tramway extension and to provide more rolling stock. Taking the corporation's business as a whole, the revenue now being received from every source, with the exception of an infinitesimal amount, was all on a sterling basis.

The annual meeting of the BRITISH VACUUM CLEANER COMPANY was held in London last week. Mr. H. Cecil Booth (chairman and managing director) presiding. In the course of his speech the chairman said that, during the last three years following on the laying down and complete equipment of their machine-tool and engineering shops, the company had made further developments in the application of their system to various industrial uses, particularly with reference to the pneumatic removal of ashes and flue dust from boilers in power-houses and factories. They had in hand contracts for the supply and erection of this type of plant for Edinburgh Corporation, West Bank Power-station, Calcutta; electricity works, Gossli, pore, Calcutta; new super power station of the Paris Union d'Electricité, Genevilliers; and the Corporation electricity works, Hereford. An abstract of the accounts appeared in our issue of Dec. 9.

The report and balance-sheet of the TEES POWER STATION COMPANY to Oct. 1, just issued, gives the expenditure on capital account to date at £996 932. During the year 167 827 fully-paid ordinary shares have been allotted to the Newcastle-upon-Tyne Electric Supply Company, the total issued and paid-up share capital being now £437 577. An amount of £21 200 first mortgage debentures has been redeemed during the year out of the sinking fund provided under the terms of the debenture trust deed. Sections of the power-station plant have been in operation intermittently throughout the year. Subject to certain adjustments which have still to be made, and to satisfactory tests being obtained, it is anticipated that the whole of the plant will be available for commercial use early next year. The amount received during the year from the Newcastle company, representing 6 per cent. on the company's paid-up share capital, was £20 977, and adding the balance brought forward from last year, £306, there is available the sum of £21 283, of which £20 800 will be appropriated in payment of a dividend of 4½ per cent. on the paid-up share capital, and £500 will be carried forward.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Partnership Dissolved.

ASHWORTH, Harry, and ASHWORTH, George, electrical engineers, 17, Mayville-road, Brierfield, and 33, Garrick-street, Nelson, co. Lancaster, under the style of H. & G. Ashworth, by mutual consent as from Oct. 22, 1921. Debts received and paid by H. Ashworth.

Bankruptcy Information.

FWLER, A. Vaughan, "Seacliffe," Fitzroy-avenue, Kingsgate, electrical engineer. Receiving order, Dec. 10. Creditor's petition.

WILLIAMS, John Glynn, 4, Blaenau-street, Duffryn, Cymmer, Port Talbot, electrical engineer. First meeting, Dec. 21, 11 a.m., Official Receiver's Offices, Government-buildings, St. Mary's-street, Swansea. Public examination, Jan. 17, 10.45 a.m., Town Hall, Neath.

Notice of Dividend.

CARR, Horace Edgar, Carlisle-street, Goole, co. York, electrical engineer. Amount per £. 5s. 5d., first and final, payable Dec. 15, Carlisle-chambers, Goole.

Liquidator's Notice.

ILFORD DRY BATTERY COMPANY, LTD. (in voluntary liquidation). Meeting of creditors at 2, Guildhall-chambers, 31-4, Basinghall-street, London, E.C. 2, Monday, Dec. 19, 1921, at 3 p.m. Particulars of claims, by Jan. 31, to G. W. Roberts, Incorporated Accountant, 2, Guildhall-chambers, 31-4, Basinghall-street, London, E.C. 2, the liquidator.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

A. & A. ELECTRICAL COMPANY, LTD. (late Nardello & Agazar, Ltd.), London, E.C. Registered Nov. 15, £9 100 (not ex.) deb., to London County Westminster & Parr's Bank, Ltd.; general charge. *Nil. Jan. 14, 1921.

A. G. E. ELECTRIC MOTORS, LTD. (late East Anglian Engineering Company, Ltd.), Stowmarket. Registered Nov. 23, £18 000 deb.; general charge. *Nil. July 17, 1920.

ADELAIDE ELECTRIC SUPPLY COMPANY, LTD., London, E.C. Registered Nov. 15, acknowledgment of indebtedness (supplemental to trust deed registered June 14, 1918), securing £350 000; charged on such part of the company's undertaking in Adelaide as is referred to in the trust deed. *£197 255. Feb. 2, 1921.

ARMATURE REPAIRING & SUPPLY COMPANY, LTD., Swansea. Registered Nov. 29, £2 000 and £200 deb.; general charge. *Nil. Dec. 14, 1920.

BEDALE & DISTRICT ELECTRIC SUPPLY COMPANY, LTD. Registered Nov. 15, £500 deb., to Sir W. C. Gray, Thorpe Perrow; general charge; also registered Nov. 16, mort. by way of further security for £1 500 secured by deb. registered Jan. 23, 1920, and above-mentioned £500; charged on power house and other buildings at Bedale. *Nil. Oct. 1, 1921.

BOURNE END & DISTRICT ELECTRICITY CORPORATION, LTD. Registered Nov. 23, £200 deb. part of £20 000; charged on land at Bourne End, also general charge.

CAMBRIDGE ELECTRIC SUPPLY COMPANY, LTD. Registered Dec. 1, £3 000 deb., present issue £2 450; general charge. *£53 000. March 21, 1921.

CONNER MAGNETO & IGNITION, LTD., London, E.C. Registered Nov. 25, £100 000 deb., to General Electric Company, Ltd., Kingsway, W.C.; general charge. *Nil. June 11, 1920.

COX-CAVENDISH ELECTRICAL COMPANY, LTD. (late Cavendish Electrical Company, Ltd.), London, W. Registered Dec. 2, £5 000 deb., present issue £2 150; general charge. *£15 000. Sept. 21, 1921.

FALK STADELMANN & COMPANY, LTD., London, E.C., gas, &c., fittings manufacturers. Registered Nov. 14, charge by way of collateral security for £100 000 (supplemental to mort. and charge registered Aug. 12, 1921), to North British & Mercantile

Insurance Company, Ltd., Threadneedle-street, E.C.; charged on land at Wandsworth. *Nil. Jan. 5, 1921.

HONG KONG TRAMWAY COMPANY, LTD. (late Electric Traction Company of Hong Kong, Ltd.), London, E.C. Registered July 26, charge created outside the United Kingdom (supplemental to charge registered Aug. 6, 1919, securing £700 000), to Hong Kong & Shanghai Banking Corporation, Hong Kong; charged on various parcels of ground, including rights, powers, &c. *£700 000 (£110 835 gs. 8d. at exchange 3s. 2d. per dollar). April 27, 1921.

LANCASHIRE ELECTRIC LIGHT & POWER COMPANY, LTD. (late Lancashire Power Construction Company, Ltd.), Manchester. Registered Nov. 9, trust deed dated Oct. 20, 1921 (supplemental to trust deed registered May 12, 1911), securing £700 000 prior lien deb. stock; charged on property as charged by principal trust deed; also registered Nov. 9, trust deed dated Oct. 20, 1921 (supplemental to trust deed registered Dec. 10, 1908), increasing rate of interest payable on £150 000 first deb. stock; charged on property as charged by principal trust deed. *£285 000. July 7, 1921.

OSWESTRY ELECTRIC LIGHTING & POWER COMPANY, LTD. Registered Dec. 2 (by order on terms), £1 500 deb. dated Sept. 27, 1921, to London County Westminster & Parr's Bank, Ltd.; general charge. *£1 800, overdraft at London County Westminster & Parr's Bank, Ltd., not to exceed £1 500, secured by deb. £788 15s. 7d. Oct. 25, 1921.

SENTINEL INSTRUMENT COMPANY, LTD. (late Sentinel Company, Ltd.), Newcastle-on-Tyne, electricians, &c. Registered Dec. 2. Mort. securing £2500 and further advances, to Newcastle-upon-Tyne Permanent Building Society. *£2 600. May 24, 1921.

SEVENOAKS & DISTRICT ELECTRICITY COMPANY, LTD. Reg. Nov. 10, £15 000 deb. (filed under Sec. 93 (3) of the Companies (Consolidation) Act, 1908), present issue £100; general charge. *£7 320. Oct. 13, 1921.

WINScombe ELECTRIC LIGHT & POWER COMPANY, LTD. Registered Nov. 15, £250 deb. balance of £4 000; general charge. *£3 750. Sept. 7, 1921.

Satisfactions.

A. & A. ELECTRICAL COMPANY, LTD. (late Nardello & Agazar, Ltd.), London, E.C. Satisfaction registered Nov. 15, £250, registered Nov. 11, 1915.

BEDALE & DISTRICT ELECTRIC SUPPLY COMPANY, LTD. Satisfaction registered Nov. 16, mort. by way of further security for £1 500, registered Jan. 23, 1920.

EAST ANGLIAN ELECTRICITY, LTD. (late Suffolk Electricity Supply Company, Ltd.), Stowmarket. Satisfaction registered Nov. 23, £1 000, registered Aug. 28, 1916.

ELECTRIC MOTORS (SOUTH WALES), LTD., Cardiff. Satisfaction registered Nov. 22, £5 000 (not ex.), registered Nov. 2, 1920.

SPLITDORF ELECTRICAL COMPANY OF LONDON, LTD., London, W. Satisfaction registered Nov. 15, £5 000, balance of amount registered Oct. 11, 1919.

Receivership.

ILFORD DRY BATTERY COMPANY, LTD. G. W. Roberts, of 2, Guildhall-chambers, 31-4, Basinghall-street, E.C., appointed receiver on Nov. 29, under powers contained in instrument dated Feb. 2, 1921.

Bankruptcy Proceedings.

SMITH, J., & SON, electrical engineers, 1, Central-street, E.C. The first meeting of the creditors was held last week at the London Bankruptcy Court. The receiving order was made on Nov. 24 on the petition of the Sloan Electrical Company, Ltd. Debtor had stated that in March, 1919, he took premises at the above address, and traded as an electrical engineer under the style of J. Smith & Son. His capital at the start was £70, and for the first year the business about paid its way, but the recent trouble in the coal and engineering industries practically put an end to his trade, and he had been unable to recover himself. The liabilities were estimated at £300, and there were no assets. The case was left in the hands of the Official Receiver for administration in bankruptcy.

PRIVATE MEETING.

[Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.]

HUNT, H. (trading as H. Hunt & Company), 6, Cooper-street, Bury, Lancs, electrical engineers. A meeting of creditors was held recently, when it was reported that liabilities amounted to £495, all due to unsecured creditors, while assets were estimated at £203. Debtor was formerly in partnership, but this partner had now gone away. Debtor has drawn small sums from the business, and his books of account have not been very well kept. He was anxious to continue the business, however, and was of the opinion that if he was allowed to do this, the business would show a fair profit. The meeting was eventually adjourned with a view to the debtor bringing forward the offer of composition suitably guaranteed.

New Companies.

The following list is compiled from information supplied by Messrs. Jordan & Sons, Ltd., company registration agents, 116-118, Chancery-lane, London, W.C. 2.

ADVANCE LAMP COMPANY, LTD. (177 868), 10, Rockerhall-alley, Dale-street, Liverpool. Registered Nov. 17. Designers, manufacturers, and dealers in electric lamps. Nominal capital, £1 000, in 1 000 shares of £1 each. Directors: W. Sutton and H. W. Sutton. Qualification of directors, £25. Private company.

ALL BRITISH SIGNAL COMPANY, LTD. (2 039F), 85, London Wall, E.C. 2. Registered Dec. 1. Incorporated in the Dominion of Canada 1921. To acquire the sole benefit for mercantile purposes in Great Britain and elsewhere of certain invention and improvements for submarine signalling, made or to be made by John Gardner, and to carry on the business of mechanical engineers, manufacturers of submarine signalling, and other apparatus constituting aids to navigation. Nominal capital, £80 000, in 320 000 shares of 5s. each. Names of persons authorised to accept service: W. A. Andoe, F. L. Roundbush, E. Heaton. Private company.

ANTI-DAZLO LENS, LTD. (178 025), 45, Jewin-street, E.C. 1. Registered Nov. 25. To acquire any invention in relation to the production and distribution of any motor, motor cycles, or other lamps or lighting apparatus, and turn same to account. Nominal capital, £2 000, in 2 000 ordinary shares of £1 each. Directors: F. A. Slaughter and H. Salsbury. Private company.

H. ARROWSMITH & COMPANY, LTD. (178 034), 260A, Deansgate, Manchester. Registered Nov. 25. Manufacturers of electrical goods, switches, adaptors, &c. Nominal capital, £2 000, in 2 000 shares of £1 each. Directors, Henry Arrowsmith and Harry Arrowsmith. Qualification of directors, £100. Private company.

CARLTON LAMP COMPANY, LTD. (177 827), 58A, Pall Mall, S.W. Registered Nov. 15, 1921. Vendors, manufacturers, and purchasers of electrical lamps and fittings. Nominal capital, £500, in 500 shares of £1 each. Directors: G. A. Sawyer and A. B. P. Roberts. Qualification of directors, 50 shares.

DAVIS, HUDSON, & COMPANY, LTD. (177 588), 178, Victoria-road, Aston Manor, Birmingham. Registered Nov. 1. To acquire and carry on business of patentees, manufacturers, and electrical engineers. Nominal capital, £1 000, in £1 shares. Directors: F. R. Hudson and Mrs. Louise Davis. Private company.

DELSTAR ENGINEERING COMPANY, LTD. (177 810), 100, Woodhouse-street, Leeds. Registered Nov. 14, 1921. Mechanical and electrical engineers. Nominal capital, £1 000, in 1 000 shares of £1 each. Directors: A. Blair and H. Creighton. Qualification of directors, one share.

LESTER, BALLANTYNE & COMPANY, LTD. (177 579), 9, Rathgar-road, Loughborough Junction, S.W. 9. Registered Oct. 31. Mechanical, electrical, automobile and general engineers. Nominal capital, £1 000, in £1 shares. Directors: L. J. Lester, J. Ballantyne, A. Collier, A. Smith and S. Osborne. Private company.

MORGANS (BIRMINGHAM) ELECTRIC MOTORS, LTD. (177 753), 20, Regent's-place, Birmingham. Registered Nov. 10. Electrical engineers, motor and mechanical engineers. Nominal capital, £3 000, in 3 000 shares of £1 each. Directors: T. J. Bowater, S. C. Bruton and S. B. Morgan. Qualification of directors, 100 shares. Private company.

OERLIKON, LTD. (177 580), Oswaldestre House, Norfolk-street, Strand, W.C. Registered Oct. 31. Electrical, hydraulic, mechanical and general engineers. Nominal capital, £40 000, in £1 000 shares. Directors: S. D. Schindler and M. W. Schindler. Public company.

A. PANK & SON, LTD. (177 968), 8, 10, 12, Bedford-street, Norwich. Registered Nov. 23. Electrical and general engineers, &c. Nominal capital, £10 000, in 10 000 shares of £1 each. Directors: A. Pank and A. R. Pank. Qualification of directors, £100. Private company.

PATERSON BOOTH & COMPANY, LTD. (178 156), 2, Quayside, Newcastle-on-Tyne. Registered Dec. 1. Consulting engineers. Nominal capital, £500, in 500 shares of £1 each. Directors, J. M. Paterson, R. J. Thompson (Junior), W. Booth and G. Chambers. Qualification of directors, £10. Private company.

PEARNS, GREG & ARMSTRONG, LTD. (177 780), 12, Hewitt-street, Knott Mill, Manchester. Registered Nov. 11, 1921. Electrical, mechanical, &c., engineers. Capital, £5 000, in 3 000 preference shares and 3 000 ordinary shares of £1 each. Directors: J. A. Pearn, R. L. Greg, and G. S. Armstrong. Qualification of directors, 300 shares. Remuneration of directors, £400.

PREMIER ACCUMULATOR COMPANY (1921) LTD. (178 158). Registered Dec. 1. Accumulator manufacturers. Nominal capital, £40 000, in 40 000 ordinary shares of £1 each. Directors, H. Stephens, Southwood, St. George's-avenue, Northampton; G. A. Schanschieff and F. C. Vine. Qualification of directors, £100. Private company.

SYMONDSBURY ELECTRIC LIGHTING COMPANY, LTD. (177 885). Symonds-bury, Bridport, Dorset. Registered Nov. 17. To provide electric light and power in the parish of Symonds-bury, Bridport. Nominal capital, £2 000, in 400 shares of £5 each. Directors: The Rev. C. F. L. Sweet, T. A. Walker, and E. J. Domville. Qualification of directors, £100.

TALBOT & LOBLEY, LTD. (177 413), 57, Victoria-street, Westminster, S.W. Registered Oct. 21. Consulting electrical and mechanical engineers. Nominal capital, £3 000, in £1 shares. Directors: H. J. Talbot and H. D. Lobleby. Private company.

TEMPLE COX RESEARCH COMPANY, LTD. (177 757), Dacre House, Dean Farrow-street, Victoria-street, S.W. 1. Registered Nov. 10. To carry on research work, the development of patents and inventions in the United Kingdom and elsewhere. Nominal capital, £20 000, in 20 000 shares of £1 each. Directors: R. Temple, E. R. Jones and P. Cox. Qualification of directors, one share. Private company.

TRAVERS & CLARK, LTD. (178 020), Royal London-buildings, 196, Deansgate, Manchester. Registered Nov. 24. Consulting engineers, &c. Nominal capital, £2 000, in 200 ordinary shares and 1 800 preference shares of £1 each. Directors: M. W. Travers and F. W. Clark.

SCINTILLATING SIGN COMPANY, LTD. (177 642). Registered Nov. 3. Exhibitors of electrical and other advertising signs. Nominal capital, £4 200, in 4 000 "A" shares of £1 each, and 4 000 "B" shares of 1s. each. Directors: E. C. Elsmore ("Aven." Meadoway, N.W.), H. S. Coleman and W. H. Rawling. Private company.

Catalogues, Price Lists, &c.

The A. & F. ELECTRICAL COMPANY have issued a new price list of their two and three phase motors.

A new catalogue has just been issued by R. O'Brien & Company of their "LYNA" GLASSWARE reflectors, hemispheres, bowls, &c.

J. & E. J. DUDRILL & COMPANY have sent us a large postcard illustrating a hundred or more of their movable self-sustaining, focussing fittings.

GENT & COMPANY has issued Folder 57, describing their "Tangent" electric motor systems. A useful table is given, containing specifications, code words, and prices.

An illustrated booklet has been issued by BELL'S UNITED ASBESTOS COMPANY giving brief particulars of some of their insulating and fire-resisting materials for electrical purposes.

"EDISWAN" SILK SHADES of every shape, size, and design, and to suit all kinds of electric lighting are illustrated and described in an artistic booklet (List No. S.S. 242), issued by the Edison Swan Electric Company.

Publication No. 1 218, issued by MARSHALL, SONS & COMPANY, of Gainsborough, deals with types "SV," "SVE," and "SVM" of their vertical oil engines. The "SVE" type is specially recommended for electric light and power installations.

A four-page leaflet (No. 333), illustrating the plant at the new electric power station open at Whitebirk, Blackburn, on Oct. 21, by the Earl of Derby, has been issued by the ENGLISH ELECTRIC COMPANY, who constructed and equipped the station.

The WALSALL ELECTRICAL COMPANY have issued a leaflet giving new prices for their battery switchboards. These prices not only take into account reductions in wages and bonuses, but have been further reduced in an endeavour to stimulate business.

Leaflet No. 2 624 has been received, containing particulars of the new improved type of BETTINGTON BOILER for use with pulverised fuel, colloidal fuel, or oil or gas firing, manufactured by the Fraser & Chalmers Engineering Works, Erith, of which the GENERAL ELECTRIC COMPANY are the proprietors.

The A.C.E.C. (Ateliers de Constructions Electriques de Charleroi) has just issued a new illustrated pamphlet describing the special type of pump and motor which the firm manufacture. The pamphlet contains an excellent photograph of the new Charleroi works taken from the air.

The GLOBE ENGINEERING COMPANY, of Brighouse, Yorkshire, have issued an illustrated leaflet giving dimensions and prices of their Protected Type direct-current motors and dynamos. These are shunt or series wound, continuously rated, and interpoles are fitted when required.

J. B. RUDKIN, the representative for Great Britain of SPRECHER & SCHUE COMPANY, electrical apparatus manufacturers, of Aarau, Switzerland, has sent us List No. 1, containing full details and prices of knife switches manufactured by the firm. Further sections of the lists, comprising the whole range of the Company's manufacturers, are in preparation and will be issued shortly.

The rolling drum type rotary air compressor, manufactured by REAYELL & COMPANY, of Ipswich, is the subject of Pamphlet No. 100 issued by the firm. The rolling drum, it is claimed, enables these machines to run at higher speeds than any other bladed rotary compressors, without the rubbing and friction usually experienced. The machines are also supplied as vacuum pumps, and for priming centrifugal water pumps, exhausters, &c.

The MITCHELL CONVEYOR & TRANSPORTER COMPANY have sent us an illustrated brochure dealing with some post-war locomotive coaling and ash handling plants, erected by them for British railway companies. They also have in hand a series of similar booklets, each dealing with a separate section of economical handling devices which they have designed and erected for various power stations, blast furnaces, breweries, coke ovens, gasworks, paper mills, &c.

The BRITISH LIGHTING & IGNITION COMPANY have issued new price lists (Nos. 104, 105, 108, and 109) of spare parts for types Z.A. 4 and Z.U. 4 and 6 magnetos. The firm announce that they are now in a position to supply spare parts for all their own types of magnetos, and also for Bosch magnetos, both for old and new types. Repairs to any make of magneto and lighting and starting equipment are undertaken, either at the company's depot in Tottenham Court-road, London, W., or at the works at Aston, Birmingham.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by MISSIE M. WILKES, B.A., & Co., Chartered Patent Agents, 2, Strand, E.C.4, London, W.C.

COMPLETE SPECIFICATIONS.

- 111 783 MERRITT, M. M. Electrolytic apparatus. (15/1/20.)
 143 248 SON, VALENTINO, FRÉDÉRIC ET DÉCORIS. Electric reading lamps. (30/5/19.)
 143 292 WESTERN ELECTRIC CO., LTD. Thermionic devices. (1/11/19.)
 143 542 HANCOCK, F. P. P. Method and apparatus of electrical energy by an electro-chemical process. (17/5/19.)
 144 713 FREHSE, R. Manufacture of metallic diaphragms of electro-chemical cells. (12/6/19.)
 145 512 RIDG, A. Electric device generating gas. (3/2/19.)
 146 935 HAYES, LEON, WARE, ART, GOS. Electrically operated motor vehicles. (8/7/19.)
 147 128 GOS, LEON, WARE, ART, GOS. Means for maintaining constant speed of an electric motor. (9/2/19.)
 147 44 GOS, LEON, WARE, ART, GOS. Arrangement for locating underground of hidden electrical conductors. (23/11/17.)
 147 444 GES. FÜR DRAHTLOSE TELEGRAPHIE. Electrical frequency multipliers. (26/10/18.)
 148 918 FREHSE, R. Electric advertising signs. (6/6/18.)
 150 573 METROPOLITAN-VICKERS ELECTRICAL CO., LTD. Interrupting devices for electric circuits. (6/11/19.)
 153 890 GRAP, F. Electrically heated ovens. (11/11/19.)
 160 430 FORD, L. P. Electrical signalling by means of alternating currents. (13/3/20.)
 167 593 SCHOLFIELD. Means for connecting the ends of electric or other conductors. (1/5/20.)
 167 709 MARKS, E. C. R. (Landers, Fray & Clark). Circuit breakers for electrically heated devices. (23/2/20.)
 167 821 POTCHIN, A. Electric accumulators. (6/5/20.)
 167 842 WATKINS, J. L. F. Resistance switches. (13/5/20.)
 167 840 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). Electric switches. (15/5/20.)
 167 841 BEVIS, H. A. PERELLI GENERAL CABLE WORKS, LTD. Electric cables. (5/2/21.)
 167 846 RETROUILLÉ & CO., LTD., A. & LESSON, B. H. Electric switches or circuit breakers. (5/5/20.)
 167 860 JONES, G. H. Electrically heated appliances. (19/5/20.)
 167 873 LEDWINKA, J. Duplex electric welding machines. (20/5/20.)
 167 890 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). Electric switches. (15/5/20.)
 167 893 BARROW, F. T. & DAYLEY, L. A. Electric battery adapted to be worn on the wrist. (1/5/20.)
 167 907 BRITISH THOMSON-HOUSTON CO., LTD., & YOUNG, A. P. Electric meters, particularly of the mercury motor type. (7/6/20.)
 167 916 SCHROEDER, G. Electric transformers. (12/6/20.)
 167 932 THOMAS, H. J. S. Electrical contacts of the plug and socket type. (22/6/20.)
 167 939 MOYD, A. L. (International Precipitation Co., Inc.). Apparatus for electrical treatment of gases. (29/6/20.)
 167 957 BRITISH THOMSON-HOUSTON CO., LTD., & HALL, V. E. Electric controlling devices. (28/6/20.)
 167 969 SIEMENS-SCHUCKERTWERKE, G. M. B. H. (P. T. H. Co.). Telephone or other call indicators. (27/8/20.)
 168 001 DAVIS, A., HUDSON, F. R. Electric switches, ceiling roses, plug and socket couplings, closures for junction boxes, and other analogous devices. (6/12/19.)
 168 018 CORSEFITS, C. E. Electric rotating furnaces. (13/4/20.) (Divided Application on 148/167.)

APPLICATIONS FOR PATENTS

July 7, 1921.

- 18 303 MARSDEN. Electro-mechanical rope safety grip for hoists, &c.
 18 420 RICHTER. Safety devices for preventing over-heating of electric flat-iron.
 18 458 CHLORIDE ELECTRICAL STORAGE CO. & DEAN, Accumulators.
 18 463 SYMPER. Strip for holding electric lamp holders in position.
 18 466 IGARIC ELECTRIC CO. (Cutler-Hammer Mfg. Co.). Motor controllers.
 18 474 BERRY. Electrically heated ovens.
 18 475 BERRY. Electric radiators.
 18 483 FRANCIS. Time-switching devices.
 July 8, 1921.
 18 484 GOLDFARB. Device for indicating interruptions in electric circuit.
 18 525 RECORD. Instruments for measurement of electrical resistances.
 18 531 MILLER. Telephone receivers operated by heat.
 18 562 HEARN. Lanterns and casings for electric and other lamps.
 18 575 WOODFORD. Automatic relay-operated starters for remote control of motors.
 18 578 SEGAL. Asynchronous motors.
 18 584 BOTTAM. Device for indicating interruptions in electric circuits.
 18 589 DININ. Accumulators.
 18 590 M. J. JACKSON (New and Old Patents, Ltd.). Electric power-transmission apparatus.
 July 9, 1921.
 18 595 GOS, LEON, WARE, ART, GOS. Switches.
 18 596 STEVEN. Electric controllers for a.c. motors.
 18 597 BROWN. Electric transmission or reproduction of sound.
 July 11, 1921.
 18 627 BUESHEIM. Contacts or switches.
 18 710 WARD, JAMES & LAWTON. Electric magnets.
 18 710 LAMBERT. High tension cable connections for internal combustion engines.
 18 712 CORFIELD. Making bath for electrolytic deposition of copper.
 18 712 EVERSHED. Metallic vapour lamp. (10/7/20, Germany.)
 July 12, 1921.
 18 753 RECORD. Electrical measuring instruments.
 18 755 GATH. Electric press switches.
 18 758 MAY & PADMORE. Electric heaters.
 18 772 HAYES. Electrically propelled lawn mower.
 18 811 WILLIAMS. Binder for securing telegraph, &c., wires to insulators.
 18 818 BENNETT. Switches.
 18 823 WESTERN ELECTRIC CO. Use of magnetic material for loading conductors.
 18 824 HALL & OTTENS. Switches.
 18 846 DUBS. National Precipitation Co. Operating circuit and switch arrangement for motor-cars.
 18 848 DUBS (National Precipitation Co.). Electric control of fluid-pressure actuated motors.
 18 860 B. T. H. Co. (G. E. Co.). Control of air-compressors.
 18 868 GRANT (Zimmermann). Electric heating devices.
 18 880 SHUTER & SMITH. Electric conductors.
 July 13, 1921.
 18 934 SCOTT. Electric light fittings.
 18 952 VILLIERS. Switching Co., BRADLEY & POUNTNEY. Contact-breakers for flywheel magnets.
 18 963 WESTERN ELECTRIC CO. Impulse transmitters.
 18 964 & 18 965 METROPOLITAN-VICKERS ELECTRICAL CO., DARER, COATES, GRIFFIN & DAVIES. Switchgear.
 18 970 MARINO. Electro-deposition of metals on aluminium and its alloys.
 18 973 B. T. H. Co. (G. E. Co.). Switches.
 18 974 MAXLEY. Data recording attachment for telephones.
 18 975 STONE & CO. Means of indicating adjustment or output of electric machines.
 18 982 SPENCER. Electric lighting and heating of railway vehicles.
 July 14, 1921.
 18 999 SHEPHERS (Dorey). Indirect lighting unit.
 19 010 SCOTT. Water-tight interlocked switch and plug and socket connection.
 19 040 SIEMENS BROS. & CO. & LE MARECAL Tungsten and tungsten filaments.
 19 041 SIEMENS BROS. & CO. & CHRISTIAN. Circuit arrangements for automatic &c. telephone systems.
 19 065 ARCHER. Accumulators.
 19 070 WESTERN ELECTRIC CO. Electric wave filter.
 19 097 OLDHAM. Switches.
 July 15, 1921.
 19 105 ALDRED & MILNES. Commutator for dynamos and motors.
 19 127 & 19 128 RADIO-COMMUNICATION CO. & SCOTT-TAGGART. Thermionic valve devices, &c.
 19 145 WEST & CO. Switches.
 19 153 LOTT. Direct electric driving of slowly-rotating shafts. (Jan., 1917.)
 19 188 RILEY. Electrically controlled door, &c., locks.
 19 189 AUTOMATIC TELEPHONE MFG. CO. Telephone systems. (28/7/20, U.S.).
 19 196 SOC. D'ELECTRO-CHIMIE ET D'ELECTRO-METALLURGIE. Static transformers for alternating currents. (14/4/21, France.)
 July 16, 1921.
 19 204 COLEBROOKE & WILLIAMS. Vacuum or low pressure tubes for electrical discharges.
 19 227 ATELIERS DE CONSTRUCTIONS ELECTRIQUES DU NORD ET DE L'EST. Protective devices for a.c. systems. (4/8/20, France.)
 19 234 MULLARD. Thermionic valves.
 19 238 ANGUS. Devices for supplying unidirectional pulsating or intermittent currents.
 19 239 DAVIS & DUBBERLY. Electric heating devices for engines, &c.
 19 255 SIEMENS-SCHUCKERTWERKE, G. M. B. H. Apparatus for metallic vapour rectifiers. (31/7/20, Germany.)
 19 258 & 19 259 DITTMAYER. Electric door-protecting alarms.
 July 18, 1921.
 19 277 JENSEN. Switches.
 19 278 MACKENZIE, GOLLAND & HOUGHTON. Electrical apparatus for raising and lowering curtains, &c.
 19 310 HOWELL'S, LTD. (Howell's Cine Equipment Co.). Electric arc regulating devices.
 19 318 MEYSTER. Electrically heated boilers. (8/9/20, Germany.)
 19 326 BRASSE. Coating for electric wires or cables.
 19 328 WESTERN ELECTRIC CO. & DEARIN. Selective switches for automatic telephone exchanges.
 19 340 B. T. H. Co. (G. E. Co.). Coating materials.
 19 345 IRELAND & LUCAS. Switches.
 19 348 SIEMENS-SCHUCKERTWERKE. Gas-voltammeter. (4/9/20, Germany.)
 19 350 & 19 352 METROPOLITAN-VICKERS ELECTRICAL CO. & BROOKS. Electric control systems.
 19 351 METROPOLITAN-VICKERS ELECTRICAL CO. & NORTH. Master controllers for electric control systems.
 19 353 METROPOLITAN-VICKERS ELECTRICAL CO., BROOKS & PRIESTLEY. Raising and lowering trolleys in connection with overhead traction.
 19 354 METROPOLITAN-VICKERS ELECTRICAL CO. & BROOKS & PRIESTLEY. Electric traction.
 19 359 BRUSH ELECTRICAL ENGINEERING CO. & SCHOLEFIELD. Securing windings in electrical apparatus.
 19 369 IGARIC ELECTRIC CO. (Cutler-Hammer Mfg. Co.). Rotary converters.
 19 378 OLDHAM. Electric lamps to be carried on the person.
 July 19, 1921.
 19 393 WALL. Systems for generation and transmission of electric energy.
 19 394 WALL. Electrical condensers.
 19 411 PILKINGTON & YOUNG. Electrical transmitter microphones.
 19 414 BEAVIS. Think telephone device for conversion of single to double bridge tests, and vice versa.
 19 433 METROPOLITAN-VICKERS ELECTRICAL CO., RELAYS. (6/8/20, U.S.)
 19 441 & 19 445 LUCAS. High-tension ignition apparatus.
 19 450 WESTINGHOUSE BRAKE & SIGNAL CO. Electro-pneumatic braking apparatus. (17/3/21, U.S.)
 19 460 BROWN. Electrodes for arc welding.
 19 468 JULIEN. Obtaining tubes electrolytically.
 19 476 GES. FÜR DRAHTLOSE TELEGRAPHIE. Production of electrical oscillations by choke coils on transformers. (21/7/20, Germany.)
 19 479 TELEGRAPHON GES. Telephonographs, &c. (24/8/20, Germany.)
 July 20, 1921.
 19 492 BRITISH INSULATED & HEATED CABLES, LTD., NESBITT & FULLER. Electric cables.
 19 512 BERRIDGE & WINNALL. Electric lamp holders.
 19 520 MARRIOTT. Electrically-heated appliances. (10/12/20, Australia.)
 19 527 MARTE. Electrically-operated switchgear, railway signals, &c.
 19 528 SMITH. Electro-magnets.
 19 539 IGARIC ELECTRIC CO. (Cutler-Hammer Mfg. Co.). Electric generating plants or systems.
 19 540 IGARIC ELECTRIC CO. (Cutler-Hammer Mfg. Co.). Rheostats, &c.
 19 543 B. T. H. Co. (G. E. Co.). Electric distribution systems.

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THE PROPRIETORS, EDITOR, and MANAGER, take this opportunity of wishing all readers of "The Electrician" a Happy Christmas and Prosperous New Year.

Notes of the Week.

The Gasfilled Lamp Patent.

WE record elsewhere an important decision of the House of Lords which upholds the validity of the LANGMUIR gas-filled lamp patent of 1913. It will be remembered that the courts below decided that, although the invention was one of great merit, and that there was good subject matter, the specification did not sufficiently define the ambit of the monopoly claimed. The word "large," as applied to the diameter of the filament, was considered to be too ambiguous and insufficiently precise in definition to limit the nature of the invention. The House of Lords have now come to the conclusion that not only were the directions in the specification adequate for an experienced lamp maker, but that it would have been inconsistent with the generality and sweep of the explanation given to have inserted a definition of the word "large." Consequently, the appeal has been allowed and the patent has been declared valid.

Agreement with American Law.

THIS decision, which is in conformity with the judgment of the Federal Court of Appeal of New York State, seems to us to be a just and equitable one. Patents involving the application of a principle to a method or methods of manufacture are difficult to construe, and very often, as in the present case, we have the most divergent views of the meaning and scope of the patent. Moreover, the principles of construction are stricter in this country than in the United States or Germany. However, we are glad to see that a refined legal technicality is not to be allowed to deprive the inventor and the owners of the patent of a

due reward for a great and epoch-making discovery. The case is a good illustration of the pitfalls of inventors, and also a warning against the use of loose words and terms in patent specifications.

The Efficiency of Wireless Plant.

APART from the press stunts, of which wireless has been the victim (or conspirator), the thing that most strikes the observer of progress in this branch of electrical service is the enormous disproportion between the hundreds of kilowatts utilised at the transmitting end and the few microwatts picked up at the receiver. No doubt this apparently inevitable state of affairs has had its influence upon those who have been engaged in the practical development of wireless, for it is only within recent years that any progress has been made in the rounding up and extermination of the losses which take place within the transmitting plant itself. The old spark transmitter had an efficiency in the neighbourhood of 15 per cent., but it is only necessary to inspect the oil-cooling system of the high frequency alternator, the water jacketing of the arc, or the red-hot anodes of the very latest transmitter, the three-electrode valve, to realise that even present-day apparatus has far to go before it approaches the efficiencies now commonplace in low-frequency and direct current work.

Reduction of Aerial Losses.

THE difficulties to be overcome in raising the efficiency of high-frequency generating plant are apparent upon very little consideration, but even so it will come as a surprise to many to learn that of the high-frequency energy generated and supplied to the aerial, as little as 10 per cent. is radiated. There is an obvious field for investigation here, and in Mr. ECKERSLEY's paper on "Aerial Resistances," read before the Wireless Section of the Institution of Electrical Engineers and abstracted in another column

of this issue, an account is given of work carried out in 1920 for the Marconi Company in which the ground under the aerial was covered with a wire network and thus screened from the electric field. As a result the losses were reduced four times. This is obviously a most important claim, and we can only regret that the discussion which took place, and which was maintained with a warmth which augurs well for the future of the Wireless Section, did not supply some of the omissions from which the paper suffers. The screen is described in detail, but we see no particulars of the earth system with which it is compared; and while there is much uncertainty as to the method by which signals are propagated it is of immediate interest to know what is the precise effect upon them of not using any earth connection. We think the subject might well come up again for discussion when it has received the further attention it deserves. For, as Mr. TAYLOR rightly points out in our Correspondence columns, the possibilities of the screening method are not generally realised.

Some Lessons from Switzerland.

LEARNING from other people is an important factor in the accumulation of our experience, and this is equally true between international industries as between individuals. The article on "Recent Developments in Switzerland," by Dr. STANLEY PARKER SMITH, which we publish on another page of this issue, should therefore be particularly useful at a time when the proper utilisation of our water-power is a matter for concern, when the wider adoption of electric traction is becoming an ever-growing necessity and when we are ever being told to look to Switzerland in things electrical.

Some Examples to Avoid.

SWITZERLAND, indeed, for the reasons upon which it is not necessary to insist, is rapidly becoming electrified. Dr. SMITH finds that it has adopted high-tension single-phase electric traction as its standard system with some success, and that it is allowing, or, rather, submitting to the National Railway Department building stations for supplying the traction load exclusively. To do this, as might be expected, has resulted in the amassing of a wealth of detail and experience of which we should do well to take advantage, if only to avoid some of the things that have been found wanting. For we cannot think that conditions over here are such as to make it economically wise for railway companies to build their own power stations or for supply authorities to submit tamely to the loss of the railway load. We are glad to see that this view is supported by the Commissioners in their recent decision on the London and Home Counties district and also in a paper read last Friday by Sir VINCENT RAVEN before the North Coast Institution of Engineers and Shipbuilders. In general it is the only course that can safely be taken and where we should do well to avoid following in the footsteps of the Swiss pioneers.

Successful Hydro-Electric Development.

As regards the system to be employed for electric traction, there is not much that can usefully be said. In this country we are now committed to a system which is radically different from that which the Swiss have found successful. But we could probably learn something useful from their experiences with the overhead equipment and, to some limited extent, with the motors and control gear. On the other hand, what Dr. SMITH has to say about the design and construction of hydro-electric stations that are now in

use, or are being built, in Switzerland should be extremely useful to electrical engineers engaged on the same task over here. The utilisation of what water power we possess is a necessity that is gradually being forced upon us as it was long ago forced upon the Swiss. The description of the various stations which Dr. SMITH gives shows that there are many difficulties to be overcome before this can be successfully accomplished, but that these problems have been solved by a thorough study of details from the Swiss standpoint and without too much outside influence. These are certainly ways in which we should do well to follow their example.

The Control of Water Power.

AFTER three interim reports from themselves and somewhat similar pronouncements from other interested bodies the final report of the Water Power Resources Committee, to which we referred briefly in last week's issue, comes as a sort of anticlimax. We knew already what can and cannot be done economically, and what is being done with the water powers at our disposal; while the proposal to place the regulation and use of this power under some new central authority or under the Electricity Commissioners had already been made in the Committee's own second interim report, which was published almost exactly a year ago. Nevertheless, this is the chief point of interest in the report, for it is the one thing on which the Committee are not unanimous. While all agree that in this country there is a lack of engineering knowledge and experience of water-power problems, a point upon which we were recently criticised for insisting, and all agree that what water-power we have should be controlled so that it can be used in the best possible way, two members, Mr. SANFORD FAWCETT, Deputy Chief Engineering Inspector of the Ministry of Health, and Mr. W. A. TAIT, a well-known consulting engineer, object to the establishment of another permanent Commission to deal with the question.

Some Authority Necessary.

THIS seems a little inconsistent, and is certainly a little disappointing. For the attitude taken up by the majority of the Committee is a notable advance upon their views at the time of the publication of the second interim report, when it was suggested that there should be three distinct authorities to deal with different facets of the problem. Opposed though we are in a general way to the multiplication of controlling authorities, there seems nothing but to bring into being yet another such body. The alternative is to add the work to the already numerous duties of the Electricity Commissioners. But this would be a mistake, closely bound up though the utilisation of water power must be with the development of the electricity supply in this country. There are already complaints that the Commissioners are too slow in coming to their decisions, and that while we wait for them the industry stagnates. To increase their duties, as is suggested, would certainly lead to yet more delay. This, however, is a relatively minor point compared with the setting in motion of adequate machinery to carry out the Committee's recommendations. We hope that Parliament will lose no time in dealing with the matter.

The East Midlands Electricity District

THE latest scheme for the reorganisation of electricity supply in an electricity district seems to contemplate purely municipal control. It is proposed to constitute a Joint Electricity Authority of 20 members for the East Midlands,

of whom twelve are to be appointed by the municipal undertakers and three by the three county councils interested, only one representative being allowed to the Derbyshire and Nottinghamshire and the Leicestershire and Warwickshire Electric Power Companies. The remaining four members are to be allocated to the railway companies and to large consumers, the latter being those whose consumption is 100 000 units a year or more. In the administrative and financial proposals the standard form seems to have been followed, and they call for no special comment.

Technical Details.

IN regard to the engineering proposals, however, we cannot see any estimates of the economy in coal consumption and administration to be effected, or mention of the generating stations to be dispensed with, and in these respects the scheme does not comply with the requirements of the Electricity Commissioners. It is proposed to employ the standard three-phase, 50-period, system for all purposes. The main transmission pressure will be at 33 000 V, with secondary distribution at 11 000 V. The first 33 000 V line will be between Nottingham and Long Eaton and Ilkeston, but at a later stage lines will be laid to Mansfield, Hucknall, Torkard, Spondon, Derby, Burton, Loughborough, and Leicester. The transmission lines will be partly overhead on poles and steel towers and partly lead-covered paper insulated cables. Four main stations and a fifth smaller generating station are proposed. The existing station at Leicester will be of 20 000 kW initial and 50 000 kW ultimate capacity; that at Nottingham of 30 000 kW initial capacity, though capable of extension to 200 000 kW; at Derby of 19 750 kW with the possibility of expansion to 40 000 kW, and at Burton-on-Trent of 7 500 kW, capable of developing up to 30 000 kW. A new station of 3 000 kW may also be erected at Newark. This seems extraordinarily small, but provision will be made for the ultimate erection of 200 000 kW of plant so that the aggregate capacity of the five stations can be increased to over 500 000 kW. The existing stations at Loughborough, Mansfield, Melton Mowbray, Long Eaton, and Ilkeston are to be continued until it is economically practicable to replace them with a bulk supply, and the two power companies and the Melton Mowbray Electric Light Co. are to continue as distributing authorities in the area covered by their provisional orders. The scheme does not contain the usual statistics of the authorised supply undertakers, the capacity of their generating stations, maximum loads, etc., so that no useful comparison can be made between the present condition and the proposed scheme of re-organisation.

An Interesting Revival.

MAJOR RICHARDSON'S success in Dundee with his two-part tariff based on room area has emboldened him to make yet another attempt to simplify the supply of electricity for domestic purposes. As will be seen from an article which we publish on another page of this issue, this simplification is an interesting combination of new and old. For, while using some form of that surface wiring upon which economists place so much reliance at the present time, it is based on a reversion to the "tree" system. In other words, a main twin cable of suitable capacity is taken through the passages and landings on each floor of the house in the form, if necessary, of a ring main. Over each doorway is placed a double-pole fuse-board, into which the main is

looped and from which a ring of conductors is run round each room at the height of the door or picture-rail level. From this sectional ring main the necessary lamp points and the heating and cooking plugs are tapped off. All the lighting is effected from inverted fittings on brackets, and each room is controlled by a single-pole master switch placed near the door. In this way it is claimed there is always a heavy main available for each room, so that extra apparatus can be added without difficulty, while at the same time fusing is cut down to a minimum, and separate systems, with their distribution boards, therefore become unnecessary. The cost of fittings is reduced and the work of wiring of houses can be carried out by them cheaply and quickly. The arrangement is, indeed, a heroic attempt to overcome the disadvantages which are now always present when it is desired to add apparatus the use of which was not contemplated when the original wiring was put in hand to a house installation, and it will be interesting to know how it works and what disadvantages, if any, are discovered in practice.

The Nation's Wealth.

IN these days of complicated arguments and views on reparations, exchanges, and prices a re-statement of the fundamental facts of economics, on which we must build any bridge that is to convey us out of present difficulties, has certain distinct uses. This being so, we recommend a perusal of a letter bearing the names of a number of influential signatories which appeared in "The Times" of December 15th. To make this perusal easier we reproduce the letter on another page of this issue. Its argument is that, as we live by exchange, every obstacle to free exchange is a charge on the community, that as saving is essential to life, every inducement should be given to save, and that to stimulate this inducement every encouragement must be given to individualism. Again, the purpose of industry is to make and supply goods, and any rigidity, whether of prices, output, or working hours, is a discouragement both to producer and buyer and thereby limits both supply and demand. These are the opinions of a group of that much-abused class, the capitalist, and, seeing that what they say is not only cogent, but trite, it may be wondered why we think it worth while to make reference to it.

The Other Side of the Picture.

BUT past and present experience shows that no real relief from existing disabilities can be achieved without the co-operation of all those classes which make up modern industry. For the capitalist to see things in the right perspective is not sufficient unless the worker follows suit. This stage, if we are to judge by a manifesto recently issued by the Trades Union Congress General Council, has, unfortunately, not yet been reached. This manifesto restates the same wrong-headed arguments in the same foolish way. It "views with alarm" what it calls a conspiracy to secure an unreasonable reduction in wages and an extension of the normal working week. Employers are roundly accused of trying "to get their own back," and are solemnly warned that "a policy of reprisals is one likely to lead to disastrous consequences." Even if employers could prove that reduced wages and increased hours would lead to industrial prosperity, these movements would still be opposed (the manifesto continues) to the suggestion that the workers' standard of life should be lowered to secure this object. The worker has a moral right to claim improvement in working conditions and to something more

than a bare living. Quite rightly the manifesto refuses to accept the present standard of living as the highest possible, but it vitiates this claim to better things by a vast amount of unsound argument and irrelevant invective. Once again it must be stated that to get our industrial machine at high speed requires the maximum of effort on everyone's part, capitalist and worker alike, for only in that way, a way which requires freedom for enterprise in the widest sense, can real prosperity be attained. Nobody knows this better than workers in the electrical industry.

Taxation and Trade.

COL. O. C. ARMSTRONG and the Federation of British Industries are on surer ground than they have been lately in a letter which has been addressed over the President's signature to the Chancellor of the Exchequer. As this letter truly says the mass of evidence collected from the chief industrial centres in this country confirms that the present burden of taxation is crippling the efforts of manufacturers to recover and extend their foreign markets and is stifling the possibility of a trade revival, which is so urgent if an alleviation of the present unemployment is to be achieved. The need for increased capital in the period of high prices and dear labour, if the value of trade is to be maintained, is equally evident, yet the increased capital cannot be available while there persists a high rate of income tax and niggling and unproductive imposts like the Corporation Tax.

The Effect of Present Taxation.

THE present high rates of taxation operate in several ways. From the consumer's point of view they strangle buying and so prevent trade expansion. From the manufacturer's point of view they not only reduce turnover, but make living from hand to mouth almost a necessity, limit output and cut down that employment which in times of depression is usually employed in making for stock. Psychologically, too, the reduction of taxation would be a stimulation to further effort and in its turn would do a great deal to lift us out of the present mess. It is true that a reduction in taxation and a cutting down of Government expenditure would mean the cessation of a number of activities which are desirable for the improvement of the nation's welfare; but this, for the time being, must be submitted to in order to obtain the still greater advantages that would result from a recovery of trade and industry.

The London Electricity Problem.

A PERUSAL of the reasoned statement of the Electricity Commissioners in announcing their decision on the schemes for the reorganisation of electricity supply in London and the Home Counties primarily arouses in us a feeling of admiration for the breadth of view they have displayed in tackling a difficult and complex problem of which solutions have often been attempted during the past twenty years. This problem, which has increased in difficulty as time has gone on, will now, we hope, be settled on a rational basis. At the same time there are certain important gaps in the chain of argument, especially as to the disposal of generating stations that will be no longer required, and a vagueness in the financial proposals which is already

arousing opposition. The Beckton site, which to many seemed preferable to Barking, is dismissed without a word.

As we anticipated at the time, no one of the three major schemes has been adopted; each of them seems to have inspired the Commissioners on certain points, but there is plenty of evidence that they have formed their own conclusions on other matters—even on the technical details.

Hasty Criticisms.

It is evident that for the success of any project such as this the goodwill and co-operation of all parties concerned are essential, and though neither of the authors of the three major schemes seem at present to be satisfied with the Commissioners' decision, it must be remembered that it is really only an interim one, which is capable of alteration and improvement before the proposed Order takes its final form. In fact, the Commissioners point out that they will consult all the parties before completing their draft, and some of the criticism levelled at the proposals is, therefore, a little hasty and unnecessary.

For instance, the London County Council appear to be greatly exercised over the conditions to be attached to the consent to the erection of the Barking station and as to who is to be the purchasing authority. The companies are equally concerned with the financial provisions and the control of the policy of the Joint Authority, and some of the local authorities are keenly insistent upon a pure municipal policy. While it is probably impossible to satisfy all these parties in full, a great deal may be done by discussion and negotiation to remove some of the objections and thus pave the way for an agreed scheme.

The Joint Electricity Authority.

It is becoming quite the settled policy of the Commissioners to propose a Joint Electricity Authority for each district, and in this particular case the suggestions of the London County Council have met with most favour. It will be remembered that the County Council suggested an Authority of twenty-eight members, including eight from the Council and six each from the local authority undertakers and the supply companies, but the Commissioners propose to give eight members to each of the latter, the Council's representation being reduced to six. The six neighbouring county councils get three members, and the railway companies one instead of two as originally proposed. We thus arrive at a Joint Authority of twenty-six, though if an outside chairman be elected the number will be twenty-seven. We notice that there is no special representation of large consumers, and the two representatives of employees of the undertakers have also been omitted. We never understood why the employees in the industry should have special representation, nor do we think they could play a useful rôle on the Authority.

The Area—Good and Bad Points.

Though the area covered is an extensive and important one an Authority of twenty-six or twenty-seven is still large enough to give a reasonably fair representation to practically every interest entitled to have a voice in settling policy. There is one thing which the Commissioners must, however, do and that is to lay down clear and definite principles in their draft order for the election of the various representatives on the Authority or they will leave open the door to interminable municipal and political controversies, which will militate against progress and be a source of great weakness in future.

Whatever principle be adopted, whether the basis of

representation be the units sold in or the total population of an area, we venture to suggest that an attempt might be made to apply the principle of proportional representation, and also that provision be made for the periodical revision of the constitution of the authority. Certain districts in the Greater London area are rapidly becoming industrialised, and as they grow in population and importance they will desire greater representation on the Authority. It is important also that the Authority should continue to be made up of those who are responsible for providing the supply and not allowed to drift into purely political or non-interested hands. Flexible rules, admitting of this and other changes which circumstances may demand, are a great advantage to a new organisation and the Commissioners might well keep this in mind.

A Blow to the Parish Pump.

We are very glad to notice that the Commissioners have paid little regard to those County Councils and other local authorities who desired to be excluded from the District. An electrical area, as they truly point out, has no relation to local government boundaries, and economy and efficiency in the supply of electricity are apparently to be the guiding principles in the formation of electricity districts and Joint Electricity Authorities. For too long have the whims and fancies of petty local authorities been allowed to check the progress of electricity supply in this country, and we are gratified to have such a clear and definite pronouncement that petty parochial parish pump policies in electricity supply are no longer to be tolerated. At the same time more might have been made of the zone idea put forward at the enquiry. For the first problem to tackle is that of development in the central area. The outer and mainly "unelectrical" districts may be left until later. That being so, due provision for such a policy might well have been made.

The Technical Problem.

There is plenty of evidence of independence of judgment in the Commissioners' statement. For instance, the technical proposals for dealing with the requirements of the District during the first stage, that is until 1925 or 1926, have been adopted and the necessary generating plant has been authorised; but the Commissioners have substituted their own plans for the second stage which includes the erection of a capital station in Barking instead of continuing the development of certain of the grouped stations. This, they contend, will involve no more new capital expenditure than would the extension of the group stations, but it will lessen the coal consumption by 10 per cent. and reduce the average cost of electricity to authorised distributors by 15 per cent. In regard to railway electrification the Commissioners have also taken a line of their own and they re-affirm the opinion that a Joint Authority could generate electricity more cheaply than an independent traction station. As electrification will take place gradually over a number of years the traction demand will be a progressive one, the Commissioners decision is the right one, if a low price over a long term of years can be guaranteed as it should be.

Inter-Connection and Grouping.

The inter-connection of the principal generating stations, coupled with the pooling of the available plant, is essential for the success of the Commissioners' proposals, and it is, therefore, necessary for the Joint Authority to acquire these generating stations (about twelve or fourteen in

number) or obtain control over their working. As we remarked, nothing is said about the fate of the other stations. The Companies, we understand, agreed to sell the stations concerned provided they obtain an extension of their tenure as distributors, and the local authorities are also willing to transfer theirs on certain terms. Unfortunately the decision of the Commissioners has for the time being shattered this agreement; we hope not permanently.

The principal difficulty in this connection, therefore, seems to be the prolongation of the companies tenure and it would be in the best interests of electricity supply if this question of the distributing powers were settled on reasonable and even generous terms, considering the pioneer work that they have undertaken. We are therefore in complete agreement with the Commissioners when they say that a substantial extension of tenure would be more conducive to the stability of these undertakings and to their efficient development than the existing short period with recurring rights of purchase at intervals, provided the extension be coupled with a reasonable sliding scale of price and dividend.

Attitude of Companies.

We notice that the nine companies which constitute the London Electricity Joint Committee are dissatisfied with the Commissioners' decision because it does not ensure that the whole of the financial control of the Authority's work shall be in the hands of those members who provide the capital or who are responsible for it by way of guarantee or otherwise. Or, in other words, that the representation of the companies on the Joint Electricity Authority is not sufficient to warrant their making capital or indeed taking part in the scheme at all. A Bill which had been prepared in consultation with the London County Council in anticipation of the Commissioners' decision on the lines put forward by the Companies at the enquiry has been withdrawn. No doubt financial control is a most important point, and as the Commissioners' proposals are only in the draft form it is hoped that steps will be taken to meet the views of the companies before the Order takes its final shape. This is essential, for no scheme could be successful at the present time without the co-operation of the supply companies. And the solution in our view should take the form of giving private enterprise full scope, subject to control over price and dividends either by a Joint Authority or by the Commissioners.

General Conclusions.

If these questions were settled, as we hope they will be, there would be very little to prevent that hearty co-operation of all supply authorities in the District which is essential for progress and for the inauguration of that cheap and abundant supply of electricity for which London has already waited too long. Under the Commissioners' scheme the question of finance would not be so difficult to solve, for the existing undertakers can carry on for twelve or eighteen months, by which time the Joint Authority will no doubt have conferred upon it the additional statutory powers requisite for carrying out its duties in a proper and efficient manner, or at least we shall know better where we stand.

It must finally be insisted that the scheme is not cut and dried, but only tentative. Unless all parties agree progress is impossible without further legislation. It is hoped that once the first shock has died away all those concerned will see the advisability of coming together and whole-heartedly assisting the Commissioners to evolve order out of chaos.

Recent Developments in Switzerland.

By STANLEY PARKER SMITH, D.Sc.

The Editor of THE ELECTRICIAN has asked me to furnish him with a brief account of a recent visit I made to Switzerland in order to see what developments had taken place during and since the war in connection with power stations and electric railways. Thanks to the courtesy of Messrs. Wüthrich & Eborall, of the Oerlikon and Brown, Boveri undertakings respectively, I was supplied with all the necessary letters, &c., for my tour.

Ateliers de Construction Oerlikon.

At Oerlikon, Dr. Behn-Eschenburg—whose name has long been a household word to English electrical engineers—welcomed me once more to the Maschinenfabrik over which he presides. While he gave me an interesting account of the experiences of the St. Gothard electrification, I could not help thinking what an enormous number of problems have been raised and solved since the days of the Seebach-Wettingen experiments, some of which I witnessed as a student. In the shops there was such a preponderance of locomotive material that all other work seemed negligible in comparison. An idea of the new locomotive erecting shop is gained from Fig. 1, which shows a number of goods locomotives for the St. Gothard Railway. The mechanical parts are supplied by the

locomotives of this firm, however, are assembled at Münchenstein, near Bâle. I had an excellent guide in Herr Schroeder, a traction expert, who spared no pains in explaining everything of interest. Experience has already proved the absolute necessity of rigid constructions for traction work, and the robust design of the main transformers for the locomotives was as good an example of this as one could wish to see. The method of cooling these transformers had several interesting features. The transformer is placed in a strong tank through which oil is pumped, while the oil is cooled in pipes along the outside of the locomotive or in a cooler acted on by a fan.

There was an interesting difference between the Oerlikon and the Brown-Boveri single-phase traction motors. In the Oerlikon motor there are no resistance connectors between the armature winding and the commutator segments; whereas such connectors are used in the Brown-Boveri motor. Both types work sparklessly, but, as in so many other spheres, it is a good thing that both methods are being thoroughly tried in practice. The resistance connectors are not placed in the slots as in earlier machines, but between the segments and the coils in such a manner that cooling is ensured. The object in reverting to the use of these connectors is to obtain

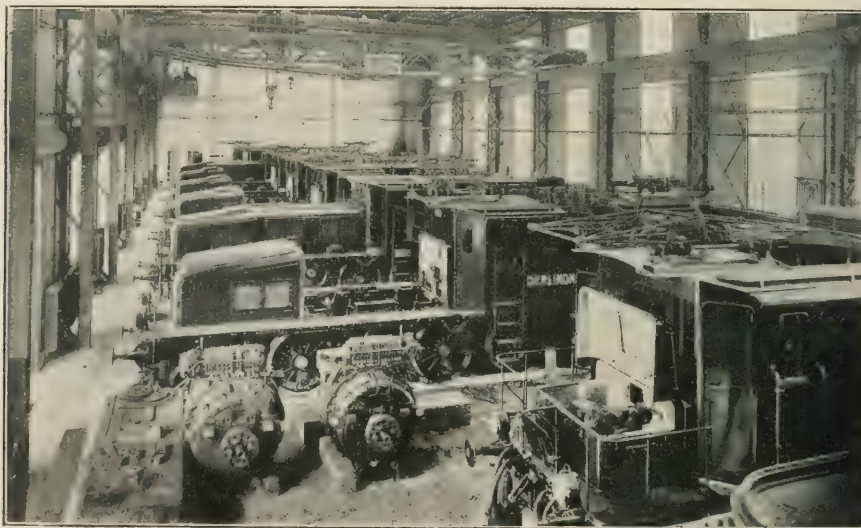


FIG. 1. THE LOCOMOTIVE ERECTING SHOP OF THE MASCHINENFABRIK OERLIKON.

Maschinen und Lokomotivfabrik, Winthertur. By removing the coupling rods, the motors can be run light in position. In order to accustom the drivers to the details of the electrical equipment, a number are sent by the Federal Railway Administration to gain experience during the erection of the locomotives. It was interesting to note that the compensated series motor with phase-displaced commutating field, introduced for traction by Dr. Behn-Eschenburg many years ago, has now become the standard motor for single-phase railways.

In the shops were also giant waterwheel alternators and low-frequency ($16\frac{2}{3}$ cycles) transformers for the railways as well as a 3-phase motor truck coach for the Burgdorf-Thun Railway, which was approaching completion.

Having thoroughly explored the shops under the able guidance of Herr Misslin, I spent a long time with the heads of several technical departments, and learned what had been done in connection with variable-speed, alternating-current commutator motors, rotary converters, and electric locomotives. The design of one machine interested me greatly—a rotary converter for 1500 V at 50 cycles for traction work. The construction and test results of this machine were discussed in every detail, until at last an old designer was satisfied.

The Baden Works of the Brown, Boveri Company.

At the Baden Works of the Brown, Boveri Company, the shops were also filled with work for the Swiss Federal Railways. The

greater freedom in the design. It may also be mentioned that, instead of using a lap winding on these armatures, a wave (series-parallel) winding with as many paths as there are poles was employed. I had also the good fortune to meet here Dr. A. Fraenckel, one of the firm's consulting engineers, whom I had good reason to remember from my Karlsruhe days, when he was one of the late Prof. Arnold's assistants.

Eglisau Power Station.

The first power station visited was the new one at Eglisau on the Rhine (see Fig. 2). Between Constance and Bâle the river falls considerably, and there are already several power stations in this section. The Swiss-German frontier at this place runs along the middle of the stream, and the power station has been erected on a new channel on the Swiss side. (A glance at the illustrations will readily show that the interest in these hydraulic stations, especially to an electrical engineer, lies mainly in the civil engineering work). The stream itself has been dammed by large gates in order to give an effective head of about 35 ft., while on the German side locks have been built for use when the river becomes navigable. This canalisation has made a wonderful difference to the river. Below the tail-race one sees the time-honoured Rhine rushing madly along over the rocks, while above the weir the stream has now more the appearance of a lake. A few more stations like Eglisau and there will be no more of the old Rhine left.

Between the intake and the gates there is a fish ladder to enable

fish to swim up stream. The weir gates can be opened either at the top or at the bottom. The top gates are opened when the amount of water not required by the turbines is small; while in times of flood the bottom gates are opened and water issues forth under a head of 35 ft. Under the terms of their concession, the power company is not allowed to exceed this head on account of flooding the higher reaches. At the time of my visit, all the water was needed for the day load—indeed the volume was only just enough to run the full number of machines, and the cooling of the transformers had to be augmented by air cooling (open doors, &c.). The gates are operated from a gallery some 60 ft. above the water level, and this, together with the station building, presents a very pleasing effect (see Fig. 2) from the distance, while from the gallery a fine view of the Black Forest is obtained. Instead of the old ferry, there is now a bridge across the weir, which will be available to the public when the bed of the river below the gates has been re-made with concrete to prevent the foundations being washed away.

In the machine room there are six or seven vertical waterwheel sets (see Fig. 3), giving together 42 000 H.P. The space between the alternator and turbine was large enough to stand in—a novel experience to have the rotor wheel spinning round over your head whilst watching the oil splashing in the Kingsbury bearing.

The station at Eglisau is linked to the Nordostschweiz Kraftnetz. This network installed in N.E. Switzerland represents fairly well what the Swiss are doing with their water-power. Wherever possible, low-head (river) stations are kept working on fairly constant loads, while high-head stations fed from storage reservoirs (natural or artificial lakes) are called upon to supply the peaks. (Of course there are also low-head stations with and high-head stations without storage capacity.) In this way water is not wasted, while the system is also good for seasonal changes. In summer, when water is plentiful, the river stations can supply much power. During this time water in the hills is being impounded. In winter, when the rivers are practically dried up in many places, the reservoirs can supply the necessary power. It was interesting to compare this method with the one involving the use of reserve steam stations, employed some years ago.

I was greatly indebted to Herr Kraft, one of the N.O.K. engineers, for showing me these works.

The St. Gothard Railway.

The mountain section of the St. Gothard Railway is already worked by electricity, and electrification is being extended to the frontier at Chiasso in the south and to Lucerne and Zurich in the north. The system is single-phase with an overhead pressure of 15 000 V at 16½ cycles. Of the twenty-six locomotives at present in service between Erstfeld and Bellinzona, the electrical parts of the goods locomotives have been supplied by the Oerlikon Company, and of the express locomotives by Brown, Boveri & Company.

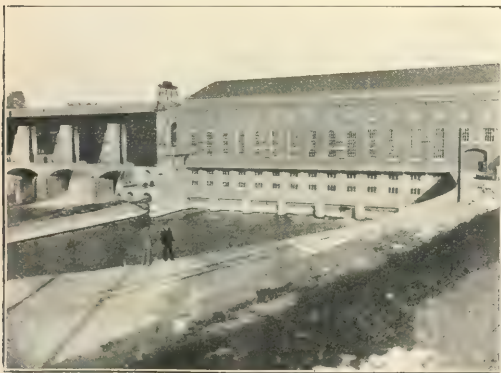


FIG. 2.—POWER STATION AT EGLISAU ON THE RHINE.

In a future delivery the goods engines will come from the Baden, and the express engines from the Oerlikon, firm—as the Pope divided the world between Spain and Portugal, so the Swiss Federal Government apparently divides its favours impartially between these two firms.

Electric traction has made a great difference on this line. Instead of three steam locomotives, two electric locomotives haul the express trains much more rapidly. At the moment, however, there is so little traffic owing to the bad trade and shortage of visitors that

full advantage cannot be taken of the electrification—the present traffic is only about half that of 1913. Fig. 4 shows Goeschenen Station at the Northern entrance, and Fig. 5 Airolo Station at the Southern entrance, to the St. Gothard Tunnel.

There are two generating stations for the St. Gothard route—Amsteg on the north side of the tunnel and Ritom on the south side. Both are high-head stations, the water for the former being obtained from the River Reuss and for the latter from Lake Ritom. The lake, now it has been deepened, has an immense storage capacity and it is intended for the winter load when the Reuss is practically frozen. The river, on the other hand, has ample water in summer, while for aesthetic reasons it is not desirable to



FIG. 3.—MACHINE ROOM AT EGLISAU POWER STATION.

draw on the lake at this period. The two stations are thus supplementary and are intended to furnish the power for the complete service on this route. Like the railway, these stations belong to the State, which has its own staff of engineers for carrying out these works.

It is interesting to note that in 1913, when it was decided to electrify the St. Gothard line, the much disputed question of the system was left open, and it was not until 1916, when the civil engineering works were well advanced, that it was decided to adopt the single-phase system at 15 000 V and 16½ cycles. By this time the soundness of the system had already been proved on the Loetschberg and Rhaetian Railways.

The Ritom Power Station at Piotta.

At the moment the Ritom Station is the only source of power for the St. Gothard line, but the load is comparatively small on account of the severe trade depression and the fact that only the mountain section as yet has been opened for electric traction. To judge from the visitors' book, a considerable number of engineers from all parts must visit Piotta every week. The chief engineer, Herr Schmidt, very courteously explained fully every detail from the working of the turbine governor to the various mishaps that had occurred since working was begun. Power is generated at 15 000 V, 16½ cycles, at which pressure the single-phase system is worked. For transmission, the pressure is transformed up to 60 000 V, the mid-point being earthed so that the cables—which were used on account of the tunnel—have only to withstand 30 000 V to earth. Alterations are now in hand for introducing peroxide of lead protective devices. Herr Schmidt explained the interesting results produced by the failure of a cable—among other things, a mighty transformer in exploding moved about 6 in. away from its position; the oil, however, was saved through having a sloping floor with a draining-off channel. Reactance coils have been added to protect the generators. A view in the machine room is shown in Fig. 6.

After lunch we visited the works near Lake Ritom, whence the water is obtained for the turbines. A funicular railway, which was built during the constructional period, runs along the pipe line and is now open for public traffic, as the lake is a favourite tourists' resort. Between the lake and the water-tower there is a short pressure tunnel through the side of the mountain. This tunnel has given some trouble from which much valuable experience has been gained. Apparently cracks are produced in the rocks during blasting, and the rocks also move under pressure; hence, unless means are taken to ensure that the lining of the tunnel

presses against a solid wall, leakage will ensue. By reducing the effective head in the tunnel, working has been made possible—when the Amsteg Station is completed, it will be possible to undertake any necessary alterations. Lake Ritom collects water from a great number of streams and commands an admirable view both of the hills and of the Ticino Valley. In winter it would appear that the sun did not penetrate into the valley, while it became very hot near the lake, though the nights were piercingly cold. The water entered the pipe line at a practically constant temperature of 4 to 5°C. all the year round; and in winter the hot air from the generators is used to prevent freezing near the penstocks and bends in the station. One of the engineers told me that, in his opinion, until the lake was drained for building the dam, the water in the lower parts had remained practically unchanged for centuries. Altogether this was a very instructive visit.

Power Station at Amsteg.

While Piotta is on the Italian-Swiss side of the Alps, Amsteg is on the German-Swiss side. The water is obtained by tapping the River Reuss between Wassen and Gurtellen, and conveying it through a pressure tunnel nearly five miles long high up in the side of a hill to Amsteg. To assist tunnelling operations the hillside is opened out at six places, most of which can be seen from the railway, as well as the works for the intake, where a curved dam is being built. Herr Studer, the engineer-in-charge of the works, was very enthusiastic in describing all the interesting and difficult points which had arisen. (It is really impossible to speak too highly of the kindness I met with everywhere.)

The lay-out of the station in many ways resembles that at Piotta, and it was very fortunate that the time of the visits showed the latter station quite recently completed and the former in the most interesting stage of construction. At Amsteg the turbines and alternators were in course of erection, so that the details of the Pelton wheels, &c., could be well seen. The stators were being wound on site. In this station three-phase generators, for supplying power into a 50-cycle network, were being installed; but these will be removed when the railway load renders it necessary to replace them by single-phase generators. The policy adopted by the Swiss Federal Railways is to generate their own power independently of industrial needs, and to supply power to the latter only during railway developments—a policy radically different from that advocated in the Interim Report for the Electrification of British Railways. Germany also favours the Swiss method, and it remains to be seen which is the better. A view of Amsteg Station is given in Fig. 7, with an electrically-hauled train on the St. Gothard Railway.

Here also there is a funicular railway alongside the pipe-line. The tunnel works were as interesting as could be imagined. Every

The Furka Railway.

In order to get to Brigue the terminus of the Simplon and Loetschberg Railways, the direct route was both handy and interesting. A few years ago a railway was built from Brigue, along the upper part of the Rhone Valley, over the Furka Pass to Disentis *via* Andermatt, to establish a connection between the east and west of Switzerland without having to go round the northern route. Though the rails have been laid and most of the tunnels pierced, the line has been opened for traffic between Brigue and Gletsch only. The remainder of the route is served by State "post-autos" (motor coaches), the successor of the old diligence.



FIG. 5.—BROWN-BOVERI SINGLE-PHASE LOCOMOTIVE PULLING PASSENGER TRAIN AT AIROLO STATION (SOUTHERN ENTRANCE TO ST. GOTHARD TUNNEL).

In Switzerland, as elsewhere, the motor coach has become a vigorous opponent to the railway, and it seemed very improbable that the unfinished part of the Furka line could ever hope to succeed against the "post-auto." In some parts of the country motor coaches have also deprived the railways of much of the light goods traffic.

The Simplon Tunnel.

The Simplon Tunnel, 14 miles in length, is the longest in the world. There are really two single-line tunnels, some yards apart and joined at intervals; but the second tunnel is only now being completed. Apparently the tunnel has been taken over by the Swiss State, while the three-phase electrification has been extended as far as Sitten (Sion), in the Rhone Valley. This extension, however, was really a war measure entailed by the coal shortage, and the three-phase is to be replaced by single-phase when the Rhone Valley line is electrified. Work on the power stations for this section has already been begun. The tunnel, however, will retain the three-phase system, because of future extensions in North Italy, &c.

It may be recalled that Brown, Boveri, & Company undertook the original electrification of the Simplon Tunnel at their own risk. That this "sporting offer" proved a success is shown by the fact that the original equipment and the Valtellina locomotives which were transferred to the tunnel service are still in use. It was also interesting to see that the Brown-Boveri four-speed locomotives with squirrel-cage rotors are still in service.

At the outset, power for the tunnel service was generated in a small station near by, the alternator being kept fully loaded the whole time by having an adjustable resistance in circuit—a simple method of regulating the turbine speed. A new station, however, has now been built at Massaboden, just outside Brigue, the water being obtained from the Rhone. This station works in parallel with another station on the Italian side of the tunnel. At times the available power is scarcely enough, but matters are helped by the fact that the snow on the southern slopes melts somewhat earlier than that on the northern slopes.

The ventilation of the tunnel is carried out entirely from the Swiss end, though at one time air was blown in at the Swiss end in summer and at the Italian end in winter. Except when a train is about to enter or emerge from the tunnel at Brigue, a curtain closes the entrance at this end. The air pressure is regulated according to the barometric reports received from Iselle, at the Italian end of the tunnel. The fans are driven by induction motors, the speed of which is regulated by Scherbius aggregators.



FIG. 4.—SCHÖLLENEN STATION AT NORTHERN ENTRANCE TO ST. GOTHARD TUNNEL, SCHÖLLENEN RAILWAY ON LEFT HAND SIDE.

precaution is being taken to prevent a repetition of the trouble at Ritom: all cracks in the rocks and spaces between the rocks and the tunnel lining are being filled in by forcing in cement under high pressure. Exhaustive experiments were also being made where insufficient information was available, showing how thoroughly the Swiss Railway Administration has taken up the question of railway electrification. It is expected to have the Amsteg Station working next year.

The Loetschberg Railway.

The Loetschberg railway, which was built for electric traction, connects Berne with Brigue, and was opened just before the war. Not only has it added to the importance of Brigue station, but it has introduced single-phase alongside the original three-phase. Consequently, when a train enters the station with a single-phase locomotive, a steam locomotive pulls the train back from the single-phase platform and pushes it in to a three-phase track, whence a three-phase locomotive hauls it into Italy.

At present there is an abnormally large amount of traffic passing over the Loetschberg Railway on account of about 10 000 tons of coal per day passing from Germany to Italy *via* this route. Consequently, the Loetschberg and Simplon locomotives are heavily worked at present.

The Loetschberg Railway is somewhat different in character from the St. Gothard Railway. From Brigue, the line runs almost parallel with the Rhone Valley line, though at a much higher altitude, as far as Hohen, whence the line turns northward and passes through some rough country before entering the tunnel at Goppenstein. Emerging at Kandersteg, fine views of glaciers and snow-topped mountains in the Bernese Alps are obtained. In descending to Frutigen, the line "loops the loop" at Blausee-Mitholz. The bridges and tunnels are intended for a double track, but only a single line exists at present, as is also the case on a section of the St. Gothard line.

The thirteen locomotives of 2 500 H.P. on this line were built to the design of the Oerlikon Company. As in most of the main-line locomotives in Switzerland, the motors are mounted fairly high and drive the coupled wheels through reduction gearing. Vibration troubles have been overcome by inserting an elastic member (in the form of a spring) inside the gear wheel, or, in more recent designs, inside the pinion. As far as one could tell, the starting of all the trains drawn by electrical locomotives was equally smooth and rapid—much smoother than the motor-coaches on the London lines—while I noticed no sign of any vibrations in the locomotive in which I travelled.

The Bernese Subsidized Lines.

In addition to the Loetschberg Railway, the Canton of Berne practically owns or subsidizes a number of other lines near the capital. These include the lines from Spiez to Interlaken and to Zweisimmen, and from Berne to Thun *via* Belp. Not only are they now electrified on the same system as the Loetschberg, but they are fed from the same supply stations at Spiez and Kandergrund. These extensions were largely due to the expense and shortage of coal.

There are fourteen 1 000 H.P. locomotives for these lines. The repair sheds are at Spiez, where the Loetschberg locomotives are also overhauled. At the time of my visit there were only three out

been punished rather badly. The later 1 000 H.P. machines have bevelled teeth, which drive at both sides of the motor.

The Federal Railways have also a line from Berne to Thun, and this has also been electrified on the single-phase system. On this section, valuable tests on interference with communication circuits have been made and successful remedies have been found.

Conclusion.

Time did not permit me to inspect the extensive electrification of the Rhaetian lines in the Engadine, where the single-phase system has also been adopted. I was able, however, to discuss the whole



FIG. 7. VIEW OF THE POWER STATION AT AMSTEG.

question of railway electrification with the several authorities in Berne, and all that I saw and heard convinced me that the Swiss had good reason to be proud of their achievements in this matter. It seemed to me also that the Swiss had gone about the problem in the right way. They had made a thorough study of their own problem and solved their difficulties without too much outside influence. Such freedom, perhaps, is not possible for every country; for example, it might not be prudent for France to adopt the single-phase system for her railways, even if it should be better than the continuous-current system, for the simple reason that the nation she most dreads has adopted the single-phase system. Great Britain, however, is free, or at least can be free from Continental or American influence in deciding what is best for her main lines. Moreover, Great Britain has firms and engineers who are financially independent of foreign developments. Consequently, the choice is or can be in our own hands; and if electrification is decided upon it behoves us, therefore, to make certain which system is best for our long-distance lines before going too far. For this reason it is perhaps fortunate that in the near future we shall probably see the Brighton main line electrified on the single-phase system, and the North-Eastern main line on the continuous-current system. My thanks are due to Mr. C. C. Hawkins—who accompanied me on part of my itinerary—for helpful suggestions in drawing up these notes.

Progress on Japanese Railways.

In the report on the commercial, industrial and financial situation in JAPAN, it is stated that the Government will construct 3 324 miles of new railways, and also improve the existing system. The total expenditure voted for the scheme is 1 419 000 000 yen, and of this sum 550 000 000 yen is to be allocated to new construction and 865 000 000 yen to improvements.

As regards improvements, the question of electrification is the one which calls for special attention. A Bill to establish a semi-official electric power company in Tokio, with a capital of 100 000 000 yen, which would supply the necessary electric power to the Government for its railways, failed to pass the Diet, and, in view of the unfavourable financial conditions since then, the Government were obliged to withdraw the measure and reduce the plan to about half of the original proposal. The work will take about five years, and will be looked after by an electric bureau which has been newly created in the Department of the Imperial Railways.

One of the new schemes is for the construction of a high-speed electric railway between Tokio and Nikko, which will cover the distance in about two hours, compared with four hours by the existing Government line.



FIG. 6.—SINGLE-PHASE GENERATORS IN RITON POWER STATION.

of twenty-eight locomotives in for repairs. One of these was a Loetschberg locomotive which had been stripped for its triennial overhaul, and the other two—one of each type—were in for faulty parts to be replaced. A certain amount of rewinding of the motors and transformers on the Loetschberg locomotives has been necessary of late, either on account of the wear and tear since 1913, or the recent exceptionally heavy coal traffic. Nevertheless, the quantity of repair work in hand seemed to be small. On the 2 500 H.P. locomotives, double helical gears are used, and some of these had

An Investigation of Transmitting Aerial Resistances.*

By T. L. ECKERSLEY, B.A., B.Sc.

It is well known to wireless engineers that long waves are necessary to transmit over long distances, but the useful radiation—which is proportional to the square of the aerial height divided by the square of the wave-length—becomes insignificant compared with the other losses when the wave-length is sufficiently long. A large part of the energy delivered to the aerial sinks into the neighbouring ground and is not recovered. With the idea of screening the earth from the electro-magnetic effects of the aerial current an inverted L-type aerial was used, and a screen of wires parallel to the horizontal part of the aerial and insulated from the ground was employed in the manner of a balancing capacity (see Fig. 1).

The Screened Aerial.

According to Maxwell's formula, an earthed screen with wires 1 ft. apart and 2 ft. 6 in. above the ground will carry 80 per cent. of the current, leaving 20 per cent. in the ground, and if the same screen is insulated there will be less than 1/10 000 per cent. R.M.S. earth current.

The screen was accordingly designed on this basis, and consisted

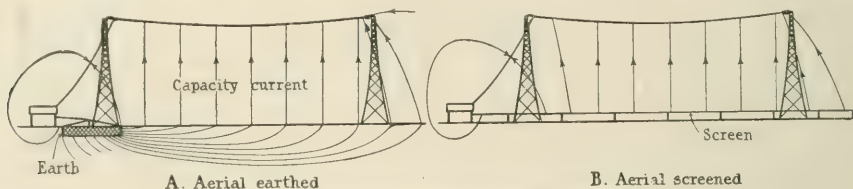


FIG. 1.—SCREENING OF EARTH-RETURN CURRENTS.

of sixty-four wires, 200 ft. long. It covered all the space below the aerial and extended in all directions an amount at least equal to the height of the aerial (i.e., 15 ft.) beyond the latter.

Comparative Results.

For the measurement of high-frequency resistance the "added resistance method" was used, but, instead of observing the reduction of current produced on inserting a known resistance, the voltage drop across the leading inductance was noted. An accuracy of 5 per cent. is claimed.

At a wave-length between one and a half and three times the natural wave-length of the aerial, the earthed aerial gave a resistance of nearly 4 O, while that of the screened aerial was less than 1 O. Thus the power required to produce a given current is reduced four-fold when using the screened aerial.

Experiments with Screen.

Experiments were made to set a limit to the number and spread of screen wires and also to indicate the origin and nature of the losses.

It was found that if the wires are sufficiently few and far between, the resistance will be inversely proportional to the number of wires, but that when the wires are so crowded that the distance between

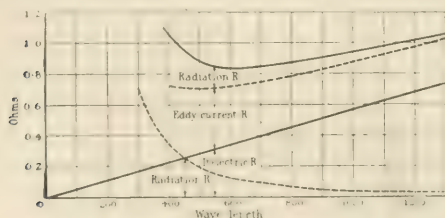


FIG. 2.—ANALYSIS OF LOSSES ON L-AERIAL AND SCREEN.

them is small compared with their height above the ground, an increase in the number of wires will not appreciably reduce the resistance; and also that the wider the screen, the less is the resistance, up to a certain point, but that an overlap equal to the height of the aerial seems to be sufficient. The aerial resistance can only be further reduced by widening both aerial and screen together.

* Abstract of a Paper read before the Wireless Section of the Institution of Electrical Engineers.

Analysis of Losses.

The aerial resistance can be analysed into four parts:—

- (a) Radiation resistance : $\propto \frac{1}{(\lambda)^2}$
- (b) Eddy-current and wire resistance : $\propto \frac{1}{(\lambda)^{1/2}}$ nearly.
- (c) Dielectric loss resistance : $\propto \lambda$.
- (d) Leakage resistance : $\propto \lambda^2$.

of these (d) seemed to be absent in this particular set of experiments, and, considering the screened aerial, the other losses bore the proportions indicated in Fig. 2.

The dielectric loss varies with the distribution of the wires of the screen and has been finally traced to the surface layer of vegetation on the earth.

Screen Oscillation.

When measurements were taken at wave-lengths close to the natural wave-length of the aerial, there was observed an increase

of resistance which was much too rapid to be accounted for by any change in the eddy currents or radiation resistances. This was found to be due to oscillation from end to end of the screen, as shown in 2 of Fig. 3.

No. 1 is the main oscillation which is responsible for the radiation of energy.

No. 2 is the oscillation from end to end of the screen, to which reference has already been made. This may obviously absorb a

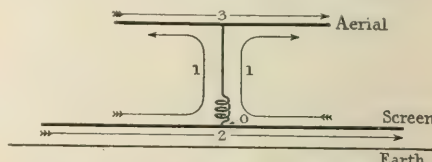


FIG. 3. INDEPENDENT FREE PERIODS OF THE SCREEN.

great deal of energy if present and, since it does no useful work in radiation, it is in every way harmful.

No. 3 is the oscillation from end to end of the aerial and is normally outside the working range of wave-lengths; for that reason it cannot be neglected. The oscillation (2) is usually somewhere near the natural period of (1), and hence is dangerous when working on the shortest wave-lengths.

Earthing of the point "O" is fairly effective in reducing the peak in the resistance curve, but it leads to about 50 per cent. all round increase of resistance. It has, however, been discovered that a point on the loading coil can be found which can be earthed without increasing the resistance.

Conclusions.

Screens have been employed successfully at large power stations, for example, at Clifden, and it now requires only one-sixth of the power to produce signals at Glace Bay equal to those formerly produced by the spark station. It is evident, therefore, that the practice of long-distance wireless telegraphy may be very considerably modified by these results.

The very favourable results so far obtained seem to augur a possibility of obtaining even better results in the future. There is still considerable room for improvement, for the earth losses in the cases already investigated still form a large proportion of the total resistance.

Obviously, if perfect radiation efficiency can be obtained, the height, size, and shape of the aerial will not matter so long as it radiates in the direction required; for all the power put into the

aerial is usefully employed in radiation. But when a small or low aerial is used we are likely to experience other troubles. If, for instance, we halve the effective height we must double the current to produce the same range; in fact, the currents required are inversely proportional to the heights. For this reason the currents with a low aerial tend to become excessive and, before long, the voltage limit of the aerial may be reached. Take the same example again; if we halve the height, we must double the capacity for the same maximum voltage in each case, and so on; lowering the aerial to half the height will in most cases hardly increase the capacity, so we shall have to spread the aerial to attain these results.

In conclusion, whatever the drawbacks of the screened aerial may be, it is certainly one degree nearer the ideal of perfect radiation efficiency.

DISCUSSION.

There was a good and representative attendance at the Institution on December 7, for Capt. Eckersley's long-expected paper on screened aerials. The paper contains many curves, doubtless a good point, but having disadvantages when the showing of them on the screen involves reading the paper almost entirely in darkness.

Although not always to the point, the discussion provoked considerable signs of life, and in spite of the Chairman's appeal for brevity was still in full blast at 7.45.

Neglect of Previous Work.

MAJOR J. ERSKINE MURRAY considered the paper to be valuable for its analysis of losses, but to suffer from a neglect of what had gone before. In 1904 Lodge had stated that, by the use of a counterpoise in the place of an earth connection, the decrement was decreased, and further that there was a maximum efficiency for one particular height. Other previous investigations which Mr. Eckersley made included no reference to that by H. True described on p. 163 of the *Jahrbuch für drahtlose Telegraphie* for 1911, or to Austin's work in the U.S.A. The troubles due to the self-oscillation of the screen might be overcome by making its wave-length identical with that of the main oscillation. A mathematical solution was given. With what kind of an earth connection was the screen being compared? Surely Fig. 1 was not to be taken seriously.

What Was the Earth?

CAPT. R. C. FRENCH also asked how the earth was formed. Did it have a fair chance in the competition? When the screen was used there was still a certain residue of earth losses. Could this be reduced by spreading a metallic network upon the ground? The need for symmetry in the connections of the screen had been shown by a case in which the aerial current was 3 A with a badly arranged screen, but 10 A with a symmetrical screen.

MR. J. E. TAYLOR had had the earth screen as a pet idea for years. He liked to consider it in theory as a Faraday cage with a hole in it. Handing in his original memorandum, dated Feb. 11, 1913, he read notes clearly explaining the purpose of a metallic network for confining the electro-magnetic waves to a good dielectric (air) and eliminating losses in the earth. He did not take out a patent. It did not pay to take out patents in the Post Office. He had to make a disclaimer—in no way connected with the subject of the debate—he had designed no Government wireless stations! Mr. Taylor makes some further points in a letter we publish in our Correspondence columns.

LIEUT. G. W. COBOLD reported results obtained with military aerials at Woolwich. A balancing capacity reduced the resistance but made no effect on strength of signals.

MAJOR H. P. T. LEFROY measured the true novelty of the paper by the great interest it had aroused. The counterpoise system of the early wagon sets had been better than an earth for transmitting but inferior for receiving.

Post Office Results.

MR. A. C. WARREN gave figures for a number of Post Office aerials. Although no screen was used their efficiency was greater than the figure of 33 per cent. mentioned by Mr. Eckersley as very good for a screened aerial. At Stonehaven the large aerial had a radiation efficiency of 24 per cent., and the small one 60 per cent.; at Caister, 40 per cent.; at Devizes, one of 30 per cent.; and another of 39 per cent. Leafield aerial had a resistance of 0.9 Ω. at 10 000 metres. He doubted the figures for Clifden which had appeared in the "Radio Review," and considered formulae given in the paper for ground loss and resistance to be vague and incorrect. He had found a resistance value of 4 Ω due to taking the aerial lead through a small insulator in a wooden hut.

Claims for Priority.

PROF. C. L. FORTESCUE considered that A. J. Madge had strong claims to priority in the application of earth screens, having installed a very similar arrangement, in which the outer end and sides of the screen were earthed in 1906. To which MAJOR LEFROY,

not content to let the Senior Service have it all their own way, retorted by quoting 1904 as the date at which Carden had used a counterpoise.

Phantom Volts.

CAPT. H. ROUND wondered whether the earth screen was not even earlier than Lodge? Was it not the Hertzian oscillator? In some experiments of his own under Signor Marconi in 1909 he had found it an advantage to lift a metallic screen from the ground. As regards the effect of the screen upon radiation he had taken note of the effect upon signal strength, using the same aerial current with and without the screen. There was no noticeable difference. He had suggested the present investigation to Mr. Eckersley without suspecting into what an experimental and mathematical whirlpool he was to be drawn; sometimes the experiments were made to fit the mathematics and at others the mathematics were made to fit the experiments. The method described in the paper balanced the electrical effects in the ground by an opposite charge on the screen and permitted the calculation of the resistance of an aerial which had not been built. He related the comment of a "spark merchant" on observing 360 A in the aerial at Carnarvon—"They are not real amperes, they have got no volts behind them." Evidently influenced by the recollection of this anecdote, Capt. Round, in replying to Mr. Warren, forgot the input volts in estimating the efficiency of the Leafield are!

Screening Effect of Counterpoise Not Realized.

CAPT. P. P. ECKERSLEY admitted that earth screens had in fact been used in the past but not, he thought, with an understanding of their function in eliminating dielectric losses in the earth. Rather, he suggested, they had been used in the spirit in which he in 1908, when at school, put the earth wires up on poles because it was a quicker method than burying them. The prior calculation of the resistance of the aerial and earth screen at Croydon was not a success. The actual value was twice too big; the station was badly placed.

MR. F. C. LUNNON showed that errors could arise in the calculation of the effective height of an aerial. The effective height of a particular aerial with wooden masts and manilla ropes was 9.64 metres calculated and 8.3 metres measured. In another case with steel masts and stays the calculated height was 16.1 and the measured height 14.

MR. E. H. SHAUGHNESSY was not convinced that we already knew so much about the subject as previous speakers had claimed. For example, the patent for the counter capacity stood in the name of Muirhead, not Lodge. He appreciated the regular tests and work done by the Marconi Company, as disclosed in the paper, and mentioned a patent of 1905 in which Signor Marconi anticipated the so-called pioneer work of Alexanderson.

THE CHAIRMAN (Prof. G. W. O. Howe) gently chided the author for calling the earth spherical rather than round in proving the energy loss in a condenser to be more fundamental than its power factor. Meissner was recently reported as saying that he expected to raise the radiation efficiency of Nauzen from $\frac{7}{8}$ per cent. to 50 per cent. As to the use of the term "earth screen" instead of "counterpoise," he suspected that, as in the words of De Forest, "Pliotron" was Greeko-Schenectady for "Audion," so "earth screen" was Chelmsford for "counterpoise."

Electro-Metallurgy in Sardinia.

Geologically the island of SARDINIA is a continuation of the Iberian Peninsula, and, like Spain, is rich in mineral ores; nevertheless, up to the present, it has been the most neglected section of Italy. Zinc, silver, iron pyrites, copper, mercury are obtained from its mines, but hitherto they have been exported as ore for the metal industries of Belgium, France, and Great Britain, which possessed the coal required for their transformation. The utilisation of the hydraulic resources of the island, in accordance with the Government programme, will, however, permit in the near future of the development of electro-metallurgy. The great artificial lake in the Tirso mountains, impounding some 15 billion cubic yards of water, is nearing completion, and with others under construction will supply Sardinian industry annually with 500 billion kWh of electrical energy. The great authority on hydro-electric installations, Eng. Angelo Omodeo, in a recent conference with a Parliamentary Commission, showed with the help of figures that the total storage capacity of all the Sardinian reservoirs will be no less than $\frac{1}{2}$ billion cubic metres, which will supply the hydro-electric installations with 100 000 h.p. of energy, and irrigate 250 000 acres of land. It will then be possible to utilise in Sardinia the 200 000 tons of zinc annually extracted from her mines, transforming them by electrolysis into metallic zinc, and electrically to transform the Sardinian iron ores into pig iron, thus producing in the island raw materials which Italy now has to import at heavy cost. And not only will these hydro-electric works build up the industries of Sardinia, but irrigation is all that is wanted to make the island, rich in summer grazing lands, into the great cattle-breeding centre for Italy, and to develop her other agricultural industries.

The Queensferry-Chester Transmission Scheme.

The inability of the local authorities in the Chester area to join the Chester Corporation in undertaking financial responsibility for a joint scheme of electricity supply caused the city authorities to consider other methods of relieving the existing shortage of supply, and negotiations were commenced to acquire a supply from



FIG. 1. VIEW IN THE BOILER HOUSE AT QUEENSFERRY STATION.

the power station at H.M. Factory, Queensferry, originally used for munition work. In July 1920 the Electricity Commissioners delimited the North Wales and Chester Electricity District and a scheme was agreed upon by the Chester Corporation and the North Wales Electric Power Company. It will ultimately form an integral part of the electrical development contemplated in the area. The city pays the Government a fixed sum per annum per kilowatt for energy used to cover standing charges and bears all maintenance and running costs.

Steam Raising Plant.

Turning first to the Queensferry station, the steam raising plant consists of thirty-two Lancashire boilers, a view of which is given in Fig. 1, arranged in ranges of eight boilers, each range having its own chimney, economisers, and induced draught fan. Each of the boilers are fitted with the Bennis sprinkler, stoker, and self-cleaning compressed-air furnace, and are capable under normal conditions of giving an evaporation of approximately 10 000 lb. of steam per hour. The coal used on boilers is handled throughout by a Bennis coal and ash handling plant in the following way: A rotary truck tipper takes the loaded railway trucks from the locomotive and revolves them through a complete circle, so that the trucks are turned upside down and completely emptied without trimming or raking. The clamping gear which holds the trucks in position is adjustable, so that the tipper can take any height of truck to the maximum size for which it is designed.

The tipper revolves on rollers, which are turned through suitable worm and spur reduction gear by a 6 H.P. motor. A truck tipper can discharge from eight to ten trucks per hour; the complete revolution occupies approximately two minutes, the remainder of the time being taken up in entering, clamping down, and removing the empty truck through the tipper.

Conveyors.

As the coal leaves the trucks, it falls into a concrete hopper, 1 ft. deep and 20 tons. From this hopper it flows by gravity through

a shoot to a "U" link steel chain conveyor, large enough to convey coal at a rate of about 60 tons per hour. The first portion of this conveyor is inclined and the remaining portion is carried horizontally over the tops of bunkers. Openings are placed at intervals in the bottom of the cast iron trough in which the conveyor runs, each opening being provided with a cut-off slide, operated by hand, so that the coal may be deposited in any part of the bunkers as required. The approximate length of the conveyor is 660 ft. The conveyor is driven by a 39 H.P. motor through reduction gearing.

The bunkers into which the conveyor delivers are constructed of brick concrete and steel and have a capacity of approximately 2 240 tons, which when fully loaded is equal to about seven days' supply. Each of the bunkers is fitted with a Bennis automatic elevator with self-starting and stopping device. This is actuated by the amount of coal in mechanical stoker hoppers, and by the aid of which a constant supply of fuel is assured for the furnaces.

Suction Ash Plant.

The whole of the boilers are fitted with a Bennis pneumatic ash suction plant. The whole of the ashes when withdrawn from furnaces are drawn through a grid into the suction pipe line, and from thence to either of two ash tanks placed in a suitable position. Apart from dealing with ashes, arrangements are made on the same plant to deal with the whole of the flue dirt which accumulates in the boiler settings, main flues, and economisers, &c., and by the arrangement of suitable connections and flexible pipes, it is possible with a minimum amount of labour to clean out the whole of the flues, &c., and deposit the flue dirt into the ash tanks, from which it may be loaded into railway trucks or carts as desired. Each ash tank is of a cylindrical type, has a capacity of about 20 tons of ashes and is lined with concrete 2 in. thick. The suction is obtained by means of a Roots exhaustor.

The generating plant, a view of which is given in Fig. 2, consists of four turbo-alternators, having an aggregate capacity of 5 500 kW.

30 000 V Overhead Plant.

The most interesting part of the scheme is, however, the transmission line. At the station has been installed a 2 200 kVA 440/33 000 V three-phase transformer, and for a distance of 630 ft. the transmission is accomplished by underground cable. For part of this distance the cable rests on the bed of the river Dee. On the north side of the river the cable is brought to a steel terminal mast shown

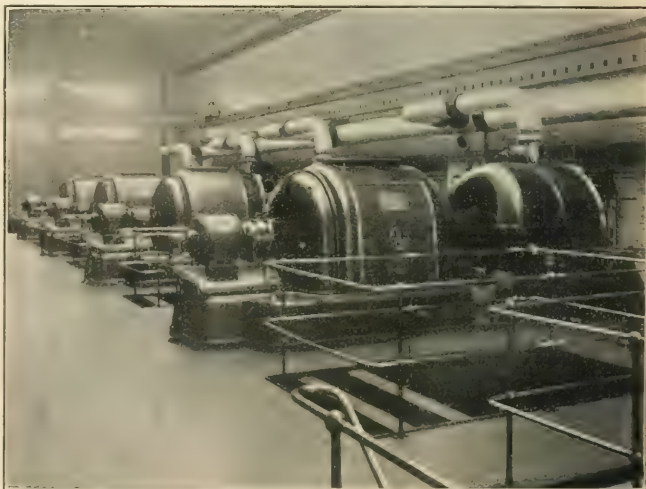


FIG. 2.—THE TURBINE ROOM AT QUEENSFERRY.

in Fig. 3 and, from thence for a distance of $5\frac{1}{2}$ miles, the transmission is effected by overhead construction mounted on steel masts spaced 400 to 500 ft. apart. The cables and lines are duplicated so that a second transformer can be added as soon as load conditions justify. Outside the city, at Sealand Road sub-station, the supply is stepped down to 6 600 V and taken to the New Crane Street

Electricity Works by underground cable. This sub-station is shown in Fig. 4.

The existing city supplies at 420 V d.c. are drawn from the old steam driven sets at New Crane Street and the hydro-electric station on the Dee, giving a total generator capacity of 2 400 kW. It is hoped that the new scheme will enable the steam sets to be superseded. A 1 000 kW rotary converter has been installed at

out by the contractors, the Metropolitan-Vickers Electrical Company, Ltd., Manchester, who supplied the switchgear, transformers, and rotaries, and Callender's Cable and Construction Company, who supplied the cables and overhead line material. The Council authorised the Electricity Committee to proceed with the scheme in June of this year, and the successful outcome is largely due to Mr. P. S. Brook, chairman of the Electricity



FIG. 3.—STEEL TERMINAL MAST, SHOWING CABLE FROM QUEENSFERRY STATION AND OVERHEAD LINE.

New Crane Street to feed the existing d.c. network, and a feeder goes out to sub-stations at the Hydraulic Engineering Company's and Brook Hirst Company's works, at both of which are 500 kW rotaries.

Opening Ceremony.

The current was formally switched on at Queensferry on December 9th by the Mayor, Alderman Dr. W. H. Griffiths, and the station and transmission line were inspected. At a subsequent meeting at Chester Town Hall, great appreciation was expressed of the remarkable expedition with which the work had been carried

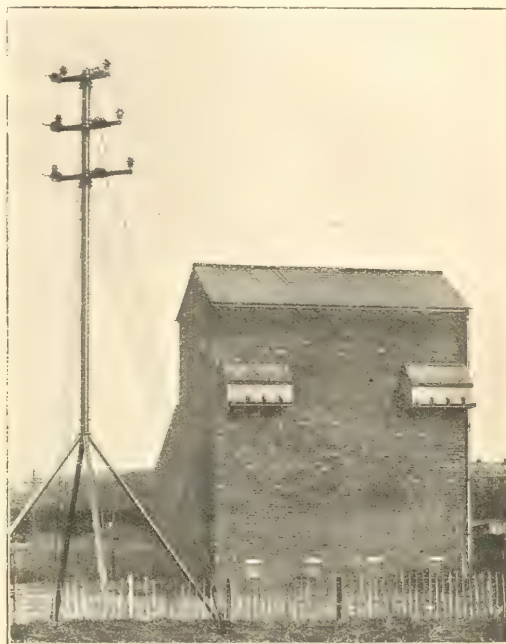


FIG. 4.—OVERHEAD LINES ENTERING SEALAND ROAD SUBSTATION.

Committee, and the Borough Electrical Engineer, Mr. S. E. Britton.

Future Developments.

Although the Electricity Act 1919 does not permit an authority to supply other authorities at a profit, the city has obtained powers to furnish electricity to consumers within a five miles radius. The object in view is to foster the industrial development of the area by adding the necessary power supply to the railway, river, and other facilities which the city possesses. The new scheme is the only example of 33 000 V overhead line construction in the country.

A New Design of Starting Equipment.

The apparatus employed for starting direct-circuit motors may be divided into two classes, the controller type and the face-plate type respectively. These two types of apparatus have, generally speaking, been used in two distinct fields of application, the former for cranes, hoists and other similar appliances where the operator is in constant attendance and where speed adjustment is constantly required, and the latter for starting, pure and simple, where a constant speed is often the order of the day, and where the actual starting is carried out by more or less unskilled personnel. These latter conditions necessitate the use of some sort of automatic arrangement in order that neither the motor nor the operator may be liable to damage from negligence or ignorance.

Some Disabilities of Face-Plate Starters.

In designing face-plate starters to meet these conditions much ingenuity has been successfully employed. At the same time, this type of starter has certain limitations, both mechanical and electrical, especially where heavy currents are employed. These disadvantages may be summed up in the statement that the operation of such apparatus depends on the pressure of a laminated copper brush for effective contact at each resistance step, and that

this pressure cannot be increased to any very high value owing to the fact that the starter-arm must be free enough to be capable of being pulled back by the safety spring when failure of supply or overload demands it. This naturally cuts down the amount of current that can be safely passed. These disabilities do not occur in a controller. It therefore follows that, if the no-load and overload features of the ordinary face-plate starter and some form of safeguard against leaving the apparatus in circuit in a mid position can be combined with the advantages obtainable with the controller type of apparatus, a notable advance in the design of this class of equipment will have been made.

A Satisfactory Solution.

The problem is one not without difficulty, but it seems to have been satisfactorily solved in the new apparatus which has recently been designed and put on the market by BROOK, HIRST & COMPANY, of Chester. As will be seen from the illustrations which we give herewith, the starter is of the drum-type, of which an essential feature are the spring-controlled self-aligning fingers. The contact pressure between these fingers and the drum may be individually adjusted, while the drum itself is ground with the copper segments

in position so that the latter form part of a true cylinder—an arrangement which assists in obtaining even contact on the fingers.

To allow for the maximum wear on the contact blocks these are formed with a horizontal-tapered slot at the back, into which the

downward position into an upright one. This first movement of the handle closes the control switch, but if the handle is released and falls to its normal position, this switch is immediately opened and the starter must be returned to the off-position before a fresh start can be made. This circuit is kept on throughout the starting notches, and is only cut out in the full-on position when an

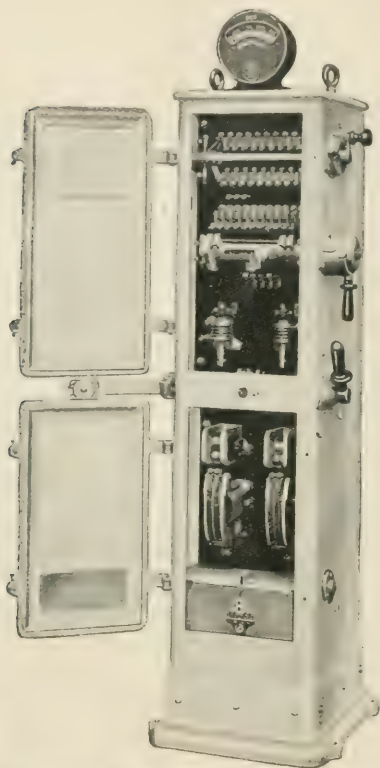


FIG. 1.—DRUM TYPE STARTING PANEL FOR VARIABLE SPEED MOTOR.

squared countersunk head of the fixing bolt slides before assembly. This bolt is finally secured by a nut, the whole arrangement being a great advance on the usual method of the blind tapped hole into which the fixing screw is secured.

An Ingenious Operating Handle.

The most interesting part of the starter is the patent operating handle. As will be seen from the illustrations, this is of the ratchet type, and is rotatable in one direction only. This handle

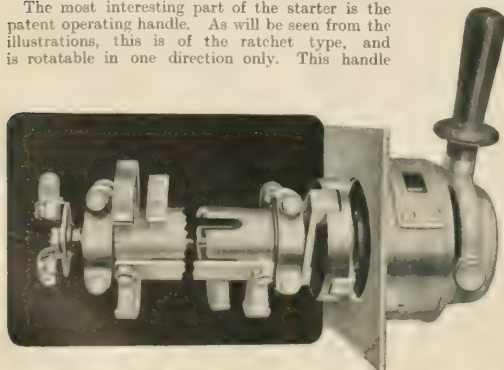


FIG. 2.—RATCHET OPERATING HANDLE, "CONTROL SWITCH" CLOSED READY FOR STARTING.

is so designed that if the starter is left in an intermediate position the circuit is immediately opened. The handle is of the free-handle type, starting being effected by raising it from a

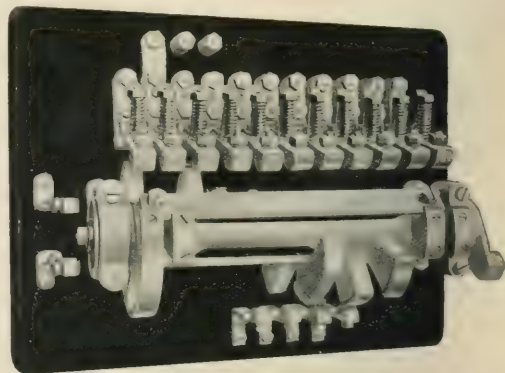


FIG. 3.—DRUM TYPE STARTER, WITHOUT OPERATING HANDLE.

auxiliary drum contact closes the holding-on circuit and allows the handle to be released.

The Slow-Starting Device.

A disadvantage of the controller design when applied to starting duty is that the handle has to be moved through the whole of the intervening stops from the "full on" to the "off" position.

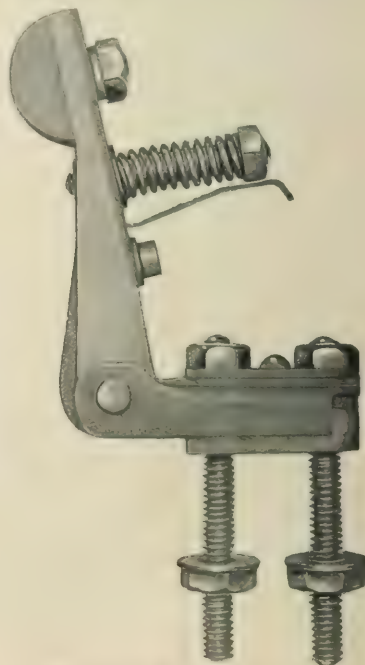


FIG. 4.—VIEW OF THE DRUM FINGER.

"In the new BROOK, HIRST starter this difficulty is overcome by a simple device which allows the ratchet handle to be moved forward from the "full on" position to "off" position without it being necessary to move the handle back over the intermediate segments. The starter can be operated with one hand.

It will be gathered from the details we have given of this device that the arrangement also allows of a definite slow motion operation

to be achieved during starting, and this is made more certain by the pawl failing to engage with the ratchet if the handle is operated too quickly. The mechanism also includes a stop which prevents the drum over-running and consequently cutting out more than one resistance step at a time, so that the combination should be well capable of performing the work for which it is designed.

Starting Panels.

This type of starter has been combined with circuit breakers and double-pole isolating switches in a series of ironclad motor

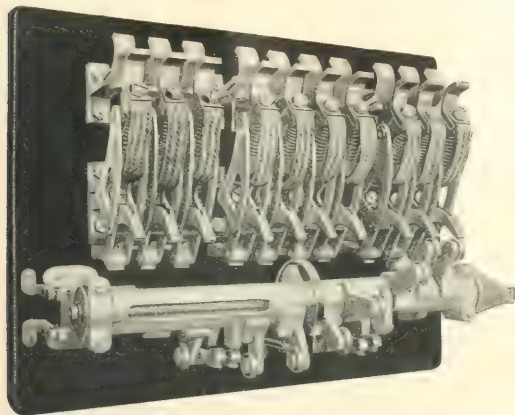


FIG. 5.—MULTIPLE LEVER TYPE STARTER (REPLACING THE DRUM TYPE FOR LARGE POWERS).

panels, to which reversing switches and shunt regulators may also be fitted when required. The double pole circuit-breaker used in these panels consists of two electrically-operated contactors acting in conjunction with adjustable over-load trips. The main current is always broken on these contactors and never on the starter. The contactor contacts are of hard-drawn copper of the solid butt type, and their action during closing, it is claimed, ensures a long wearing period. As the contacts close there is a rolling action between them. The contact springs are of copper-plated steel and a weak pressure insufficient to give proper contact is not possible.

When the contactor is breaking circuit the rolling action of the contact is reversed, so that the arc is broken at the initial stage and not at the final position. Consequently, any arcing on breaking circuit does not affect the quality of contact at the point at which it is maintained. These contactors are fitted with magnetic blow-outs, and the balance of the moving part is such that they do not rebound, and there is, therefore, no tendency to draw out the arc.

Resistances.

These motor starting and control panels are also arranged so that inching may be carried out, either from the starting position or from special buttons, while stop buttons may also be fitted as required. Another useful feature is the door-locking device, which prevents the panel doors from being opened while any part is alive. In the larger size of starter grid resistances are used, though in the smaller sizes a tubular form wound with a wire of a non-rusting alloy on an insulating tube with high resisting properties is employed. In the latter type of resistance, after winding, the whole tube is covered with cement and the tubes are fixed vertically so that a through draught gives a maximum heat dissipating power.

A Reunion of Pioneers.

It is proposed to hold a dinner of the MUNICIPAL ELECTRICAL OLD STAGERS at the Hotel Cecil, on Friday, January 20th, at 7 p.m. for 7.30. The usual painful half-hour will, on this occasion, however, give old friends an opportunity to renew acquaintances, and time for the same purpose will also be available after the dinner, as only one toast in addition to the loyal ones will be set down, though it is hoped that some half-dozen old staggers will speak on their reminiscences for about five minutes each. Tickets, which are 25s. each, inclusive of wine, can be obtained from Mr. C. H. Wordingham, 7, Victoria-street, Westminster, London, S.W. 1.

It is proposed to invite the following gentlemen as guests:—Mr. S. T. Allen, president of the I.M.E.A.; Mr. H. Booth and Sir Harry Haward, the only commissioners who are not eligible to attend as old staggers; Ald. G. Pearson, hon. solicitor of the I.M.E.A. throughout its career; Mr. W. L. Madgen, first hon. sec. of the I.M.E.A.; Ald. W. Walker, chairman of the National Joint Industrial Council for the Electricity Supply Industry; and Mr. A. P. Trotter.

The "Dundee" System of Heavy Duty Wiring.

By Major H. RICHARDSON, O.B.E., M.C.

Although there has been a great deal of argument in favour of the two-part tariff as a method of charging for the supply of electricity for all purposes to houses, there has not so far been any real attempt to alter the existing methods of wiring with a view to devising a simple system which can be quickly, easily, and cheaply fitted up, and which would at the same time give possibilities for wide extension both as regards the addition of extra points and the increased loading of apparatus used.

Recently electricity has been given its chance to show what it can do in the way of lighting, cooking, and heating—in a word, what it can do towards the "all-electric" house. It must, however, be admitted by those directly concerned with the layout and erection of these installations that the existing methods of wiring on the multiple distribution or central distribution system, as generally used for most installations in houses, are much too costly and cumbersome, if it is the intention to use electricity for heating, cooking, and auxiliary purposes.

A Method of Electrical Reinforcement.

"All-electric" houses, so far as the wiring goes, would appear to include in their construction a reinforcement of the walls by means of cables, or conduit, culminating in long rows of distribution fuses fitted in glass cases in perhaps three or four positions in the house, and finishing up at the meter with elaborate porcelain handle fuses and D.P. main switches, minus only the switchboard attendant for their operation and maintenance.

Without making invidious comparisons we have only to watch our gas competitors pipe and fit up a similar house for a similar



HALL, SHOWING MAIN CIRCUIT CABLE FOR SERVICE AND RETURN OF "RING" MAIN LOOPING, INTO ROOM CIRCUIT AND FUSES OVER DINING ROOM AND KITCHEN. NOTE MAIN CIRCUIT GOING UP THROUGH CEILING TO SECOND FLOOR OF HOUSE.

purpose to realise that if electricity is to make any headway at all, existing methods of wiring must be altered and brought more nearly to those found in the common gas main run all over the house and tapped off as required for lighting points, cooking stoves or heaters. Gas has all along offered a single medium for lighting, heating, and cooking, and electricity can now through the

introduction of the multi-part tariff do likewise so far as the rates of charging are concerned.

Overcoming Present Difficulties.

It cannot be said, however, that the fitting up of the installation itself has marched with the advantages to be gained thereby, so

found satisfactory, and it has been decided to substitute in their place a two-pin 5 A socket and plug mounted on the base block of the bracket light. Each bracket light has a switch lampholder fitted with "chain-pull" action. These bracket fittings should, if possible, be placed from 2 ft. to 2 ft. 6 in. from the ceiling, and they should be placed on opposite walls in equal numbers, depending on the size of the room to be lit. The wall sockets and plugs with the control switches are brought down and fixed on the wall within easy reach (generally at a height of 4 ft. 6 in.) at whichever part of the room the heating or cooking apparatus is required.

The Advantages of the Method.

The chief advantages claimed for such a method of wiring are:

1. There is always at hand a heavy main to each room which can be conveniently and easily tapped for extensions.
2. Fusing devices are cut down to a minimum.
3. Separate systems and central distribution boards are unnecessary.
4. Expensive ceiling fittings or electroliers are unnecessary.
5. A complete installation for lighting, heating, and cooking can be carried out quickly and expeditiously in houses at present using other methods, without a great deal of preliminary work, and with a minimum of trouble and annoyance to the tenant.

6. The installation can be added to with ease on the rare occasions this would be necessary.

7. Faults are easily located by the consumer, owing to the fuseboards being outside rooms they control.

A Move Towards Simplicity.

It might of course be argued that switching has been reduced much below requirements, and that the installation generally is crude and old-fashioned, being laid out somewhat on the lines of the old "Tree" Distribution System. To a certain degree that may be so, but it is the opinion that electric installations are too elaborate for the average house so far as switching and fittings are concerned, and the initial installation as a rule is generally only fitted up to meet existing needs with the result that when it is desired to add one or two radiators or a small cooking stove, the wiremen have to be



DRAWING-ROOM SHOWING TWO BRACKETS WITH SPECIAL SHADE. TWO MORE ON OPPOSITE WALLS. NOTE THAT ADVANTAGE HAS BEEN TAKEN OF PICTURE RAIL TO RUN ROOM CIRCUIT.

with the set purpose of arriving at some definite ideas on the matter, the Dundee Corporation Electricity Supply Department recently drew up a special wiring layout and fitted up a seven-room house, including the usual scullery, kitchen and bathroom in accordance therewith.

Briefly, the method of wiring adopted was as follows (it being assumed that a bulk supply is given on the two-part rate of charge for all purposes). Metallic sheathed surface wiring is used throughout. From the street service connection, at which point there is the usual D. P. switch and fuses, a main twin cable of suitable capacity (not less than 7/0-029 sq. in. conductors) is taken round the passages landings, or corridors of each floor of the flat or house. Depending on the style, shape, and size of the house, it may often be possible to run one "arterial" main for the whole building and later, if necessary, make a "ring" main of it. The main cables are kept at the height of the architraves of the doors, all possible advantage, of course, being taken of existing mouldings to hide the presence of the cable, an arrangement to which any of the present day surface wiring systems admirably lend themselves. Over each doorway is placed a D.P. porcelain bridge fuseboard, comprising two bridge fuses (not less than 25 A capacity) into which the previously mentioned "arterial" main is looped as it runs from doorway to doorway. From each set of fuses another "arterial" main (not less than 3/0-036 sq. in. conductors) is run round each room at about the height of the door or picture rail level, and this can if required also be completed as a "ring" main. From these auxiliary mains and fuses controlling the respective rooms are then taken the necessary lamp points, heating and cooking plugs.

The lighting of the public rooms and bedrooms has been carried out by bracket fittings, on the walls, the whole of the lights and power plugs in the respective rooms being controlled by a S. P. master switch placed at a convenient height on the wall at the door. Each bracket is given a projection of about 18 in. and is fitted with an inverted type shade giving an indirect effect from the ceiling. An extra switch lampholder is shown fitted to the elbow of some of the brackets, for connecting up small auxiliary apparatus, such as kettles, toasters, irons, &c., but in practice these were not



OTHER END OF DRAWING-ROOM SHOWING MASTER SWITCH. NOTE JUNCTION BOX OVER DOOR FOR FUSEBOARD OUTSIDE.

called in to run a special circuit right back to the service connection, the existing installation in nearly every case being much too weak to carry any of the present day apparatus for heating and cooking.

It is claimed that the layout just described does at least give an installation which is capable of carrying heavily loaded apparatus of a kind which is unfortunately even to-day not catered for in the usual house installation.

Correspondence.

EARTH SCREENS IN WIRELESS.
To the Editor of THE ELECTRICIAN.

SIR,—I was rather surprised at the relatively cold reception afforded to the paper read by Mr. Eekersley before the Wireless Section of the Institution recently, and can only conclude that the full possibilities of the screening method were not realised by the majority of those present. Personally, I regard the step as the most revolutionary advance made in the art of wireless telegraphy and one likely to have far-reaching consequences. Past experience has shown that resonance and sympathy are the life and soul of the wireless, and the direction in which progress is now being made is, I think, likely to transcend any other tuning improvements. It should be borne in mind that the new method is by no means fully developed. It has not yet been fully applied to transmitters, whilst receivers have not been treated at all.

A large part of the discussion turned on counterpoises, and the members appeared to be satisfied that no essential difference existed between counterpoises and screens. Let me take a simple illustration. An insulated network or arrangement of parallel wires covering an area of ground away from the antenna with which it is associated constitutes a counterpoise, but it does not make an earth screen. In fact, it simply acts as a capacity to earth with a concentrated electric field beneath it, and therefore causes large earth losses. Even if placed beneath the antenna, if it is not of a sufficiently large size or suitably shaped to catch the field from the antenna, it may still act mainly as a capacity to earth. Thus it will be seen that if one sets out to design a counterpoise system, there is certainly no guarantee that an effective earth screen will result.

To my mind, this improvement adds another wireless avenue to those which, without much ingenuity, can in some measure be adapted to supersede wires for purposes of inland telegraphy and telephony, and thus make the telegraphs pay once more, as well as providing a cheap system of telephony for various purposes.—I am, &c., J. E. TAYLOR.

Wokingham, Dec. 19th.

"PRINCIPLES OF RADIO COMMUNICATION."
To the Editor of THE ELECTRICIAN.

SIR,—In the review of the new book entitled "Principles of Radio Communication," by Mr. J. H. Morecroft, appearing in the September 23rd issue of your valued publication, we note the following quotation:

Possibly the modern static high frequency generator of the Arco type, which is being more and more applied abroad for high power stations, could profitably have been more extensively treated than the older Alexanderson machine which, owing to its limitations, has been less extensively used for long distance work.

Your reviewer fails to appreciate how extensively the Alexanderson alternator is used in the high power stations which are now being operated commercially. In addition to the machines now doing commercial service in the United States, the British Marconi Company has installed two Alexanderson machines in their Carnarvon station, and the Radio Corporation has also contracted to install two Alexanderson alternators in Warsaw, Poland, for communication with the United States.

With regard to the extensive use of the Arco type of machine in high power stations, we are not aware that this machine is in commercial operation at present in any country but Germany at Nauen, while, on the other hand, Alexanderson machines are already in use and daily commercial long distance service at the following stations: New Brunswick, N.J., Marion, Mass., New York Radio Central, L.I., Tuckerton, N.J., Bolinas, Cal., Kahuku, T.H., and Carnarvon, Wales.

Regarding the relative limitations of the two machines, we would say this, both machines depend for their commercial effectiveness on the constancy of their frequency and on the purity of the wave form emitted. The Alexanderson machine generates the frequency required for its output circuit, and is used to feed its output circuit through a high frequency transformer in practically the same way as the ordinary 60 cycle circuits are fed by ordinary 60 cycle machines. Any change in frequency of the alternator causes a corresponding change in frequency in the output circuit. The Arco machine generates its current at a frequency much lower than that required for the output circuit and between the machine and the output circuit there are installed a series of frequency transformers or multipliers by means of which the primary or machine frequency is raised to correspond to the frequency required in the output circuit. Thus, with the Arco machine, the correct frequency for the output is obtained by means of a series of tuned circuits of a very special nature. The result of this is that any change in frequency of the Arco machine causes a change in the output frequency which depends not only on the change in the speed of the machine, but also on the multiplying power of the frequency raisers used between the machine and the output circuit. To maintain a constant frequency,

the Alexanderson machine is equipped with a governor which will hold its speed constant within one-tenth of one per cent.

We believe that the Arco machine has no advantage over the Alexanderson machine in the production of a true sinusoidal wave. Moreover, it must be remembered that in commercial practice, the wave shape supplied to the antenna circuit is, in the case of the Alexanderson machine, exactly that generated by the machine, whereas, in the case of the Arco machine, this wave shape is dependent upon the frequency change circuits associated with that machine as well as on the wave shape generated by that machine.

Regarding the ruggedness of the two types of equipments, this may be considered to be practically equal, but, since the Arco machine has between the output circuit and the machine certain highly critical frequency transformer circuits, the adjustments of the Arco machine would appear to be rather more delicate than those required for the Alexanderson machine to carry on commercial operation. The lower frequency of the Arco machine has manufacturing advantages, but the additional external equipment required and the critical adjustments thereof must be taken into consideration when comparing the two machines.

Since there are still many controversial questions in a new art, such as wireless communication, it would be highly appreciated if you would present to your readers our views in the matter as expressed above, in whatever form suits your preference.—We are, &c.,

C. H. TAYLOR, Asst. Chief Engineer.

New York, December 9. Radio Corporation of America.

LIABILITY FOR DAMAGE TO TELEPHONE CABLES.
To the Editor of THE ELECTRICIAN.

SIR,—I am afraid that your "Note of the Week" with the above heading in the ELECTRICIAN of the 2nd December, 1921, is somewhat misleading. This may be due largely to the way in which the court proceedings were reported. You state in the Note "It appears that certain telephone cables were laid in Liverpool in 1903 when there were no electric mains in the subway, but the corporation claimed that in virtue of a clause in an agreement made in 1896 with the National Telephone Company they were exonerated from liability to pay damages for nuisance for causing loss to the company or their successor in title the Postmaster-General." Now this is not accurate, in that the telephone cable was laid after the electric light main, and further there was no reference to a subway in the proceedings at all. However that may be, it is feared from your concluding remarks that it may be inferred that the matter is simply a haggle over a small sum of money which did not require to be taken to the courts. This is not so, as the case is fundamental, involving many other similar cases, and as it is of interest to the industry generally it is suggested that the main facts about the nuisance should be more clearly stated.

The Corporation of Liverpool own a power main laid in the streets, and the late National Telephone Company, as "second-comer," crossed this main with a pipe containing a cable, the clearance given being 2 inches or less; the County Court judge held that it was laid in contact or virtually in contact with the iron troughing of the power main. Fifteen years after the telephone plant was laid the power main failed, and, ignoring the fact of an agreement between the Liverpool Corporation and the late National Telephone Company, the principal interest lies in whether the owner of the power circuit is responsible for repairing the pipe and cable damaged by the escape of electricity from the power main. The County Court judge held that there was a *prima facie* case of "nuisance" which had been committed by the corporation in allowing the current to escape, but as the damage had been contributed to by the close proximity in which the telephone plant had been laid to the power main the corporation was not liable. The Appeal Court held that the County Court judge was wrong in this, and that there being a nuisance there could be no contributory negligence on the part of the person whose plant was damaged. Mr. Justice Shearman cited a case of water escaping from a reservoir and damaging the contents of a house or cellar owing to there being a crack in the walls; he stated that the fact that that damage would not have occurred but for the crack did not relieve the owner of the reservoir from liability.

It is clear also that if there can be contributory negligence in such a case then a definite distance which is safe would have to be decided by the court, and as cases have occurred where burn-outs have affected plant over distances varying between 6 in. to 3 ft. away this would mean that wherever a power main is laid as first-comer it would obtain a monopoly of a considerable amount of soil all round it.

I am, &c.,

S. C. B. A.

[We regret that the report of the court proceedings was not clear as to location of the electric main and telephone cable, but our main suggestion was, that an impartial arbitrator, such as a consulting electrical engineer, could have determined the dispute more expeditiously and cheaply than any court. Already, we suppose, the legal costs incurred are ten times more than the amount in dispute,

there was to be a further appeal we naturally deprecated a step which involved still further costs. The honour of giving one's name to a leading case is a barren one. We knew a man who fought a case involving a sum of 18s. up to the House of Lords, but he wound up in Carey Street. This fate is not likely to overtake the Postmaster-General who can fall back upon the taxes, or the Liverpool Corporation who can have recourse to the rates.—ED. E.]

THE ECONOMICS OF VEHICLE CHARGING.

In the Editor of THE ELECTRICIAN.

SIR,—In your issue of Friday the 2nd December, reference is made to a statement of Mr. Wigfield of Islington to the effect that his department had to pay approximately £5 000 for the plant to charge eleven electric vehicles. I cannot allow this statement to pass unchallenged in view of the misleading effect that it cannot fail to have on the minds of intending users of electric vehicles.

The fact is that the charging plant including motor-generator, switchboard, and charging panels is procurable at about one-fifth of the amount mentioned. It would appear that the figure of £5 000 is either a mis-print, or that it includes important items not correctly described under the heading of charging plant. It would be interesting if Mr. Wigfield would detail the manner in which the figure of £5 000 is arrived at, and state the nature and capacity of the plant installed.

Allowing 6 kW per vehicle, the capacity of the plant for eleven vehicles should be 66 kW, assuming that all the vehicles have to be charged at the same time, and it is impossible that such an installation could cost anything approaching the figure mentioned.—I am &c. "ELECTRIC VEHICLE."

The Nation's Wealth.

The following letter, which deals with the fundamentals of a subject of highest importance to electrical engineers, is reproduced from "The Times" of Thursday, December 16th:

SIR, Having regard to the supreme importance of a right understanding of economic matters at this juncture in our country's history, the following points, which seem sometimes to have been forgotten, may be helpful.

We live by exchange. Every one of us is occupied day by day in exchanging something we possess or some service we can render for the things or services of others. Every obstacle to free exchange is a charge on the community. The freer the exchange the higher the level of prosperity. An article or a service is worth what it will fetch. Any attempt, whether by combines of capital or labour, or by superior authority or force or legislation, to impose an unnatural price, defeats its own object. No power can force the buyer to buy so freely as the knowledge of a fair deal.

Saving is essential to life. We enjoy a harvest because somebody had the wisdom to save part of last year's seed. Saved wealth multiplies, consumed wealth disappears. Every inducement should, therefore, be given to save. Individualism is essential to wealth creation. Experience shows that the individual can only live by what he has saved; a combination of the two methods producing the most satisfactory results. Collectivism dissipates and eventually destroys wealth. The community acting collectively seldom saves anything. Its tendency always is to mortgage the future, and leave debts for following generations. This process, unless restricted within very moderate limits, is full of danger.

Full economic liberty is unattainable. As producers we must be slaves to ourselves as consumers, or else as consumers we must be slaves to ourselves as producers. The producer must wait in the market-place to be hired, or else the consumer must wait in queues to be rationed. We must be slaves to our capacity and masters in the other. By keeping our producer-slaves in slavery we have raised the standard of living many hundreds per cent. By allowing our position as consumers to be subordinate to our position as producers we must retrace our steps and lower the standard of living.

The purpose of industry is to make and supply goods for the general enjoyment. The only test of its success is the market test, the free and unfettered judgment of all expressed individually through the machinery of buying and selling. When the consumer ceases to be the first consideration with industry its true purpose is forgotten.

The arbitrary fixing of a price of anything, whether an hour's work or a pint of milk, tends to restrict both the demand for and the supply of that thing. Just as in nature the tide flows and ebbs alternately, so in economic affairs a natural price is always moving forwards and backwards. As a price "flows," producers are encouraged to come forward, and as a price "ebbs" buyers are attracted. In this way the maximum of activity is maintained, and all parties benefit. Rigidity discourages producers and buyers alike, and limits both supply and demand.

Every good citizen is anxious to serve his fellows, and in public discussion there is much talk of services. The only true measure of service through industry is the willingness of the served to accept it. In a free market every service offered is subject to the test of public opinion. Thus through capitalism and the higgling of the market we ensure to the community the best service.—Yours faithfully, HUGH BELL, RICHARD D. HOE, GEORGE LAMBERT, W. HIPPER, WALTER RUNCIMAN, ERNEST J. P. BENN.

8, Bouverie-street, E.C. 4.

Salesmanship and Domestic Apparatus.

The second of the series of lectures on SALESMANSHIP, organised by the Electrical Development Association, was held at the rooms of the Chartered Institute of Patent Agents, Holborn, London, on Friday last. Mr. J. W. BEAUCHAMP occupied the chair.

Mr. E. R. MORTON opened the proceedings with a paper on "The Selling of Domestic Electrical Motor-Driven Appliances," in which he pointed out the advantages of electrically driven apparatus in the home, and gave some useful hints to salesmen concerned with the selling of these appliances. One great advantage which such a salesman had over the heating and cooking salesman was that the current consumption of the appliances was so small that it very rarely happened that any material saving in running costs could be effected by installing a power circuit. The actual cost per unit of electricity was also immaterial, because, whatever a householder was paying for lighting, the addition of a small motor-driven appliance would not materially affect his bill. Every one of these appliances could, if necessary, be operated from any lamp socket. There were no vital objections to this course, except where the appliance was used in a room or building having a floor giving a good earth, but it was usually so easy to fix up a socket with earth connections that in the majority of cases the progressive contractor would throw this in if he could secure the order for the appliance. The flexible supplied by most makers was suitable for ordinary use, but where conditions were likely to be severe it was sometimes desirable to fit a length of C.T.S. or other tough rubber-sheathed cable.

A Thorough Knowledge Necessary.

Coming to the actual selling of the appliances, Mr. Morton emphasised the necessity of acquiring a thorough knowledge, not only of the appliances, but of their application and use, and the necessity of knowing something of competing machines, in order to dispose of competitors' claims to superiority. In this connection, however, the salesman must not suggest that the competing electrical appliance was no good at all. Another point which must be borne in mind was that appliances needed attention from time to time, such as oiling and minor adjustments. Therefore, a point should be made of calling on a customer a few weeks after delivery had been made, to see that the user was not only familiar with the operation of the appliance, but was also keeping it in order.

Advertising Essential.

Advertising was essential. Every piece of advertising matter should give an open invitation to see the appliance under actual working conditions, in the home itself. Advertising in local papers, showing films at neighbouring cinemas, &c., were forms of advertising the results of which varied with different districts, but the best advertising of all was a good show window.

Having got into the demonstration at home stage, the salesman should let the prospect handle the appliance himself.

The author then dealt briefly with the sale of several apparatus, including electric washing and ironing machines, electric dish-washers, sewing machines equipped with electric motors and foot control, vibrators, fans, &c. In conclusion, Mr. Morton pointed to the value of a good hire-purchase scheme, to the possibilities of which too little attention had been given in the electrical industry. In this connection, however, the salesman must be specially tactful. Finally, the central station engineer must not regard the additional load on his station consequent upon the increased use of motor-driven appliances as not worth worrying about, and he pointed to the fact that new customers were often brought over to electric light simply because it was a necessary adjunct to having labour-saving appliances.

Some Useful Suggestions.

The discussion which followed the reading of the paper was lengthy and animated, and, apart from the question of salesmanship, suggestions were made for improving and adding to existing apparatus.

Mr. C. G. NOBBS suggested the provision of a warming closet with the electric washer, for the purpose of which the waste heat from the hot-water supply cylinder could be used, or the provision of an electric heater. Also, a hydro-extractor, such as used in laundries for drying clothes, might be useful. The wringers used with electric washers at the present time were on the small side, in his opinion. He also thought the cost of the electric washer was too high.

The Economics of Washing Machines.

This question of cost was dealt with by other speakers, and Mr. J. G. WHYTE mentioned a British manufacturer who had estimated that he could turn out fifty washing machines of the type now sold at about £60, for £35 each. Furthermore, the machine would be improved in some of its details, and Mr. Whyte suggested that the margin between what ought to be the cost of production and the actual selling price was too high. It was pointed out by Mr. Young, a contractor, however, that the entire blame should not be placed upon the manufacturer, because he had to do a great deal of the experimental work, and if he had no return for that he would have no inducement to try. As in other industries, however, once the demand were created the price of the machines would drop.

Mr. ROBERTS urged the importance of a system of maintenance in connection with electrical machines.

Mr. W. E. WARRILLOW pointed to the disadvantage of noise made by electric washing machines. In America he believed that the

washing machine was successful because the law of nuisance, as understood in this country, did not apply. Other speakers also dealt with this question. He appealed for a standard vacuum cleaner, and mentioned that he had had such an appliance in his own home for ten years, and that he had had no trouble with it at all. The standardisation of these appliances would do away with the petty differences which existed at present as between the salesmen of different varieties of cleaners.

Mr. YOUNG pointed to the necessity for the manufacturers of appliances to advertise in the daily Press first, and then the contractor could do his share locally.

Mr. HARRISON dealt at some length with American selling methods, and pointed to the necessity for enthusiasm on the part of the sale-man.

Mr. MORTON, replying to the discussion, said that the main reason for not providing drying machines with washing apparatus was that artificial drying had a detrimental effect upon the clothes. With regard to high prices, he pointed out that much propaganda work had to be done by manufacturers. Advertising was very necessary, but the biggest advertising campaign in the world would fail unless the public could see the goods in a dealer's shop. This was a real difficulty, and many dealers had not even an electric vacuum cleaner in their showrooms. He believed that contractors could sell better than the big stores, because they could get into more intimate touch with their customers.

National Association of Supervising Electricians.

We are glad to see that the salaried classes in the electrical industry are more and more realising the advantages of combination, as we have always taken up the attitude that such combinations, when governed by a proper policy, can only result in the highest efficiency and prosperity, not only for those immediately concerned, but for the industry as a whole.

THE NATIONAL ASSOCIATION OF SUPERVISING ELECTRICIANS, which was formed in 1914 with educational ideas, and, for reasons of policy, had later to be registered as a trade union, is now increasing its field of operations. The Association has always maintained, as one of its foremost planks, the necessity for education and efficiency among its members. It criticises rigidly the qualifications of those desiring admission to its ranks, and it is now generally recognised that to be a member of the N.A.S.E. carries with it something more than ability to pay a subscription.

Recognised by Employers.

As a result of recent negotiations the Association has been recognised by employers, and an agreement has been entered into on the subject of staff foremen's status and wages between the Association and the National Federated Electrical Association with a view to still further development, and especially with a view to increasing membership. The Association has also appointed Mr. A. Brammer general secretary. Steps are also being taken to form district branches in Manchester, Birmingham, Middlesbrough, and Portsmouth, and in other towns as the need arises.

What the Association Does.

Full particulars as to conditions of membership are obtainable from the offices of the Association, 29, Metropolitan Buildings, 63, Queen Victoria Street, London, E.C. 4, and the general secretary will be also pleased to meet those interested or to address meetings on its aims and objects. Besides having a technical library, employment bureau, and legal department for the service of members, lectures are frequently given in London, and an annual dinner is held each year. In 1922 this latter function will take place at Frascati's Restaurant in Oxford Street on Saturday, Jan. 28.

Electric Pastry Ovens.

We are glad to learn from the BRITISH ELECTRIC DEVELOPMENT ASSOCIATION that considerable success has been achieved in the construction and sale of electric ovens for use by pastry cooks and confectioners. Not only does such an oven possess all the well-known advantages of easy regulation, constancy of product, and cool running, but it provides by its cleanliness and attractive appearance an excellent advertisement—so much so that it is often placed in the windows of high-class bakeries and tea shops. Combined with the right sort of girl, it is then a regular business puller. Testimonials, of which we have seen copies, indicate the satisfaction of all classes of user with this apparatus, even when the price of electricity is relatively high.

The new "PASSMETER" Booking Office scheme was brought into use at Kilburn Park Station, on the Bakerloo section of the London Electric Railway, last Friday. The system involves the use of three separate registering cyclometers, two of which are automatic. The first registers the dating and cancellation of each ticket, setting the passenger free to proceed through the "passmeter," whereby another cyclometer automatically records his passage. With the third cyclometer the booking clerk registers the passage of season ticket-holders. From the "passmeter" the traveller goes straight on to the lift, escalator, or platform, as the case may be, without any ticket examination at the customary barrier, though ticket collection is still carried out in the ordinary way.

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Wireless and Wire Telephony.

An interesting demonstration of wired and wireless telephony was given by the MARCONI WIRELESS TELEGRAPH Co. on Sunday last, when the Post Office, by placing a trunk line between London and Southwold at the company's disposal, and the Dutch telephone authorities, by providing similar facilities between Zandvoort and Amsterdam, enabled conversation to be carried on between London and Amsterdam.

A number of conversations were successfully effected, and as the circuits were duplex throughout, by using a slightly different wave length for speaking in the two directions, and by separating the transmitting and receiving stations at either end, this was done without the complications usually necessary in wireless telephony. The customary telephone and mouthpiece were employed, and as wireless transmission was carried out on an unusually short wave length, the conversation was relatively immune from atmospheric disturbance.

While it is not likely, and indeed it is not claimed, that the wireless telephone will replace the ordinary telephone for some time to come, there are certainly occasions where it may be commercially profitable to arrange for speech to be conveyed by wireless over a part at least of the distance separating those in conversation, and for this purpose last Sunday's demonstration is of interest.

Wireless Notes.

The gale over the week-end caused considerable damage to the wireless station near BERGEN.

The report of the Commission appointed to design the IMPERIAL WIRELESS STATIONS has been presented to the Cabinet, and will be published shortly.

Cardiff and Newport Chambers of Commerce have decided to send a deputation to the Postmaster-General, urging the establishment of a WIRELESS STATION AT BARRY. Pleasure steamer companies are compelled by legislation to install wireless apparatus on vessels, and the nearest station at present is at Poldhu, in Cornwall.

THE TRANSATLANTIC LOW-POWER WIRELESS TESTS, organised by the amateurs of America, and carried through with an official receiving station at Ardrossan, have now been completed. During the ten days' period, messages were accurately received from forty-three different amateur stations in the United States and Canada, and the experiment is regarded as an unqualified success. The private equipment was restricted to 1 kW power, while commercial stations used on an average about 250 kW.

Sir Alfred Ewing, the Principal of Edinburgh University, opened an exhibition of wireless telegraph and telephone apparatus in James Gillespie's School, Edinburgh, on Saturday, held under the auspices of the EDINBURGH AND DISTRICT RADIO SOCIETY. Nineteen of the material on exhibition was home-made, and was stated to be absolutely efficient in working. A reception apparatus in the exhibition actually cost 17s. 6d., and yet it could receive messages from a radius of 1,500 miles. The purpose of the exhibition was to interest a larger body of people in the doings of the society.

France has recently been carrying out experiments on the Nord Railway with regard to the employment of WIRELESS TELEPHONY BETWEEN MOVING TRAINS, and between a moving train and a fixed point. Wireless antennae were fixed on to a railway carriage, and a compartment of the same carriage was fitted as a transmitting and receiving station. Between two telegraph poles by the side of the line horizontal antennae were fixed at a given point. As soon as the train left Paris a wireless conversation was begun between the train and the wireless station at the Gare du Nord, and was continued until the train arrived at Creil, thirty-four miles distant. Without any modification of the wave length, the voice remained, it is stated, equally clear whatever the distance of the train from Paris, and whatever its speed, which was at times fifty miles an hour. Experiments are to be tried between Paris and Calais.

Telegraph and Telephone Notes.

TELEPHONIC COMMUNICATION has now been established between BASS ROCK and NORTH BERWICK.

THE LEEDS Telegraph and Telephone branch of the Union of Post Office Workers has passed a resolution expressing alarm at an announcement that the Geddes Economy Committee consider that the Civil Service bonus should be withdrawn, and pledging members to resist any attempt to destroy the National Whitley Council agreement.

The Federal Government have approved the proposed DUPLICATION OF THE PACIFIC CABLE, and it is understood that the other Governments have assented. According to the "Telegraph" correspondent at Melbourne it is proposed to include Samoa in the new system. The present section from Suva to Fanning Island runs near Samoa, and a slight deviation to the extent of fifty miles would enable an automatic relay station to be established near Apia at a small increased cost. This plan will link up another area of British territory to the cable system, and also be of considerable advantage in handling traffic. Over the present stretch from Suva to Fanning Island, 2,000 miles, transmission is at the rate of twenty-two words a minute. Over the shorter sections, Suva to Samoa and Samoa to Fanning, it is thirty-five words a minute.

Legal Intelligence.

The Gas-Filled Lamp Patent. Success of B. T.-H. Appeal.

On Monday the House of Lords (Viscounts Haldane, Finlay and Cave and Lords Dunedin and Shaw) unanimously allowed the appeal of the British Thomson-Houston Co. against the decision of the Court of Appeal which affirmed a judgment of Mr. Justice Sargant dismissing their action against the Corona Lamp Works for an injunction to restrain the latter from infringing Patent No. 10,918, 1913, for "Improvements in Incandescent Electric Lamps," commonly known as the gas-filled lamp patent.

VISCOUNT HALDANE, in delivering judgment, said the patent related to an electric lamp in which the filament incandesces in an atmosphere of gas or vapour of low heat conductivity. Mr. Justice Sargant had held that there was good subject matter, but that the patent was bad because it failed sufficiently to define or limit the ambit of what it claimed, and the Court of Appeal affirmed this conclusion. In the Court below the controversy turned mainly on that of ambiguity in statement and insufficiency in directions, but in the House of Lords this question had been less prominent than that of the subject matter. The primary controversy in that House had been whether subject matter had been sufficiently established, as consisting in an invention really new in point of principle, and, if so, then whether the claiming clauses and directions in the patent were sufficient to inform people, assuming them to possess skill in the manufacture of electric lamps, how to apply the general principle in particular ways. As to the methods recommended, the question was whether those given were clearly enough described. For, if so, and if the fundamental principle had been explained, it did not matter, for the ambit or discovery claimed, if there were alternative methods of applying the principle which were not given exhaustively, provided these were no more than mechanical equivalents to the particular methods prescribed. Having dealt with the history of the incandescent lamp and with the state of knowledge in 1913, his Lordship said it was known that inert gases could be employed which would fill the vacuum in lamp bulbs and greatly diminish vaporisation, and among such known inert gases was argon. But, on the other hand, the introduction of any gas gave rise to conduction and convection to such an extent that the temperature of the filament became too low for incandescence to take place, unless a current, producing heat energy by overcoming resistance, were sent through in an amount such that the filament was soon destroyed. The dilemma had seemed insuperable, for between 1882 and 1913 nothing had been accomplished to get rid of it. In 1913 a patent was taken out in this country embodying an invention of Dr. Langmuir.

Nature of the Invention.

The idea underlying Langmuir's invention was this. If the surface of the filament rendered incandescent by the current was increased in area it had been found by experiment that the light rays radiating from this surface increased in volume in a proportion much greater than that of the increase of temperature required to obviate loss due to conduction and convection by reason of the filament having been placed in an atmosphere of inert gas. By the introduction into the bulb of such a gas vaporisation could be much reduced, and incandescence would be maintained if the current was made sufficient to replace the heat lost by conduction and convection. Under such a method the temperature could be preserved at a degree sufficient to render incandescent a larger surface than was possible in a vacuum. A larger surface than lamp makers had been accustomed to use could therefore be made to radiate light rays. It was shown that when this new principle was carried into effect about 10 per cent. increase of absolute temperature yielded proportionately three times the light formerly obtained. The application of this principle, as a mere principle, of course, could not have been patented. But the inventor claimed to have shown practical methods which could put it into operation. If he actually did so his invention was a patentable one.

His Lordship did not think that in the patent before them it was intended to define, or that it was possible or necessary to define, the expression "large" as referring to any definite limits. All that was necessary was to tell the lampmakers how to get as large an incandescent surface as they wanted for their practical purposes. He made plain to them in the specification that that was no longer impracticable, and that if they would adopt his new process of manufacture they would attain a valuable commercial result. He showed them how, by coiling a small filament, to get the large incandescent surface notwithstanding that the diameter of the filament was narrow and one therefore requiring only a small amount of current. In that way the "half watt" lamp became attainable. In the light of the directions given in the body of the specification, his Lordship thought that in the words there was claimed what had been already adequately described. It was no mere abstract principle, but a method or process of manufacture, capable of being at once put into operation by any experienced electric lamp maker, with such adaptations as his commercial requirements and standards suggested. To put it into operation required no new inventive capacity, and it would have been inconsistent with the generality and sweep of the explanation given to have inserted a definition of the word "large," otherwise than relatively to current practice. Such a definition, if attempted, would have limited unnecessarily the ground over the whole of which the new method was to be made operative. The principle and its working in practice need not be distinguished in the fashion which was required when the discovery was of some merely particular and qualified kind. Mr. Justice Sargant thought

that there was a direction that the diameter of the coil was to be "substantially of the order of 10 mils, a figure clearly indicated by the specification as constituting a thick filament." No doubt a filament of such a diameter would be thick or large, within the language of indication. But when he went on to suggest that the illustration did not suffice, inasmuch as the claim was not, so far as size was concerned, definable quantitatively, but only by reference to other variables, he (Lord Haldane) could not agree with him. Therefore he thought that the claim was not one merely for articles falling within particular limits of size in filament, but for a general process of manufacture applicable in all the cases which practical experience allowed. That was because of the character of the pioneer invention which the patent described. It was in truth an invention of an ingenious and useful process of manufacture in which the integers, so far as old, were combined in accordance with a principle that was new and embodied a fresh invention. For these reasons he submitted that the judgment in the Court of Appeal should be reversed.

Viscount Cave's judgment was to the same effect, and Lords Finlay, Dunedin and Shaw concurring, the appeal of the British Thomson-Houston Co. was unanimously allowed with costs.

Edge v. S. Metropolitan Electric Tramways and Lighting Co.

Last week Mr. Justice Swift awarded £2,000 damages to the widow and family of the late John Edge. The deceased was riding a motor-cycle along the road from Mitcham to Croydon, when a motor-lorry skidded and knocked over the cycle, causing fatal injury to Mr. Edge. The Judge held that the accident was due to the dangerous condition of the road, as the tram rail was about an inch above its surface.

Alleged Theft of Osram Lamps.

At Bow-street Police Court last week Edward Alex. Kann was remanded on a charge of STEALING from his employers, the General Electric Company, 3,600 OSRAM LAMPS, valued at £360. It was stated that accused had been in the employ of the prosecutors for over eleven years, and when arrested he held a responsible position in the manager's office at £420 a year. The lamps were sent to a regular customer of the company who had not ordered them, and Kann then arranged to collect them. Instead of having them returned to the prosecutors, the defendants sold them to Messrs. Drake and Gorham Wholesale, Ltd., who, on discovering they were charged 1s. 2d. each for lamps which in the ordinary way cost 2s., communicated with the prosecutors.

F. M'Nally v. Murdostoun Colliery Company.

In the Outer House of the Court of Session, Edinburgh, on Saturday last, Lord Sands and a jury concluded the trial of an action brought by the plaintiff to recover from defendants £500 as damages for the death of his son Francis. On Jan. 13, 1920, the deceased, who was employed by a contractor to remove dirt from the pit-head at defendants' colliery to a bin close at hand, ran into a live electric cable. At the point where he touched the cable there were about 2 in. bare and uninsulated, and the result was that young M'Nally received a fatal electric shock. The plaintiff pleaded that the cables were allowed to sag instead of being kept taut between the posts, and that they were not inspected to see that they continued in safe condition.

The defence was a denial of liability, with a plea by defendants that they had discharged their duty in every respect in taking precautions for the safety of workmen.

The jury returned a unanimous verdict for the defendants.

Attorney-General v. Southport Corporation.

This action, which has been commenced at the instance of the Birkdale Electric Supply Company, and challenges the claim of Southport Corporation to supply electricity in Birkdale, was again mentioned to Mr. Justice Petersen on the 16th inst.

Mr. Tyldesley Jones, K.C., said that the case raised the question as to the right of supplying electricity in that part of the borough of Southport, which was formerly known as Birkdale. Plaintiffs' case depended partly upon their rights and powers under a certain agreement, and partly on a question of *ultra vires*. It would be impossible to try such a case on a motion, and the parties had agreed to allow the matter to stand until the trial of the action, and to ask leave to apply for an early hearing. The case would take at least two days, as there were agreements, provisional orders, and Acts of Parliament, which would have to be carefully examined.

His Lordship said he would give liberty to the parties to apply to expedite the trial of the action when they were ready. There would be no order on the motion, except that the costs be costs of the action.

Illegal Supply Connections.

At Eastbourne Police Court last week the Corporation summoned two persons for making improper and unauthorised connections to the supply mains of the Electricity Department, and fines were imposed.

In the case of John E. Dunn, the Hutments, Victoria-drive, the Town Clerk (Mr. H. W. Fovargue), who prosecuted, said that on Sept. 7th defendant made an extension to the electric lighting of one of the hutments where he resided, as a result of which he added an extra light to the bedroom. He did that without asking for the consent of the Electricity Committee, who had taken up the prosecution mainly for the purpose of giving an object lesson to defendant and others. In that case the electric supply to an adjoining hut

was damaged by what defendant had done. It was not an isolated case, and it was becoming a practice for extensions to be made in that manner.

Mr. J. K. Brydges, Borough Electrical Engineer, gave evidence of the agreement entered into by defendant to pay fourpence per light per week for the summer months and ninepence per week in the winter months.

The Bench suggested defendant might use one lamp in the bedroom, but he might not use an additional lamp in the living room.

Mr. Brydges replied that the point was that defendant made an extension which he was not entitled to do without the sanction of the Corporation.

The magistrates fined defendant 5s.

In the second case, a man named J. O'Connor, an electrical contractor, was charged with making an unauthorised connection at 71, Cavendish-place, on Oct. 28.

The Town Clerk said that the occupier of the premises made an application on Sept. 20th for an extension to provide him with an electric fire. That connection was duly made, and later it was discovered that further extensions had been made without authority. It was found that the power provided for the fire was being used through an extension to drive a sausage machine, and that a further extension was taken to the cellar where it was used for lighting. The charges for lighting and power were higher than that for heating, and defendant ought to have known that he could not make the extensions without authority.

The occupier gave evidence that he had had the lighting wiring done some time ago. His wife then wanted heat, and the same man put the heating apparatus into the premises. He then called defendant to put in the machine. He did not know anything about the need for an application, and left that to defendant.

The defendant said that the offence was committed owing to a misunderstanding. When the occupier (Mr. Breeze) asked him to do the work he said the wiring had been done, and by that he understood that everything was in order.

Ultimately a fine of 30s. was imposed.

Electric Traction.

It is announced that from December 31 SCARBOROUGH electric tramway service is to stop permanently.

Last month 359 suggestions were received from the staff of the LONDON UNDERGROUND COMPANIES for various improvements in services and working devices.

ABERDEEN Town Council are proceeding with their application for a Provisional Order to authorise the construction of additional tramways and other works.

By the sale of "Distress Tickets," CARDIFF Tramways raised, in two days, over £100 for the Lord Mayor's Distress Fund. A further million tickets have been ordered.

The Ministry of Transport have sanctioned, under certain specified conditions, the borrowing of £36 096, for the renewal of various parts of PLYMOUTH electric tramway track.

WALSALL Town Council have approved an agreement with the South Staffordshire Tramways (Lessee) Company for through running of trams between Walsall, Wednesbury, and Darlaston.

WIGAN Tramways Committee is to receive £500 per annum for the carriage of mails and postmen on the electric trams. Last year the Post Office only contributed £200. The Watch Committee will pay £200 in respect of the conveyance of the police.

At last week's meeting of the NEWCASTLE Corporation Transport and Electricity Committee it was reported that the laying of tramway lines from Barras Bridge to the High Level Bridge would be begun in the course of a few weeks. The extensions to the car sheds at Byker are also to be begun shortly.

EDINBURGH Tramway Committee decided last week, by a narrow majority, to recommend that the electrification of the tramways be proceeded with, and that the overhead system be generally adopted. In a subsequent division, the Committee also recommended that application be made to the Ministry of Transport to sanction the erection of centre poles in Princes-street. At a public meeting held subsequently, the above recommendation to proceed with electrification was approved, but a resolution protesting against the erection of overhead wires and centre poles was carried by a large majority.

The Ministry of Transport has informed the TAUNTON Town Council that an Order has been made abrogating as from Dec. 6 the powers of the Taunton Electric Traction Co., in respect of the tramways authorised by the Taunton Tramways Order, 1900, and the Taunton Tramways (Extension) Order, 1907.

The question of restoring the tramway service was raised at a meeting of TAUNTON Town Council last week, it being stated that the present bus service was inadequate. Purchase of the undertaking by the Council was suggested, but did not receive much support. The Mayor said no steps would be immediately taken for the removal of the lines. Before the trams could be run again another Provisional Order would have to be obtained, and that would take at least twelve months.

After an all-day sitting, on Thursday last week, of the National Industrial Council of the TRAMWAYS INDUSTRY the DEADLOCK which

had arisen at the previous meeting was REMOVED, it being unanimously agreed to appoint a joint sub-committee, consisting of seven members from each side of the Council, to proceed at once to consider and revise the whole of the terms of the March, 1919, agreement without any conditions and without binding the Council to adhere to the guaranteed forty-eight hour week. The committee will meet at once and report to a special meeting of the Industrial Council in February.

At their meeting on Monday the L.C.C. HIGHWAYS COMMITTEE announced that they had decided to postpone until after the end of the present financial year the consideration of any further fare reductions. The Committee is also to consider the advisability of connecting the tramway end in the Tower Bridge-road with the line through Tooley-street to Greenwich, so that a through service can be run. It is thought it would make a useful connection now that the Council has decided to remove the tramway tracks in Grange-road and Southwark Bridge-road.

It is proposed to institute a scheme of awards to tramway employees for suggestions, &c., for the improvement of the tramway service, and the Committee has been authorised to settle the details.

In view of the proposed through running agreement with the London United Tramways, in respect of the Merton and Wimbledon tramways, expenditure on capital account of £5 500 has been authorised for lowering the roadway under Balham High-road railway bridge.

Municipal Accounts.

For the half-year ending September, LINCOLN tramways showed a loss of £314.

For the half-year ended Sept. 30, the accounts of STOCKTON tramways showed a surplus of £4 224 towards the formation of a reserve fund and the payment of interest and redemption.

The CITY OF EDINBURGH ELECTRIC LIGHTING ACCOUNTS for the year ended May 15 show the capital expenditure at that date to be £1 678 750, an increase of £360 121 over the previous year. The total amount borrowed, was £1 676 758, of which £802 591 has been repaid, but sanction to borrow a further sum of £631 902 has not been exercised. The total revenue for the year under review amounted to £314 669; expenses were £241 054, leaving a gross profit of £73 615. The interest, income tax, and repayment of capital, however, required £74 578, leaving a deficit of £963. This sum has been provided out of the reserve fund, which now amounts to £115 632. Units generated numbered 10 687 219 (9 924 955).

The accounts of the ELECTRICITY UNDERTAKING of LEITH, which was incorporated with Edinburgh in November, 1920, have been kept separately for the year to May 15, 1921, and the figures in the balance-sheet at that date have been incorporated in the Edinburgh report. The accounts show that the total revenue for the past year was £79 457, expenses were £77 237, leaving a gross profit of £2 220. After providing for interest, repayment of loans, income tax, &c., there was a deficit for the year of £11 210. The reserve fund stands at £10 893. Units sold numbered 7 145 501, against 5 119 848 last year, and the maximum demand was 3 048 kW (2 918 kW).

The accounts of CARDIFF ELECTRICITY UNDERTAKING for the year ended March 31, show the capital expenditure to that date to be £383 532, including £42 807 expended during the year. The over-expenditure on the account amounted to £19 086. The income during the year under review was £160 879, an increase of £43 271 over the previous year; expenditure was £109 108 (£76 355), leaving a gross profit of £51 788 (£41 271). After providing for various charges a net profit of £23 711 (£5 130) remained. The unappropriated revenue balance at March 31, 1920, was £37 801 12s., to which £23 710 16s. was added for the present year, making a total of £61 602 8s. Expenditure deducted out of this amount was £4 247, leaving a revenue surplus of £57 356. Of this £15 000 has been appropriated to the relief of the rates. The amount paid off and set aside for redemption of debt represented 49.58 per cent. of the total capital liability of the undertaking.

The accounts of CARDIFF ELECTRIC TRAMWAYS AND MOTOR-BUS UNDERTAKINGS for the year ended March 31, show that the total expenditure on capital account, including expenses of raising corporation stock and works of a capital nature paid out of revenue and reserve fund, amounted to £870 491 10s., the account closing the year with an under-spent balance amounting to £31 405, new money to the extent of £74 899 having been transferred out of the proceeds of the issue of 6 per cent. stock. The traffic receipts for the year amounted to £290 891 against £278 384 for the previous year. The receipts from parcels' service were £907 (£838). The total income was £367 262, or £38 602 more than in 1920. The amount carried to net revenue account was £64 431 (£109 775). In accordance with a resolution of the Committee, an appropriation of £37 000 from the net revenue balance of £40 700 brought forward at March, 1920, has been transferred to the depreciation fund, leaving a credit balance of £3 700. The reserve fund now stands at £10 744 10s. The deficit is, in a great measure, due to increase in wages, which amounted to an increase this year over last of £40 745. Increase in cost of materials was another factor, whilst the increase in mileage was 453 633. The operating costs for the year were 19.76d. per mile, which compares favourably with those in other parts of the country.

Electricity Supply.

Two new electricity generating sets have been started at the W. J. P. Station.

THE NEW Electrical Maintenance Company is holding an exhibition of modernity about saving appliances.

AYLESBURY Town Council has decided to apply to the Commissioners for a loan of £2 000 for meters.

SHEPNEY Borough Council have agreed to supply electricity in bulk to the London Hydraulic Power Company at Wapping.

WALLASEY electrical supplies were cut off for two hours on Sunday morning to enable certain important extensions to be connected up.

WALSLEY Town Council have approved the recommendation of the Electricity Committee that £695 should be spent on renewals of machinery.

SPALDING (Lincs.) Urban Council have refused to grant permission to the South Lincs. Agricultural Company to supply electricity to the residents close to their works.

BRIDGEND (Glamorgan) Urban Council have decided to support the Parliamentary Bill of the South Wales Electricity Distribution Company, permitting local authorities to become shareholders in the undertaking.

The CHADDLE and GATLEY ELECTRICITY SPECIAL ORDER, 1921, for the supply by Chaddle and Batley Urban Council of electricity within the Urban District, has been submitted to the Minister of Transport for confirmation.

The new sub-station at Mill Hill, BLACKBURN, was inaugurated last week. Two of the largest mills in the vicinity are being equipped with machinery for power and lighting, and a fair number of applications from business men have been received.

Sir William Mackenzie, K.C., the referee appointed under Sec. 16 of the Electricity (Supply) Act, 1919, has heard evidence on the claims made on behalf of certain members of the Electrical Power Engineers' Association and the National Amalgamated Union of Engineers, Firemen, Mechanics, Motormen, and Electrical Workers against MORLEY Corporation for compensation for deprivation of employment ensuing upon the closing down of the Corporation's generating station consequent upon an agreement between that Corporation and Leeds Corporation. The decision of the Referee will be announced in due course.

The question of securing the abatement of the SMOKE NUISANCE in London has been under consideration by the Public Control Committee of the LONDON COUNTY COUNCIL, who report that for some considerable time serious smoke nuisance has been observed from the shafts of the electricity generating stations of the Hackney, Hammersmith, and Islington Borough Councils. Correspondence has passed between the different Councils concerned, and it is now recommended that proceedings be instituted against both Hammersmith and Islington Councils in regard to an alleged smoke nuisance at their electricity works.

HAMMERSMITH Electricity Committee have under consideration the formation of a Development Department for the purpose of investigating new electricity consuming devices and methods, and of giving consumers advice in the use of new systems and apparatus. They are of opinion that steps should be taken to provide a showroom in the borough. As a preliminary step they have submitted to the Finance Committee a reference regarding the allocation of a portion of the land for a showroom, between the temporary office premises and the Central Library, and the Council have given permission for the use of part of the Town Hall for a fortnight for the holding of an electrical exhibition.

New Schemes and Mains Extensions.

WOLVERHAMPTON Electricity Committee is to be approached by RUGLEY with regard to supplying the district with electricity.

WEXFORD Corporation have accepted the proposal of Mr. J. J. Stafford to supply electricity at 6d. per unit for lighting the town.

WARE Urban Council have assented to the application of the North Metropolitan Electrical Power Distribution Co. for a Special Order for the Council's area.

The Commissioners of the MANX village of OSCHAN have asked the Manx Electric Railway Company for an estimate for lighting the whole of the district by electricity.

Owing to the additional demand for electricity created by the extension of the Railway Approach Market, HAMMERSMITH Borough Council have decided to erect a new sub-station.

DOLGELLY Urban Council are to discuss with Evan Jones & Son, of Bala, the possibility of providing power at the Llwyn Mills of the firm for an electric power scheme for Dolgelly.

THE FLINTSHIRE and HAWARDEN Councils have decided to oppose the application by the Chester Corporation to the Electricity Commissioners for a Special Order authorising an extension of the area of supply.

The Mersey Power Company is making small extensions in the FRODISHAM district, where the Council has decided to have KINGSWAY lighted by electricity from the present standards.

WHITEHAVEN Town Council has applied for a loan of £8 500 for plant and extensions to the economiser. The Council has decided to give a supply of electricity to the Castle, which is to be converted into an infirmary.

CANNOCK Urban Council last week considered plans for the erection of a new transformer station in Queen-street, in connection with the supply of electricity to the district, and decided to apply for sanction to a loan of £36 753 to carry out the work.

Two schemes of reorganisation of electricity supply in the EAST LANCASHIRE DISTRICT are proposed. One will be submitted by Burnley, Accrington, Colne, Darwen, Nelson, Rawtenstall, and Brierfield. Other local authorities will submit an alternative scheme before March 31 next.

On the invitation of Councillor J. Moore and the Borough Electrical Engineer (Mr. Bache), the Mayor and Corporation of CHELTENHAM last week visited the Corporation Electricity Works and inspected the recent additions to the plant, which include a 1 000 kW Parsons' turbo-alternator.

KEITH Electricity Committee have considered the report of Mr. Macewan regarding the proposed introduction of electricity into the burgh, but have decided to make no recommendation to the Council pending the further development of the County scheme.

BRENTWOOD DISTRICT ELECTRIC COMPANY are applying to the Electricity Commissioners for a Special Order authorising the Company to produce and supply electrical energy in Brentwood and certain parishes in Billericay and Romford Rural Districts.

STOCKTON HEATH Council has decided to urge the Warrington Council to proceed immediately with the laying of cables, as although some residents have installed electrical fittings, the bulk of intending consumers are not prepared to do so until the cables have been laid.

It is proposed to proceed with the scheme for the supply of electricity to the towns and villages of the VALE of CLWYD, provided Ruthin, Denbigh, St. Asaph, and Rhuddlan between them guarantee for a term of years a consumption of 320 000 units, which it is calculated could be supplied at 1½d. per unit.

The HAYWARDS HEATH ELECTRICITY SPECIAL ORDER, 1921, made by the Electricity Commissioners on the application of E. A. Bridge, H. Dearden, H. Finch, T. White and E. Prior, for the supply of electricity in Haywards Heath and Cuckfield Urban Districts, and parts of Cuckfield and Wivelsfield Rural Districts, has been submitted to the Minister of Transport for confirmation.

The question of lighting INVERURIE by electricity came before a meeting of the Council last week, when it was stated that the matter had been discussed in April, 1915, and abandoned on account of the Government refusing a loan. It was agreed to bring the question up at the next meeting, and in the meantime the reports of the experts in 1915 are to be circulated among the members.

PAISLEY TOWN Council are applying for sanction to borrow £30 000 for mains and sub-station plant extensions. This does not include any sum for generating plant extensions, but it will be necessary, Mr. Blair Smith, the borough electrical engineer, points out, at a very early date to consider what provision should be made for increased demands on the power station during the winter months of 1922-23.

KEIGHLEY TOWN Council have decided to apply for sanction to borrow £10 000 for the erection of an overhead transmission line from Eastburn to Skipton, in connection with the agreement to supply electricity to Skipton. A resolution was also passed at last week's meeting of the Council that, subject to a grant being obtained from the Unemployment Grants Committee towards the cost of the scheme, new direct current cables be laid in the central portion of the town to supersede the existing ones, and that application be made for sanction to borrow £8 000 for the purpose.

STEPNEY (London) Borough Council have applied to the Electricity Commissioners for a Special Order to empower the Council to continue and maintain their Limehouse generating station, to extend same from time to time, and to exempt the Council from proceedings for nuisance in respect of the generating station, etc.

On Monday the Borough Council also passed a resolution authorising the Electricity Committee to proceed immediately with the full scheme for the extension of the Limehouse Generating Station, subject to the Unemployment Grants Committee providing half the interest charges for five years, and to the Electricity Commissioners granting a five years' suspension of the Sinking Fund on the capital, and on sanctions already received, but not yet fully exercised.

KETTERING Urban Council have published a neat little pamphlet giving an account of the extensions which have recently been carried out at the Electricity Works; sanction was obtained from the Commissioners in July last year, and the additions have increased the capacity of the plant from 2 630 to 4 130 kW. The new plant includes a 1 500 kW Parsons' geared turbine coupled to a Mather & Platt shunt-wound dynamo, surface condensing plant, a Weir turbine air pump, a Stirling water tube boiler capable of evaporating 30 000 lb. of steam per hour, together with superheater, two Babcock & Wilcox chain grate stokers, dumping hoppers, steam piping, a Dayenport cooling tower and tank, &c. The whole of the contracts were executed to the specifications of Mr. W. A. Walker, the Council's electrical engineer.

The difficulty following upon the refusal of the Commissioners to approve of electrical extensions at ACCRINGTON seems likely to be amicably arranged. Accrington desired to borrow £150 000 for electrical extensions, and declined to take a supply from Blackburn on the ground that it would cost them £10 000 a year more owing

to the high price asked by Blackburn than if they generated their own current. The Commissioners have now agreed to sanction borrowing powers if Accrington Council will agree with the Blackburn Corporation to the laying of a 33 000 V cable between the generating stations of the two towns at an equal cost to each, for the purpose of giving and taking a mutual and reciprocal supply. Accrington have approved of these terms, and have arranged a conference with the Blackburn authority to link up the two towns.

At their meeting at Exeter last week, DEVON COUNTY COUNCIL received the Dartmoor Preservation Committee's report of the hydro-electric power scheme to supply several South Devon towns, and involving an expenditure of from £350 000 to £500 000. The Council adopted the Committee's suggestion that the scheme should be referred back, with the addition of Sir H. Lopes, Messrs. Murrin, Oxley Parker, and Toms. The project would require watching, and would clash with the Torquay electricity proposal. The plan involves the construction of one reservoir on the higher waters of the East Dart, and another immediately below Dartmeet; an aqueduct from the lower reservoir to a point above New Bridge, with a line of pipes descending from that point to a power-house at New Bridge. From the power-house electric cables would radiate so as to supply electricity to Torquay, Newton Abbot, Paignton, Dartmouth, Brixham, Dawlish, Teignmouth, Bovey Tracey, Totnes, and Buckfastleigh.

We announced recently that CHESTER Corporation had decided to extend its electricity supply area to the adjacent rural districts, and the Tarvin and Chester Rural Councils have already assented to the application for a Special Order. The city electrical engineer (Mr. S. E. Britton) reports that, taking the added area as a whole, and judging by the inquiries received from different parts, there appears to be a keen desire to obtain a supply of electricity. The district is densely populated, and contains property of sufficient value to create a demand which will enable electricity to be given on favourable terms. It is not proposed to prepare a complete scheme of distribution for the whole area, but to accept the powers and obligations of the Electricity Supply Acts, and to develop the supply as the demand arises. An extra high-tension feeder will be laid from Queen's Ferry in order to give a supply in Hoole and Newton. It is proposed to appoint a consultative committee to deal with questions relating to extensions in the rural areas, and as soon as sanction has been received the Electricity Committee propose to undertake capital works estimated to cost about £14 000.

The Committee offer to give a bulk supply to Wrexham from Queen's Ferry up to 1 000 kW per annum at £5 per kW of demand and 1.1d. a unit, subject to a coal clause. The basic price has been fixed at 25s. a ton for washed slack, and the variation 0.1d. a unit for each 6d. rise or fall in the price of such fuel.

Alteration of Charges.

Electricity charges in AYR are to be reduced by 25 per cent.

WHITEHAVEN has decided to make a small reduction in electricity charges as from the New Year.

RUSHDEN and District Electric Supply Company have reduced the charge for electricity for power and heating by 3d. per unit.

BEVLEY (KENT) Urban Council has discontinued the rateable value tariff for electricity, and has decided to charge 8d. per unit.

At WALTON-ON-TIMES the electricity charges have been raised from 10d. to 1s. per unit by the Urban Electric Supply Company.

HIGH WYCOMBE (Wycombe Borough) Electric Light and Power Company announce a reduction of 10 per cent. in the price of electricity for power from Jan. 1.

The Electric Light and Power Company at NORTHAMPTON have reduced the price of electricity by 3d. per unit, and in order to encourage the heating demand a scale of discounts, ranging from 5 per cent. on accounts for 100 units per quarter to 25 per cent. for 500 units has been put in force.

After a very heated and somewhat disorderly meeting of the BRIGHTON Town Council last week, it was decided to reduce the charges for electricity for private lighting from 7½d. to 7d. per unit, from the date of the December meter readings, in order to make a contribution in relief of the rates.

Educational.

The GOVERNORS OF NOTTINGHAM UNIVERSITY COLLEGE have accepted an alternative site, offered by Sir Jesse Boot, for the proposed new University. In addition to £50 000 for the new University, Sir Jesse Boot has also given £100 000 towards the expense of its erection.

French engineering firms of Lorraine district (rolling stock, railway material, &c.) have consented to accept, for periods of two or three months, a few BRITISH ENGINEERING STUDENTS during their summer holidays. Applications, in writing, stating age, qualifications, and giving references, will be received (until further notice) by the Hon. Sec., British Section of Société des Ingénieurs Civils de France, 45, Great Marlborough-street, London, W. 1.

The BRITISH ELECTRICAL & ALLIED MANUFACTURERS' ASSOCIATION recently granted the following SCHOLARSHIPS in electrical engineering (steam turbo-generators), each tenable for one year and each carrying a maintenance allowance of £100 and the payment of college fees: Leonard Hulford Loder Badham, tenable at the City and Guilds (Eng.) College, South Kensington; John Henry Butcher, tenable at the City and Guilds (Eng.) College, South Kensington;

James Ernest Macfarlane, tenable at Brighton Technical College. The following in mechanical engineering (steam turbines) have also been granted: William Stanley Bowers, tenable at Finsbury Technical College; John Arthur Snape, tenable at Manchester College of Technology; Morris Lord Yates, tenable at Manchester College of Technology.

Personal and Appointments.

Mr. R. M. ELLIOTT has been elected chairman of Stockton Joint Tramways Committee.

ALDERMAN ATTLEE has been appointed chairman, and COUNCILLOR LAZARUS vice-chairman, of Stepney Electricity Committee.

COUNCILLOR BEDFORD has been appointed chairman, and ALDERMAN JOHNSON vice-chairman of Hammersmith Electricity Committee.

Mr. H. E. DALZELL has resigned, after many years' service, from the position of Chief Mechanical and Electrical Engineer to the Southern Railways of Peru and Dependencies.

Mr. W. ELLES-HILL has been appointed secretary to the Trade Facilities Act Advisory Committee. The offices of the Committee will shortly be removed from 7, Whitehall-gardens, to 17, Throgmorton-avenue, London, E.C. 2.

In commemoration of the visit of the Prince of Wales to Calcutta University several honorary degrees have been conferred. These include a science degree on SIR WILLIAM J. POPE, Professor of Chemistry at Cambridge University.

The MELBY SPORTS CLUB (Post Office Engineering Department, City Internal) have arranged to hold their first annual concert at the Talbot Restaurant, London Wall, E.C., on Saturday, Jan. 14. Tickets, at 1s. 6d. each, can be obtained from any member of the club.

The Crompton Medal, awarded annually by the Institution of Automobile Engineers for the best paper of the session, has been presented to Mr. H. L. HEATHCOTE, Chief of the Research Laboratories, Rudge-Whitworth, Ltd., for his paper entitled "The Ball Bearing in the Making, under Test and on Service."

Dr. JOHN B. WHITEHEAD, dean of the engineering school, and professor of electrical engineering at Johns Hopkins University, U.S.A., has been awarded the 5 000fr. prize of the Institute Electro-technique Montefiore, of Liège, Belgium, bestowed every three years for original work on the scientific advancement in the technical application of electricity. The Prize was given for an essay on "The Corona Voltmeter and the Electric Strength of Air."

Business Items, &c.

Mr. W. CRABTREE, electrical engineer, Barnsley, has opened new premises at 2B, Peel-street.

Practical demonstrations of the "Magnet" electrical labour-saving appliances were given last week at HILL, UPTON & COMPANY'S showrooms in Oxford.

The ANTI-ATTRITION METAL COMPANY have removed from Cornwall-buildings, Queen Victoria-street, to larger premises at 1, Victoria-street, London, S.W. 1.

The name of the Manila Electric Railroad & Lighting Corporation has been changed to the MANILA ELECTRIC CORPORATION. It is not proposed to change the name on the stock certificates already issued.

The MCGRAW-HILL COMPANY have purchased the "Electrical Review," of New York, which will in future be published monthly at Chicago under the name of "Electrical Review and Industrial Engineer."

BRUCE PEEBLES & COMPANY announce that their works will be closed from Friday, Dec. 30, until Monday, Jan. 9, 1922. No goods will be received or despatched between these dates, and only urgent correspondence will be dealt with.

A British West Indian firm in Trinidad would be glad to receive CATALOGUES AND CURRENT PRICE LISTS of United Kingdom manufacturers of ELECTRIC MOTORS. The name and address of the firm may be obtained from the Department of Overseas Trade.

The HOTPOINT ELECTRIC APPLIANCE COMPANY have transferred their business to 51, Berners-street, Oxford-street, London, W. 1. Extensive show-rooms have been acquired, and a model kitchen and dining-room have been fitted up entirely with Hotpoint electric appliances.

On Tuesday the METROPOLITAN-VICKERS ELECTRICAL COMPANY opened a new showroom and an electrically-equipped kitchen at 232, High Holborn, London, W.C. The showroom is arranged in sections, in each of which the decoration represents a certain period, and the electric fittings are designed to harmonise with the decoration. There are also a trade counter and a store, which are kept stocked from the main stores in Wardour-street. We hope to give details of some of the electrical exhibits in an early issue.

DRIVER, DRENNAN & COOPER, LTD., announce that the name of the Company has been changed to the BRITISH DRIVER-HARRIS COMPANY, LTD. This change has been effected for the purpose of securing the advantages to be derived from the consolidation of the title of the former Company with that of the American Driver-Harris Company. The change involves no alteration in the constitution, objects, or management of the business. The shareholders and their holdings remain the same, and the direction of this business remains in the same hands as heretofore.

Institution Notes.

The annual meeting of the Scottish Local Section of the Institution of Electrical Engineers was held in the Grosvenor Restaurant, Gooden Street, Glasgow, on Saturday, Dec. 17, Mr. A. S. Hampton presiding, in the absence of the president, Mr. E. T. Gossin. The concert was largely attended, about 400 members and friends being present.

The PHYSICAL SOCIETY OF LONDON have invited members of the INSTITUTION OF ELECTRICAL ENGINEERS to attend the Annual Exhibition of Scientific Apparatus, to be held at the Imperial College, on Wednesday and Thursday, Jan. 4 and 5, in the afternoon from 3 to 6, and in the evenings from 7 to 10. Tickets can be obtained from the Secretary of the Institution.

At the first meeting of the Professional Committee of the proposed INSTITUTION OF CHEMICAL ENGINEERS recently, Sir Arthur M. Duggall was elected as chairman. Other working officers appointed were: Vice-chairman, Mr. W. J. U. Woolcock; hon. treasurer, Mr. F. H. Rogers; hon. secretary, Prof. J. W. Hinchley; assistant hon. secretary, Mr. D. M. Newitt; and acting secretary, Mr. A. C. Flint.

THE WOMEN'S ENGINEERING SOCIETY are organising a Labour Saving Competition. The competition will be open to all women, irrespective of nationality, and is divided into the following sections: (a) Engineering devices suitable for mechanical, electrical, and automobile work; (b) structural improvements; and (c) any other labour saving appliances for the home. All models and drawings must reach the offices of the Society, 26, George-street, Hanover-square, W. 1, on or before March 31, 1922.

At the annual meeting of the FARADAY SOCIETY, on Dec. 13, the following officers and Council were elected:—President: Prof. Alfred W. Porter. Past Presidents: Mr. J. Swinburne, Sir R. T. Glazebrook, Sir Robert Hadfield, Bart. Vice-Presidents: Mr. W. R. Cooper, Prof. C. H. Desch, Prof. F. G. Donnan, Dr. J. A. Harker, Mr. E. Hatchesek, Prof. T. M. Lowry, Dr. G. Senter. Treasurer: Mr. Robert L. Mond. Council: Prof. A. J. Allmand, Dr. H. Borns, Mr. Cosmo Johns, Prof. J. R. Partington, Mr. C. C. Paterson, Dr. J. N. Pring, Prof. W. G. McC. Lewis, Prof. A. C. Rankine, Dr. E. K. Rideal, Sir Robert Robertson. The annual report stated that during the year under review four general discussions had been held, three of them in co-operation with other Societies, and that reports of the proceedings of these discussions had been published and were in considerable demand. The work of the Society had greatly expanded, and an appeal was made for an increased membership, without which it would be difficult for the Society to keep pace with its increasing activities without a higher subscription. Up to the present this has been avoided.

Miscellaneous.

The 1922 Convention of the INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION will take place in Wolverhampton and the neighbourhood from June 20-23 inclusive.

As a result of the disastrous FLOODING OF THE RIVER HULL over the week-end, the electricity supply was interrupted, 1,300 telephone subscribers were disconnected, and the tram service between Thornaby and Middlesbrough was suspended for three hours.

In reply to a question by Mr. W. Thorne in the House of Commons on the 16th inst., Sir R. Horne announced that the Government was not contemplating the construction of SUPER-POWER STATIONS, and the electrification of the railways by Germany as part of the reparation payments.

In connection with the CENTRAL TELEGRAPH OFFICE BENEVOLENT FUND, the ladies of the Interkom Klub gave two performances of "The Tempest" at the Guildhall School of Music last week in aid of the Orphan Working School and Alexandra Orphanage, Havestock Hill. About £200 was raised.

Germany's claim to have succeeded in making "SYNTHETIC" GOLD out of baser metals by means of the electrical vacuum furnace is attracting very little serious attention in this country either in commercial or scientific circles, although the possibility of obtaining gold by synthetic processes is not denied by some.

The following have been added to the PERMANENT PANEL from which committees are selected to consider and report upon complaints referred to them by the Board of Trade under Part II. (Prevention of Dumping) of the SAFEGUARDING OF INDUSTRIES ACT: Sir Thomas W. Allen, Mr. F. J. Blakemore, F.G.I., Mr. Frank Moore, Mr. T. H. Ryland, J.P., and Provost A. B. Weir.

Mr. John Lee, Controller of the Central Telegraph Office, speaking at a Rotary Club luncheon at the Hotel Cecil last week, said that the IMPERIAL CABLE carried nearly a quarter of a million words a week from London to Nova Scotia, and across Canada and the Pacific to Australia. On these Government controlled lines a million telegrams a month pass in both directions. He urged business men to hand in their international messages as early as possible during the day. They could, if they chose, hand them in by telephone.

As from Jan. 1 the English and Welsh RAILWAYS have decided to DECREASE the rates as follows for an experimental period of twelve months:—Coal, coke, patent fuel, limestone for chemical works: The increase in the base rates in operation on Jan. 14, 1920 (now 100 per cent.), to be reduced to 75 per cent. Lime in Class "B" of the general railway classification for iron and steel-making purposes: The present flat rate of 6d. per ton reduced to 4d. per ton. Limestone for Class "B" of classification: The maximum addition of 4s. per ton where applicable retained.

Imperial and Foreign Notes.

It is stated that out of 3,700,000 hectares of cultivated land in SWEDEN, about 35 per cent. are electrified, of which 22 per cent. are provided with both light and power and 13 per cent. with light alone.

In order to obtain funds for the electrical tramways, street improvements, and other purposes, the CITY OF AUCKLAND last week offered for subscription £400,000 in debentures to bearer of £100 at £94.

A conference of the Institute of Engineers (Australia), the Australian Chemical Institute, and the Australian Institute of Mining and Metallurgy has decided to form the FEDERAL ENGINEERING COUNCIL, AUSTRALIA, with headquarters at Sydney.

A contract has been let to a Penang firm for the supply of electric light to the towns of Alor Star, the capital of Kedah (MALAY STATES), and Sungei Patani. The Alor Star supply is expected to be in operation by April, and at Sungei Patani the work is already in hand.

The following goods may now be exported from GERMANY without licence:—Steam engines, steam and gas turbines, whether or not combined with dynamos, winding engines, turbines, water wheels and hydraulic engines, combustion and explosive engines (except those for vehicles), gas engines for blast furnaces, hot air and compressed air engines and other power machines (except electric locomotives, locomotives, and electric motors), wind motors, winding machines, power machines (except electric motors), combined with non-portable winches or capstans, &c.

THE WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY has received from its Japanese agents (Takata & Company) an order from the Daido Electric Power Company of Japan for two large hydro-electric plants, of the total value of \$2,000,000. These plants are to form a part of a super-power system for the Tokio district, similar to that now under construction for the area between Boston and Washington. The current is to be transmitted at 154,000 V. This is the second large order that the Westinghouse Company has received from Japan within the last few weeks. The first order was for switching equipment for the Tokio Electric Company, and amounted to about \$1,000,000.

The manufacturing tax on electric light bulbs in ITALY has been fixed as follows for each bulb:—(a) Incandescent electric light bulb of any system: 1. Up to 10 W. with carbon filaments, 25 cts.; other, 50 cts. 2. From 11 to 50 W. with carbon filaments, 75 cts.; other, 1 lire 50 cts. 3. From 51 to 100 W. with carbon filaments, 1 lire 50 cts.; other, 3 lire. 4. From 201 upwards, with carbon filaments, 3 lire; other, 6 lire. (b) Arc lamps, excluding the carbons, 3 lire. (c) Carbons, pure or metallised or of any other system, for arc lamps, 2 lire per kilogram. A surtax at the same rate is levied on such goods when imported from foreign countries. Goods manufactured for export are exempt from the tax. The date of enforcement of this manufacturing tax (and import surtax) is to be fixed by the Minister of Finance.

THE SOVIET FOREIGN TRADE COMMISSARIAT has published a first list of undertakings which are to be leased to foreign concessionaires. This includes the Nizhni-Dnieprovsk Engineering Works, all steel works and electrical stations of the Dnieper district, all steam mills, and the tramways of Kieff, Charkoff, Ekaterinopol, Elizabetgrad, Odessa, Kremenichug, Orel, Winnitsa, and Nikolayeff. The concessionaires will be obliged to undertake to restore production to a certain level. Of the output 10 per cent. will be put on the home market, 20 per cent. will be bought by the Foreign Trade Commissariat, 10 per cent. will be reserved for the supply of Soviet landed properties. The State will take from 20 to 50 per cent. of the net profits. The concessionaires will be given security of tenure, but will have to undertake to feed their employees. The original owners of the undertakings will have a prior right to concessions.

Exhibition Notes.

Electrical equipment promises to be one of the strong features at the BIRMINGHAM SECTION OF THE BRITISH INDUSTRIES FAIR, which will be held from Feb. 27 to March 10 next year. Next week the work of erecting the stands on the three large aerodromes at Castle Bromwich, and fixing the heavy plant, will be begun.

The space available for foreign exhibits at the TOKIO PEACE EXHIBITION, to be held from March to July next year, has been over-applied for, but Arthur Buckley & Company, of Tokio, have secured a special site for the erection of a British Pavilion, and intending exhibitors can obtain space on application to the London office of the firm, at 40, Westminster Palace-gardens, Victoria-street, London, S.W. 1. Rates of freight on goods for exhibition have also been arranged by the firm, ranging from 20 per cent. to 50 per cent., according to date of shipment. Firms intending to exhibit should apply at once.

THE FEDERATION OF BRITISH INDUSTRIES have resolved that the Prime Minister should be asked to give an assurance that before adopting any alterations for variations in regard to reparations payment, the Government should submit their proposals to Industry generally, and to the particular trades whose interests might be affected.

Tenders Invited and Accepted.

UNITED KINGDOM.

EDINBURGH CORPORATION. Dec. 27.—Fifty-three electrical equipments for trams. Forms of tender from the Tramways Manager, 2, St. James-square, Edinburgh.

WEST DERBY GUARDIANS. Dec. 28.—Electric light and power installation (including generating plant), electric lift service, and telephone installation at the Walton Institution. Specifications from Mr. E. B. Bailey, 37, Moorfields, Liverpool.

NAVAN ROMAN CATHOLIC CHURCH AND PRESBYTERY. Dec. 29.—Wiring and lighting. Particulars from W. H. Byrne & Son, architects, 20, Suffolk-street, Dublin.

LONDON COUNTY COUNCIL invite applications from firms, and particularly manufacturers, to be placed on the lists of persons or firms from whom the Council from time to time invite tenders for the supply of electrical and mechanical equipment and spares, &c., required for the Council's tramways. Applications for inclusion in the first lists of goods required must be sent in not later than Dec. 31.

BIRMINGHAM SALVAGE AND STABLES COMMITTEE. Jan. 2, 1922.—Contract No. 1 (a) eight-cell destructor in two units; Contract No. 2, electric garage. Particulars from Mr. J. Jackson, Superintendent, Salvage Department, Council House, Birmingham.

LIVERPOOL OVERHEAD RAILWAY. Jan. 2.—Six months' supply of electrical fittings, insulating taps, &c. Particulars from Mr. E. J. Machell, General Manager, 31, James-street, Liverpool.

SWINDON AND HEDDINGWORTH BOARD OF GUARDIANS. Jan. 4.—Installation of the electric light at the Children's Home. Particulars from the Clerk, Mr. W. P. Kirby, 17, Bath-road, Swindon.

MALDEN AND COOMBE URBAN COUNCIL. Jan. 10.—Two 10 h.p. horizontal electric motors, starting gear, &c., and electric lighting in the subsidiary pumping station at Blake's-lane; one 2½-ton electric lorry with tipping body; and mercury vapour rectifier outfit. Particulars from the Engineer and Surveyor, Municipal Offices, New Malden.

LONDON COUNTY COUNCIL. Jan. 12.—Electric passenger lift, to lift a load of 1½ cwt., at Geoffrey House, Tabard Estate, Bermondsey, S.E. 1. Specification from the Chief Engineer, Gloucester House (Room 91), 19, Charing Cross-road, W.C. 2.

PETERBOROUGH CORPORATION. Jan. 12.—One 3000 kW turbo-alternator, with condensing plant, two 750 kW rotary converters, two 100 kW motor converters, e.h.t. and l.t. switchgear; steam, water and drain pipes, &c. Specifications from the City Electrical Engineer.

LEEDS ELECTRICITY DEPARTMENT. Jan. 12.—Single-phase Watt meters, minimum number required 2000. Particulars from Mr. C. Nelson, Heford, Manager, Electricity Department, 1, Whitehall-road, Leeds.

EAST HAM CORPORATION. Jan. 12.—Extension No. 4. Sec. A: 1500 kW rotary or motor converter, for converting 3-phase 50 period 6500 V to d.c. 450-500 V; Extension No. 4 S. Sec. A: e.h.t. and l.t. switchgear and connections. Particulars from Mr. W. C. Ullmann, Nelson-street, East Ham, E.

WORTHING CORPORATION. Jan. 23.—One Diesel engine and c.e. dynamo; and vulcanised bitumen-sheathed paper-insulated concentric and triple concentric cable. Specifications, &c., from the Borough Electrical Engineer.

DUNDEE CORPORATION.—Electric lighting of public clocks at Broughty Ferry, Lochee, and St. Peter's. Particulars from the City Architect.

AUSTRALIA.

CITY ELECTRIC LIGHT COMPANY, LTD., BRISBANE.—Feb. 10, 1922.—*Supply and delivery of six miles of three-core 0.15 by 0.15 by 0.15 paper insulated cable, suitable for 5500 V, with a non-earthed system. Tenders, accompanied by a preliminary deposit of £100, to the Engineer and Manager, Boundary-street, Brisbane.

POSTMASTER-GENERAL'S DEPARTMENT, MELBOURNE. Feb. 14.—*29½ tons Wheatstone tape of various patterns. (Schedule No. 3.) Local representation is essential.

AUSTRALIAN COMMONWEALTH GOVERNMENT. Feb. 14.—30 tons approximate Wheatstone tape paper white. Particulars from the Supply Officer, Australia House, Strand, London, W.C. 2.

THE COMMONWEALTH OF AUSTRALIA. Feb. 15.—Telegraph apparatus and parts (Schedule 544). Particulars from Supply Officer, Australia House, Strand, London, W.C. 2.

NEW SOUTH WALES GOVERNMENT RAILWAYS AND TRAMWAYS DEPARTMENT (Electrical Engineer's Branch).—Feb. 22, 1922.—*Supply, delivery, erection and maintenance of one 5000 kW 50 cycle turbo-alternator with condenser and accessories, at Zarra-street power house, Newcastle. (Contract No. 556.) Tenders, or proper forms and accompanied by a preliminary cash deposit, to the Secretary for Railways, Phillip-street, Sydney, N.S.W. Local representation is essential.

NEW ZEALAND.

POST AND TELEGRAPH DEPARTMENT. Jan. 17.—*25 000 dry cells for telephone work.

BOROUGH COUNCIL OF PALMERSTON NORTH. Original closing date Sept. 24. Extended date not yet decided.—*Service meters: (a)

Single-phase, 230 V, 400 5 A, 150 10 A, 50 15 A; three-phase, balanced load, 400 V, 100 10 A, 30 25 A, 15 50 A, 10 75 A, 5 100 A. (b) 19 50 kVA single-phase transformers, with oil, complete; 1 complete winding h. and l. tension, for one leg; spare parts and accessories.

SOUTH AFRICA.

MUNICIPAL COUNCIL OF JOHANNESBURG. Jan. 4.—*Supply and erection of one two-phase alternating-d.c. 2000 kW converter, switchgear and spares. The h.t. supply is two phase, 3000 to 3300 V per phase, 50 periods, and the converter is to be capable of supplying (a) d.c. three-wire from 460 to 520 V as a shunt-wound machine; and (b) traction supply from 500 to 550 V as a compound-wound machine.

ELECTRICAL DEPARTMENT OF DURBAN CORPORATION. Jan. 18. 1922.—*372 consumers' Whr. meters, including 37 d.c. meters, 275 single-phase, 50 cycle induction type meters, and 60 three-phase, 50 cycle, induction type a.c. meters for unbalanced loads.

PUBLIC WORKS DEPARTMENT OF THE UNION OF SOUTH AFRICA. Feb. 1.—Conduit and conduit fittings. Particulars from the Electrical Engineer, Public Works Department, Pretoria.

SOUTH AMERICA.

STATE ELECTRICAL POWER STATION, MONTEVIDEO. Dec. 30.—*(a) A group, comprising a four-stroke Diesel engine, coupled to a three-phase alternator, with the following characteristics: 50 cycles, 2000/2200 V between phases, 200 kW, and power factor of 3; (b) a group, comprising a four-stroke Diesel engine, coupled to a d.c. generator of 300 kW for a three-wire system of 2 by 230 V. The d.c. generating set must be delivered immediately after the acceptance of the tender. Local representation is essential.

CHILEAN STATE RAILWAYS. Feb. 4, 1922* :—1 electric compressor; 1 air storage drum and 1 continuous current electric motor (70 h.p.); 1300 electric filament lamps for lighting locomotives; 38 wall telephones.

ARGENTINE MINISTRY OF PUBLIC WORKS. Feb. 21, 1922.—*Nine electric motors, 36 tip waggons, 1 centrifugal pump with electric motor. Specification expected at the Department of Overseas Trade by Dec. 28.

BELGIUM.

ST. BERNARD (HEMIXEM) MILITARY DEPOT. Dec. 29.—Electric light installation. Particulars from the Musée Commercial, 15, rue de Augustins, Brux.

BULGARIA

BULGARIAN DIRECTION OF POSTS, TELEGRAPHS AND TELEPHONES. Jan. 10, 1922.—Supply of sixty 50-line and fifteen 100-line telephone exchanges. Particulars and drawings may be obtained from the Bulgarian Legation, 3, Queensberry-place, S.W. 7.

LONDON County Council have accepted the tenders of Cryselco, Ltd., and English Electric and Siemens Supplies, Ltd., for electric lamps.

WEXFORD Corporation have accepted the tenders of Ferguson and Brutz, Dublin, for £2574, for the erection of poles, mains, etc., in connection with the new lighting scheme.

HAMMERSMITH BOROUGH COUNCIL have accepted the tender of Ferguson, Palin, Ltd., for two stonework cells, bus bars, and isolators at £334 16s. in connection with the supply of electricity to Ealing.

BLACKPOOL Corporation have accepted the tenders of Strachan and Henshaw for coal and ash handling plant: E. Bennis & Company for railway wagon tippler; and E. Wood & Company for coal storage hopper, for the electricity works.

WHITEHAVEN TOWN Council have accepted the tender of Babcock and Wilcox, Ltd., for boilers, super-heaters, stokers, pipework, and a feed pump for the Electricity Works, at £7295; and that of E. Green & Son, for an extension of the economiser, at £298.

FULHAM (London) Council have received 22 tenders, ranging from £4345 to £7051 4s., for 11 000 yards 0.2 sq. in., 3300 V concentric paper-insulated and lead-covered cable, and the tender of W. T. Henley's Telegraph Works Company (£4400) is recommended for acceptance.

BRISTOL Corporation have accepted the following tenders:—British Insulated and Helsby Cables, Ltd., copper rail bands; Hackbridge Electric Construction Company, Ferranti, Ltd., Metropolitan-Vickers Electrical Company, and British Electric Transformer Company, transformers.

STEPNEY Borough Council have accepted the following tenders:—Drew-Bear, Perks & Company (lowest tender received) for steelwork for the lift well at Osborn-street sub-station, of £89 10s. Four tenders received; highest £135 10s.: Perry & Co. (Bow), Ltd. (lowest received), for well and river pipe work at Limehouse generating station, at £20 22s. Six tenders received; highest, £32 50s.

THE METROPOLITAN ASYLUMS BOARD received twenty-eight tenders for the installation of electric lighting cables at the training ship "Exmouth," at Grays, Essex, the highest being £1439 15s. 4d., and the lowest tender, that of E. Beckwith & Company, £451, is recommended for acceptance.

THE METROPOLITAN ASYLUMS BOARD have also accepted the tender of W. J. Furze & Company (lowest tender received), for a lightning conductor installation at St. Luke's Hospital, Lowestoft, at £101 10s. (Three tenders were received, the highest being £146.)

* Particulars from the Department of Overseas Trade.

Companies' Meetings, Reports, &c.

New Companies.

MISSISSIPPI RIVER POWER COMPANY have declared a dividend of 12 per cent. on the preferred stock to holders of record on Dec. 22.

BANK BUILDERS have declared a dividend of 5 per cent., as usual, on account, for the year ending June 30, 1922, payable on Jan. 1.

THE AUTOMATIC TELEPHONE MANUFACTURING COMPANY has declared a dividend at the rate of 6 per cent. per annum on the preference shares for the half-year ending Dec. 31.

THE VICTORIA FALLS AND TRANSVAL POWER COMPANY have declared a dividend for the past six months at the rate of 6 per cent. per annum, less tax, on the preference shares.

A dividend of 12 per cent. for the current quarter has been declared by the **MANILA ELECTRIC CORPORATION** on the common capital stock to stockholders of record, December 23.

The annual report of the **MANX ELECTRIC RAILWAY COMPANY** shows the gross receipts to be £63 707, as compared with £89 780 in 1920, and the number of passengers carried 667 178, against 926 312 last year.

At the meeting of the **ALLGEMEINE ELEKTRISCHE GESELLSCHAFT**, Berlin, a dividend of 16 per cent. on the ordinary shares was declared, compared with 14 per cent. last year. The capital has been increased by 250 000 000 marks to 1 100 000 000 marks.

JUTLAND ELECTRIC TRAMWAYS & LIGHTING COMPANY announce a dividend of 8 per cent. on the preference shares for the period ended September 30, 1921. After placing £5 000 to general reserve and depreciation fund and £1 909 for corporation tax, £545 remains to be carried forward.

The **STOCK EXCHANGE COMMITTEE** have granted an official quotation to £3 500 000 7 per cent. mortgage debenture stock of the **General Electric Company**, and have specially allowed dealings in £750 000 6 per cent. mortgage debenture stock of the **Newcastle-upon-Tyne Electric Supply Company**.

The profits of the past year of the **BARBADOS ELECTRIC SUPPLY COMPANY** amounted to £5 271, and £2 767 was brought forward. After providing for debenture interest and taxes, £6 084 remains. It is proposed to add £5 000 to the depreciation reserve, and to carry forward the balance of £1 084.

The accounts of **ACAR, CROSS & COMPANY** to June 30, show profit after providing for debenture interest, &c., of £146 091, making available, with £25 328 brought forward, £171 419. A further dividend of 74 per cent. has been declared, making 15 per cent., less tax; £40 000 has been placed to general reserve, leaving £40 387 to be carried forward.

MARCONI'S WIRELESS TELEGRAPH COMPANY announces a dividend of 7 per cent., less income tax, on the 250 000 7 per cent. cumulative participating preference shares, and an interim dividend of 5 per cent., less income tax, upon the 2 636 906 ordinary shares. These dividends will be payable on February 1 to shareholders registered on December 16 and to holders of share warrants to bearer.

The **EASTERN TELEGRAPH COMPANY** announce a dividend at the rate of 34 per cent. per annum, less income tax, on the preference stock for the quarter ending December 31, 1921, and the third quarterly interim dividend of 24 per cent. on the ordinary stock, free of income tax, in respect of profits for the year ending December 31, 1921. Transfer books of the ordinary stock will be closed from January 29 inclusive.

Sir R. Murray Heslop, Bart., presided at the first meeting of the directors of the **BIDEFORD & DISTRICT ELECTRICITY COMPANY** last week. Estimates for erecting a generating station with producer gas plant, using sawdust as fuel, and for laying the necessary mains, erecting sub-stations and transformers, were submitted by **Crompton & Company**, and were accepted. The agreements with the Borough and Urban District Councils concerned, entered into by **Mr. S. R. Knill** on behalf of the company, were approved, as also was an agreement for the lease of the generating station site and for the supply of sawdust at 6d. per ton for a period of 28 years. A prospectus inviting public subscriptions will be issued next month.

Presiding on Tuesday at the annual meeting of the **CORDBA LIGHT, POWER, & TRACTION COMPANY**, held in London, **Sir G. A. Touche** said that conditions generally had changed so materially since the war that modifications of the company's concessions were required to enable them to do justice to the possibilities of the situation, and the board were hopeful that the Government of the Province and the Municipality would agree to certain changes. That was one of the most important reasons for the financial schemes which had been put forward. Previous to the general meeting, extraordinary general meetings of the holders of the 5 per cent. debenture stock, the promissory note holders, the preference shareholders, and the ordinary shareholders were held, to consider a scheme of arrangement made between the company and the different classes of stockholders, with certain modifications. The chairman explained that, in deference to representation, by certain of the promissory note holders, it had been arranged that they should receive for each £100 of notes, £50 in debentures, and £75 in preference shares, in lieu of £50 debentures, £50 preference shares, and £50 in ordinary shares, as originally arranged. That modification would necessitate the arrears of preference dividend being discharged in ordinary stock, which, however, he would point out, had a very substantial value. The scheme was approved with one dissentient by the meeting of debenture stockholders, and unanimously at each of the other three meetings. An abstract of the year's accounts appeared in our last issue.

The following list is compiled from information supplied by Messrs. Jordan & Sons, Ltd., company registration agents, 116-118, Chancery-lane, London, W.C. 2.

AQUA ELECTRIC COMPANY, LTD. (178 170), 116, Putney Bridge Road, S.W. 15. Registered Dec. 2. Electrical, gas, and water engineers. Nominal capital, £8 000 in 8 000 shares of £1 each. Directors: To be appointed by subscribers. Qualification of directors, 100 shares. Remuneration of directors, £1 ls. each meeting attended. Private company.

BLOCKLEY ELECTRICAL ENGINEERING COMPANY, LTD. (178 315), the Electricity Works, Blockley, Worcestershire. Registered Dec. 10. Nominal capital, £1 000, in 1 000 shares of £1 each. Directors: A. E. Beck and L. A. Beck. Qualification of directors, ten shares. Private company.

DUBILIER CONDENSER COMPANY (1921), LTD. (178 13), Ducon Works, Goldhawk Road, Shepherd's Bush, W. 12. Registered Dec. 2. Electricians, mechanical engineers, and manufacturers of electrical condensers. Nominal capital, £25 000 in 25 000 shares of £1 each. Directors to be appointed by subscribers. Qualification of directors, £100.

ELECTRIC AND RAILWAY FINANCE CORPORATION, LTD. (178 213), 2, Bond Court, Walbrook, E.C. 4. Registered Dec. 5. To carry out financial and commercial operations of every description. Nominal capital, £500 000 in 500 000 shares of £1 each. Directors, to be appointed by subscribers. Qualification of directors, £1000.

RAMSEY ENGINEERING COMPANY, LTD. (178 255). Registered Dec. 5. Mechanical and electrical engineers and contractors. Minimum subscription, 7 shares. Nominal capital, £40 000 in 5 000 preference shares of £1 each and 140 000 ordinary shares of 5s. each. Directors, to be appointed by subscribers. Qualification of directors, £100. First directors, 1 share. Remuneration of directors, £50 each. Chairman, £100. Subscribers, E. G. de Mattos, 55, Chepstow Place, W. 3; D. Ramsay; J. Burke.

STENTOPHONE MOTOR ACCESSORIES (1921), LTD. (177 431), 21, Ombersley-road, Balsall Heath, Birmingham. Registered Oct. 22. To acquire business of Stentophone (Motor Accessories), Ltd., carried on at Alcester-road, Moseley, Birmingham, and carry on business of manufacturers of motor accessories, magnetos, &c. Nominal capital, £75 000, in £1 shares. Directors: A. H. Trelogan, Sarah A. M. Trelogan, E. Trelogan, W. Sames, H. W. Sames and W. L. Sames. Private company.

TAYLOR CAR SYNDICATE, LTD. (178 401), 7, New-square, Lincoln's Inn, W.C. 2. Registered Dec. 14. To acquire certain patents for inventions in relation to variable speed, power, transmission gear, and turn same to account. Nominal capital, £100, in 400 shares of 5s. each. Directors: G. H. Dawson, and J. L. Cunningham. Qualification of directors, one share.

UNION ELECTRIC WELDING COMPANY (EGYPT), LTD. (177 649) Registered Nov. 3. Electric blowpipe and other forms of welding and soldering. Nominal capital, £10 000, in £1 shares. L. Savon and Company, Ltd. (managers). Subscribers: E. O'Reilly and H. J. Mitchell, 52 Bishopsgate, E.C. 2. Private company.

WHEELER'S ELECTRIC SHADE CARRIER, LTD. (177 916). Registered Nov. 19. To acquire patents in relation to improved means for securing shades to holders of electric lamps, and turn same to account. Nominal capital, £10 000, in 10 000 shares of £1 each. Directors to be appointed by subscribers. Qualification of directors, £100. Subscribers: H. F. Wheeler, 83a, Mosley-street, Manchester; T. Smith, 71, Princess-street, Manchester.

WINTERSGILL & WORTH, LTD. (177 727). Registered Nov. 6. Mechanical and electrical engineers. Nominal capital, £500, in 500 shares of £1 each. Directors: G. Wintersgill (18, Devonshire-road, Middlesbrough) and W. M. Worth. Qualification of directors, 50 shares. Private company.

Arrangements for the Week.

FRIDAY, Dec. 23rd (to-day).

EDINBURGH ELECTRICAL SOCIETY.

8 p.m. At Philosophical Institute, 4, Queen-street, Edinburgh. Paper on "Watts on Wheels," by Mr. E. O. Catford.

ROYAL INSTITUTION.

At Albemarle-street, London, W. Christmas Lectures on "Electric Waves and Wireless Telephony," by Prof. J. A. Fleming, F.R.S.

THURSDAY, Dec. 29th.

3 p.m. Lecture I., "Surface Waves on Liquids."

SATURDAY, Dec. 31st.

3 p.m. Lecture II., "Waves in Air."

FRIDAY, Dec. 30th.

ELECTRICAL POWER ENGINEERS' ASSOCIATION (Southern Division).

7 p.m. At Central Hall, London, S.W. Lecture on "British Practice in High Tension Distribution," by Mr. P. V. Hunter.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Partnerships Dissolved.

DURDEN, Ebenezer, THOMPSON, George William, and ALL-FORD, Alfred Seymour, electrical engineers, 13, Queen-street, Liverpool, under the style of E. Durden and Company, by mutual consent as from Dec. 8, 1921. Debts received or paid by E. Durden and G. W. Thompson.

FENELEY, George Henry, and BLOOD, Harold Thomas, mechanical and electrical engineers, 40A, Windsor Bridge, Salford, and Hawthorn Road, Hale, under the style of Feneley & Co., by mutual consent, as from Sept. 30, 1921. Debts received and paid by G. H. Feneley and H. T. Blood.

NAYLOR, Charles Haslewood Sharpe, and BRADLEY, John Edgar, electric light and power engineers, 53, Regent-road, Morecambe, Lancaster, under the style of The Manchester Electric Repairing and Maintenance Co., by mutual consent as from Dec. 12, 1921. Debts received and paid by J. E. Bradley.

Bankruptcy Information.

FWLER, Alfred Vaughan, "Seacliffe," Fitzroy-avenue, Kingsgate, electrical engineer. First meeting, Dec. 23, 11 a.m., Official Receiver's Office, 68A, Castle-street, Canterbury. Public examination, Jan. 7, 10 a.m., Guildhall, Canterbury.

HOPKINS, J. Howard, formerly trading as The Electrical Maintenance Co., 57, Castellaine-mansions, Maida Vale, late 140, Wardour-street, London. Receiving order, Nov. 30. Creditor's petition. First meeting, Dec. 30, 12 noon, and public examination, March 3, 11 a.m., Bankruptcy-buildings, Carey-street, London, W.C.2.

Notice of Intended Dividend.

TOMS, John Henry, 13, Gray's Inn-road, London, electrical engineer. Trustee, Harold John de Courcy Moore, 2, Gresham-buildings, Guildhall, London, E.C. 2.

Notice of Dividend.

DOUGHERTY, Samuel Horace (trading as The Mersey Electric Co), 106, Kensington, late 36, Renshaw-street, both Liverpool, electrical engineer. Amount per £, 9d., first and final, payable Dec. 21, 30, North John-street, Liverpool.

Company Winding-up Voluntarily.

ROTARY IGNITION, LTD. Mr. F. Morse, 1 and 2, Great Winchester-street, London, E.C.2, appointed liquidator.

County Court Judgments.

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days.]

LEES, Wm., New Field Cottages, Walker Fold, Horwich, electrical driller. £11 ls. Oct. 19.

SOHO ELECTRICAL WORKS, Room 9, Islington, Liverpool, electrical engineers. £33 3s. 1d. Oct. 21.

VALLANCE, Mr. J. W., 34, New Bolsover, Chesterfield, electrician. £28 0s. 4d. Oct. 19.

WHEELER, Mr. G., Homeleigh, Whippendale-road, Watford, electrical engineer. £36 15s. 2d. Oct. 19.

Bills of Sale.

[The undermentioned information is from the Official Registry. It includes Bills of Sale registered under the Act of 1882 and under the Act of 1878. Both kinds require registration every five years. Up to the date the information was obtained it was registered as given below; but payment may have been made in some of the cases, although no notice had been entered on the Register.]

CRIMIN, Harry, 69, Sturge-street, Heeley, Sheffield, electrical engineer. Dec. 14. £30.

HOWELL, Frederick Hugh, 117, Topsham-road, Upper Tooting, electrical engineer. Dec. 14. £30.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act,

specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

CHIPPERFIELD, LTD., Oulton Broad, electrical engineers. Registered Dec. 7, £50 second mortgage, to S. Bailey, Lowestoft, solicitor; charged on factory at Bridge-road, Oulton Broad. *£448. Dec. 6, 1920.

LOWTH & SMITH, LTD., Manchester, electrical engineers. Registered Dec. 6, £500 charge, to T. Davies, Levenshulme, painting contractor; general charge. *Nil. Aug. 17, 1921.

Bankruptcy Proceedings.

OWEN, Joseph (trading as J. Owen & Sons), 186, Westcombe-hill, and 3, The Grove, Greenwich, Kent, electrical engineer. In this case (ELECTRICIAN, 25/11/21, p. 695) the following are London creditors: Edey & Company, £16; Ediewan Electric Company, £12; Electrical Supplies Company, £123; Falk Strademan & Company, £40; General Electric Company, £106; National Electric Company, £22; Rose Bros., £42; Sunlight Manufacturing Company, £38.

PRIVATE MEETING.

[Inclusion under this heading does not necessarily imply failure. Many private meetings are called merely for the purpose of the debtor consulting his creditors as to his position when he may not be insolvent.]

GREEN, NUTTALL & COMPANY, electrical engineers and contractors, 76, Victoria-street, Manchester. The creditors were called together last week, when a statement of affairs was presented, which disclosed total liabilities of £598, all due to trade creditors, and an estimated deficiency of £463. It was unanimously decided that the estate should be dealt with under a deed of assignment, with Mr. Arthur T. Eaves, C.A., of Harry L. Price & Company, 15, Fountain-street, Manchester, as trustee. The following are creditors: City Electrical Company, London, £117; General Electric Company, Ltd., Manchester, £70; Hart Accumulator, Ltd., Manchester, £54; Electrical Supplies Ltd., London, £45; A. & A. Electrical Company, Ltd., £18.

Receiverships.

SOUTH WESTERN ENGINEERING COMPANY, LTD. A. W. Watts, of 364, Camden-road, as receiver on Dec. 9, 1921, under powers contained in debenture dated Sept. 9, 1920.

WATCHMAN COMPANY, LTD. N. Bell, of 78 and 79, Wool Exchange, E.C., was appointed receiver and manager by Order of Court, dated Dec. 2, 1921.

Prices of Metals, Chemicals, &c.

		TUESDAY, DEC. 20.			
		Price.	Inc.	Dec.	
Copper—	Best selected per ton	£67 15 0	5s.	—	
	Electro Wirebars	£75 10 0	—	—	
	H.C. wire, basis	0s. 11 ½d.	—	—	
	Sheet	0s. 10 ½d.	—	—	
Phosphor Bronze Wire (Telephone)—					
Phosphor-bronze wire, basis		1s. 3 ½d.	—	—	
Brass 60/40—					
Rod, basis		0s. 7 ½d.	—	—	
Sheet, basis		0s. 10 ½d.	—	—	
Wire, basis		0s. 11 ½d.	—	—	
Pig Iron—					
Cleveland Warrants per ton		£5 5 0	—	—	
Galvanised steel wire, basis 8 SWG ..		£22 0 0	—	—	
Lead Pig—					
English		£27 0 0	—	—	
Foreign or Colonial ..		£25 10 0	—	5s.	
Tin—					
Ingot		£12 15 0	£1 5 0	—	
Wire, basis		2s. 3 d.	—	—	
Aluminium ingot ..		£125 0 0	£5 0 0	—	
Sal ammoniac.—Per cwt. 65s.-60s.					
Sulphur (Flowers).—Ton £12 10s.					
" (Roll-Brimstone).—Per ton £12 10s.					
Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.					
Copper Sulphate.—Per ton £28 10s.					
Boric Acid (Crystals).—Per ton £55.					
Sodium Bichromate.—Per lb. 6d.					
Sodium Chlorate.—Per lb. 3 ½d.					

Rubber.—Para fine, 1s. 2 d.; plantation 1st latex, 10 d. to 11 d.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by MESSRS. MERRILL, BEES & CO., Chartered Patent Agents, 7, Strand, 22, Chancery Lane, London, W.C.2.

COMPLETE SPECIFICATIONS.

- 112,891 MERRILL, JON. T. E. Electric welding electrodes. (25/9/19.)
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 112,998 MERRILL, JON. T. E. Electric welding electrodes. (25/9/19.)
 112,999 MERRILL, JON. T. E. Electric welding electrodes. (25/9/19.)
 113,000 MERRILL, JON. T. E. Electric welding electrodes. (25/9/19.)

APPLICATIONS FOR PATENTS

- 19,584 COLEBROOKE & WILLIAMS. Renewal of filaments of thermionic valves.
 19,591 DOULTON & MORRIS. Internal shaping of clay in production of insulators, &c.
 19,636 DAVIS. Electric couplings.
 19,637 DAVIS. Switch boxes.
 19,647 METROPOLITAN-VICKERS ELECTRICAL CO. Electric railway control systems.
 19,650 TRAGER. Device for maintaining constant voltage in variable speed dynamos.
 19,665 POUCHAIN. Accumulators.
 19,700 COWPER-COLES. Production of metallic objects and coating one metal with another by electro-deposition.
 19,712 AMOS & LLOYD. Electric alarms.
 19,731 CALDERALL. Renewal of incandescent lamps. (3/3/21, Italy.)
 19,737 CHANDLER. Directional wireless apparatus.
 19,734 DE GESSLER. Electric device of the cartridge fuse type.
 19,738 LON. Electro-magnets.
 19,744 HUNTER. ELECTROCHEMICAL CO. Electrolysis of solutions. (5/8/20, U.S.)
 19,750 BRUSH ELECTRICAL ENGINEERING CO. & SCHOLEFIELD. Cooling transformers.
 19,751 POWER EQUIPMENT CO., CRAWFIS & KEITH. Enclosed switch fuse.
 19,804 HALL. Electric terminal jaw punching.
 19,814 CRENDEN CONDUITS CO. & DAVIDSON. Supports for electric resistances.
 19,815 JORG. Electric machinery.
 19,816 RUSSELL-JONES & WOOD. Electro-magnetic separators and extractors.
 19,834 GEMMELL & WOOD. Electro-magnetic separators and extractors.
 19,840 WADE (Sever) Ltd. Electric signal apparatus.
 19,852 NEE & APOSTOL. TELEPHONE & ELECTRICAL WORKS. Adjusting device for electric meters, &c. (24/7/20, Belgium.)
 19,854 NEW ANTWERP TELEPHONE & ELECTRICAL WORKS. Voltage coils for electric meters, &c. (24/7/20, Belgium.)
 19,877 PEAKE. Guides for trolley heads.
 19,878 DAVIS. Means for recording telephone calls.
 19,896 TAYLOR. Long distance power transmission with underground cables.
 19,914 CLARK'S Neo-ELECTRIC DEVICES, LTD. & KINNARD. Means of registering telephone calls.
 19,916 COUTYOT. Magneto-phones.
 19,917 SULLIVAN. Duplex, &c., telegraph systems.
 19,925 BROWN & REES. Incandescent lamp.

- 19,930 LUDI. Electric Circuit breaker for vulcanising apparatus. (24/7/20, Switzerland.)
 19,937 SWEETLAND. Electric hand drills.
 19,940 ART. GERS. BROWNS. BOWEN PT. (IE. Compensation of electric networks. (31/7/20, Switzerland.)
 19,947 LEE. Electric cables.
 19,954 B. T. H. CO. (G. E. Co.). Electro-magnetic control systems.
 19,961 AUTOMATIC TELEPHONE MANUFACTURING COMPANY. Telephone systems. (11/21, U.S.)

July 26, 1921.

- 19,971 DICKERSON & GILLBORN. Portable electric power machine stand.
 19,991 WILLMAN. Selective switches for automatic telephone exchanges, &c.
 19,996 RUTLEDGE, LTD., & BROWN. Devices for avoiding noise from electric lamps of automobiles, &c.
 19,997 GRIFFITHS. Electric filament lamp holders.
 19,999 PRITCHETT & GOLD & E. P. S. CO. Accumulator boxes.
 20,004 TENANT. Switches.
 20,009 CHENEY. Storage battery electrolyte.
 20,009 EVER-READY CO. (Great Britain) (Hoka Electrochemische Fab. Ges.). Dry batteries.

July 27, 1921.

- 20,096 MIDLAND ELECTRIC MFG. CO. & BARBER. Switches.
 20,114 BUSBRIDGE. Suspension of electric light fittings from overhead conductors.
 20,117 ELY. Locking lamp bulbs to sockets.
 20,127 BROWN. Carbon boxes for holding electric lamps.
 20,178 CRANO-VIVAS. Apparatus for making and breaking electric circuits of automobiles, &c.
 20,183 B. T. H. CO. (G. E. Co.). Voltage regulating systems.
 20,186 KAPLAN. Electric battery lamp.
 20,202 COLEMAN. Electrically illuminated advertising devices.

July 28, 1921.

- 20,219 JOHNSTON. Electro-magnetic vehicle coupling.
 20,230 LACOCK. Girder attachments for electric conduits, &c.
 20,243 KRATT. Electrically heated kettles, &c.
 20,244 KRATT. Electrically operated water heaters.
 20,254 TATCHEER. Electrically oxidising or reducing substances.
 20,266 MILLER. Telephones operated by heat.
 20,271 SILLMAN, BURNKOFF & HANES. Electric heating devices.
 20,280 CRANO-VIVAS. Electric switches.
 20,281 EGGINGTON & LUCAS. Terminals or connections for electric circuits.
 20,289 HOLLISTER. Magneto electric machines.
 20,292 G. E. CO. & CAMPBELL. Maintenance of high vacua in closed vessels.
 20,296 LOTH. Electrically controlling bodies at a distance. (29/7/20, France.)
 20,299 B. T. H. CO. (G. E. Co.). Control for electric machines.
 20,334 STEENHARDT. Construction of ceramic vessels with electric heating.

July 29, 1921.

- 20,345 ALLEN. Magneto timing of engines.
 20,360 FOXTON. Dynamos for motor vehicles.
 20,361 COX. Switches.
 20,368 & 20,369 ROGERS & SPICER. Electric horns.
 20,380 JOSEPH. Electric kettles, &c.
 20,384 WESTERN ELECTRIC CO. Telephone systems. (25/9/20, U.S.)
 20,391 SPREADBURY. Apparatus for measuring distance between two wireless stations.
 20,395 THATCHER. Electrolytic cell.
 20,402 RICKARDS. Electric foot battery.
 20,406 GREENSLADE. High frequency inter-valve transformers.
 20,419 LEMOINE. Electric furnaces. (29/7/20, France.)
 20,420 ELPHICK. Electric stand lamps, portable radiators, fans, &c.
 20,435 SCHWABE & CO. Electric flash lamps. (1/3/21, Germany.)
 20,437 VESME. Method of increasing output of gas from electrolytic apparatus.

July 30, 1921.

- 20,443 TAYLOR. Electric transmission.
 20,446 TUCKER & CO. & BROTHERS. Interlocking devices for switches.
 20,467 BOOTH. Controlling electric lighting circuits.
 20,468 BOOTH. Resistances.
 20,469 BOOTH. Conduit for conductors.
 20,498 LONDON ELECTRIC FIRM. Flexible couplings for power transmission.
 20,503 PETERSEN & WELLS. Electric gramophone.
 20,504 MARCHSNER. Electrode insertion for mercury vapour arc rectifiers of glass.

August 2, 1921.

- 20,545 STANDARD MOTOR CO. & MAUDSLAY. Electric horns.
 20,565 LENAGHAN. Electric calling devices.
 20,594 ALKAN. Switches. (19/3/21.)
 20,595 ASSOCIATED EQUIPMENT CO. & BATTY. Speed regulating devices for electric vehicles.
 20,605 D'HAINAULT. Electric stockings, socks, &c.
 20,624 ROSS. Electric fuses, &c.

August 3, 1921.

- 20,629 DANNAN. Electric control of indicators.
 20,632 WALL. Wireless control of vessels.
 20,644 BROOKE & KEAR. Control of a.c. motors.
 20,659 COZENS. Electrical and mechanical lock for lifts.
 20,666 LAWLER. Electric player for pianos, &c.
 20,672 WESTERN ELECTRIC CO. & DEAKIN. Telephone systems.
 20,683 PATTAN. Switches.
 20,687 DUBILIER. Condenser and clamp therefor. (7/2/21, U.S.)
 20,688 DUBILIER. Insulating structures for high potential condenser terminals, &c. (18/2/21, U.S.)
 20,699 B. T. H. CO. (G. E. Co.). Electro-magneto switches.
 20,701 GORDAN. Electrode for welding.
 20,712 GODFREY. Switch for converting two lamps from parallel to series.

August 4, 1921.

- 20,761 WATSON. Switches.
 20,763 SELVATICO. Electric ovens.
 20,764 SIEMENS-SCHUCKERTWERKE. Commutating apparatus. (9/8/20, Germany.)
 20,770 SIMMS (General Railway Signal Co.). Electrically-operated switch.
 20,790 GES. FÜR DRAHTLOSE TELEGRAPHIE. Antenna systems for wireless signalling. (6/8/20, Germany.)
 20,793 WHITE (Sungamo Electric Co.). Mercury motor meters.

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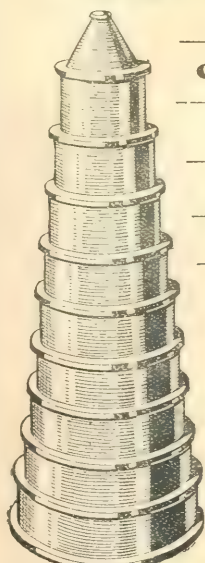
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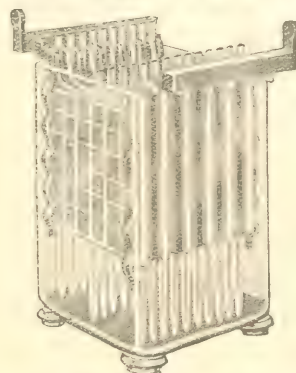
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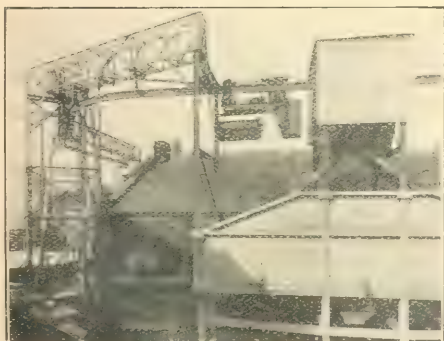
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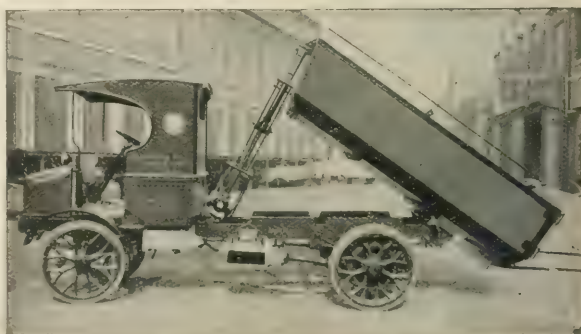
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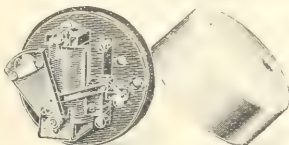
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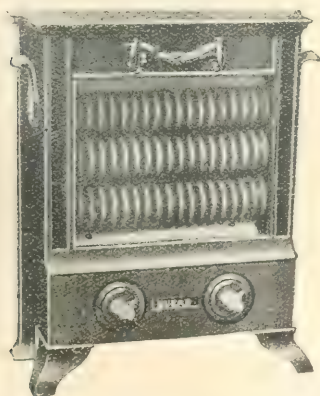
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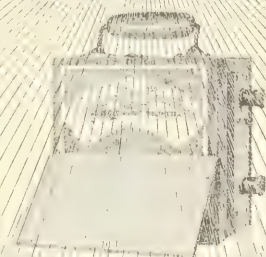


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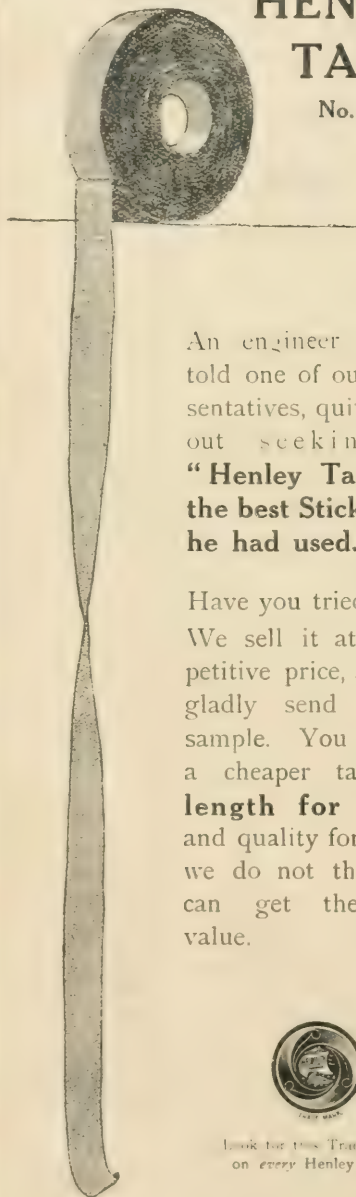
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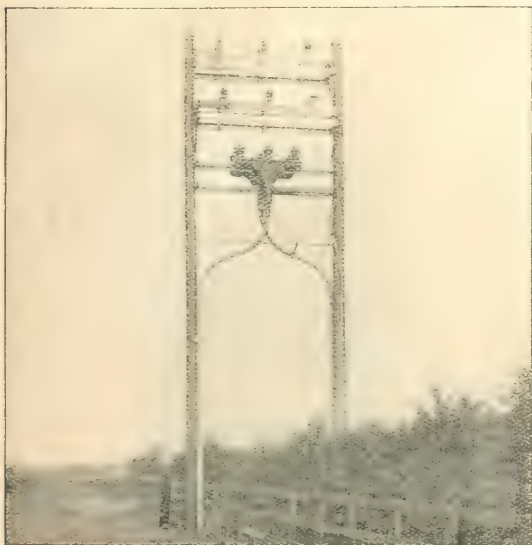
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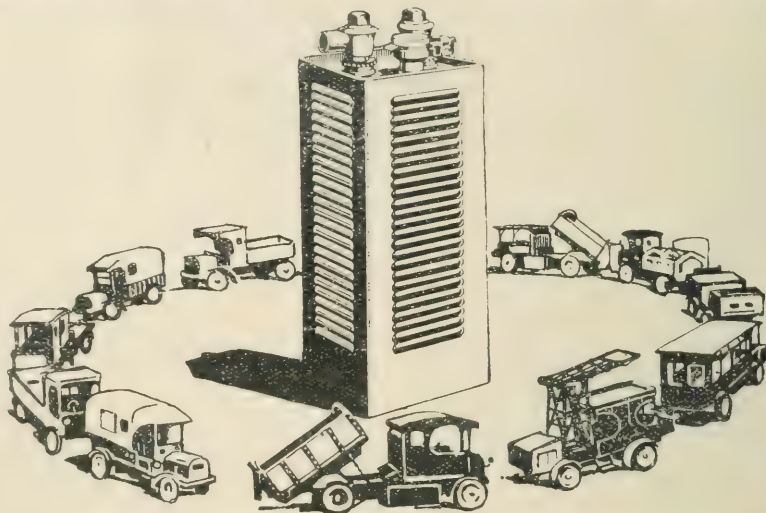
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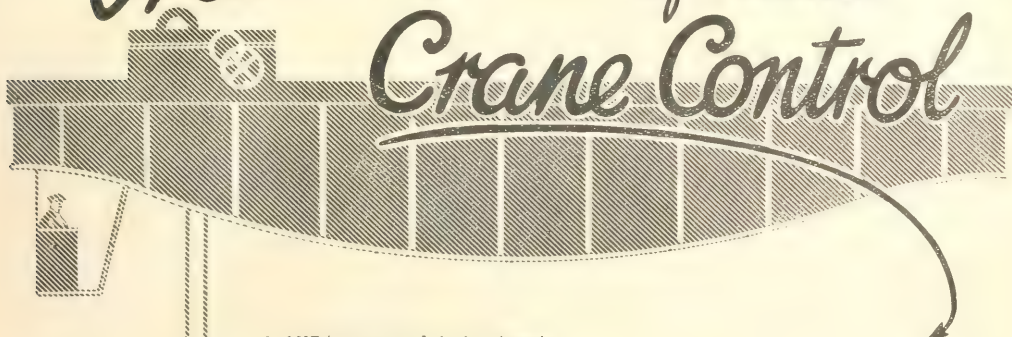
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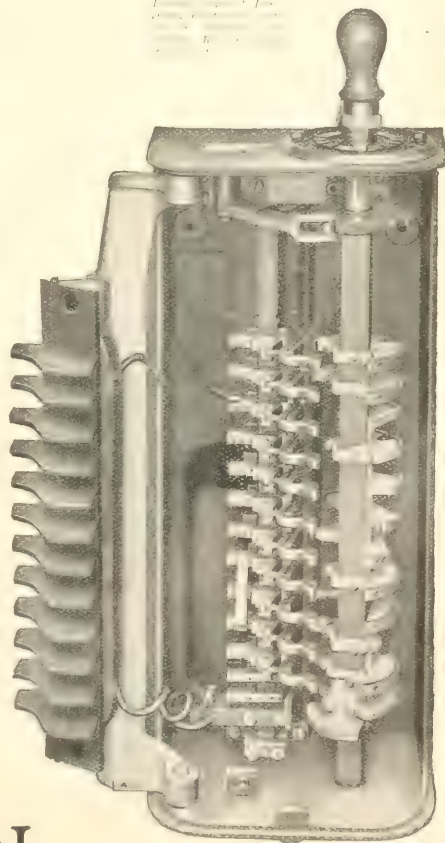
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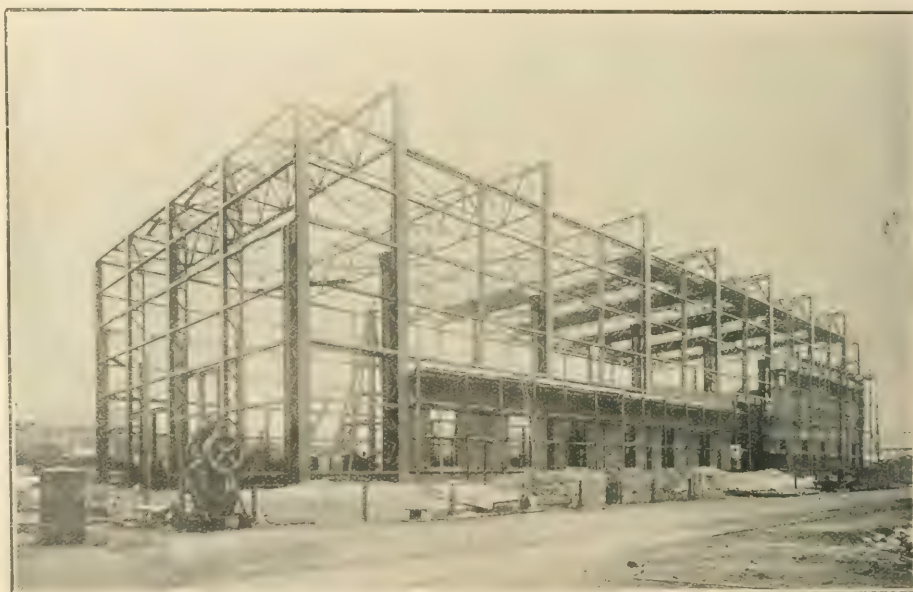
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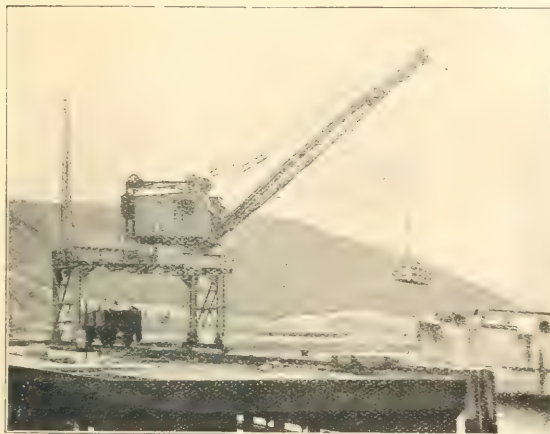
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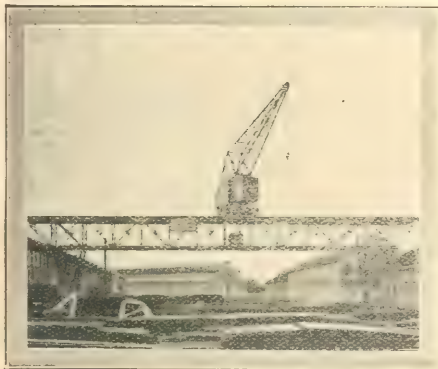
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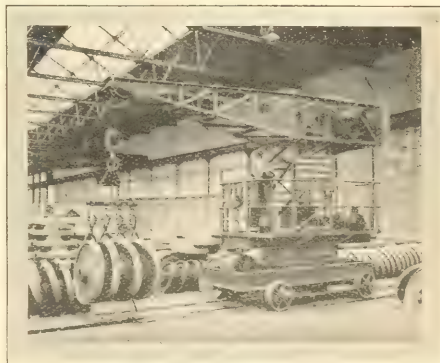


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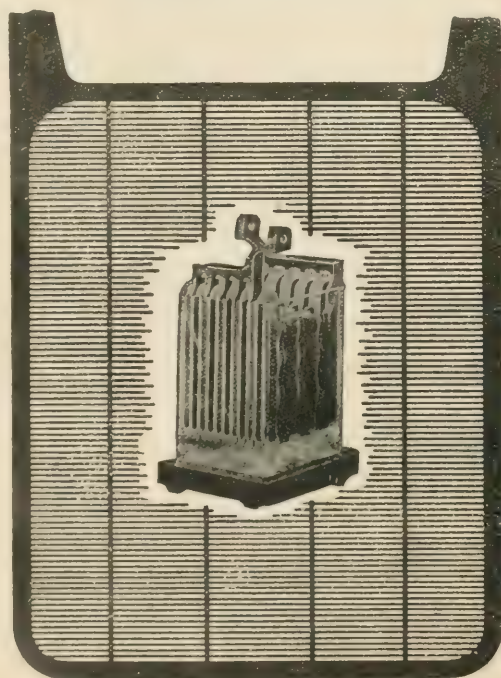
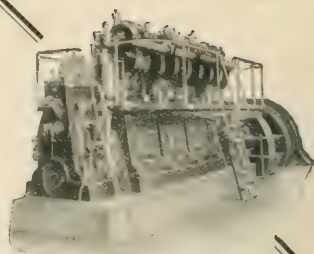
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FIG. 1325

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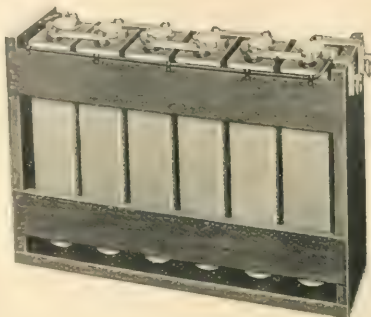
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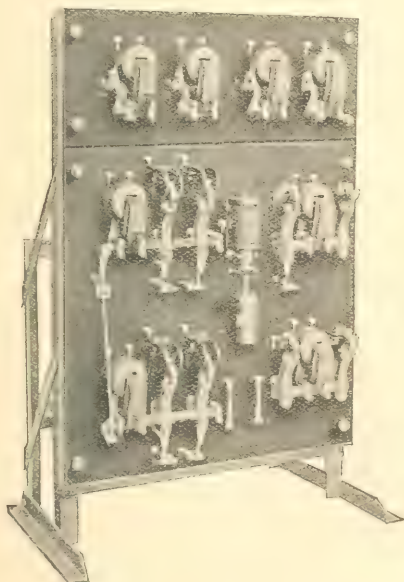
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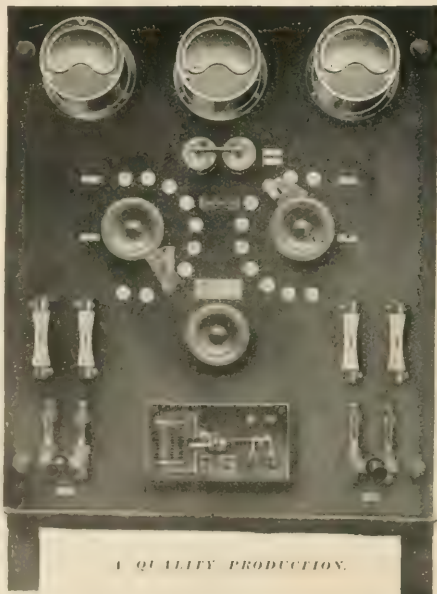
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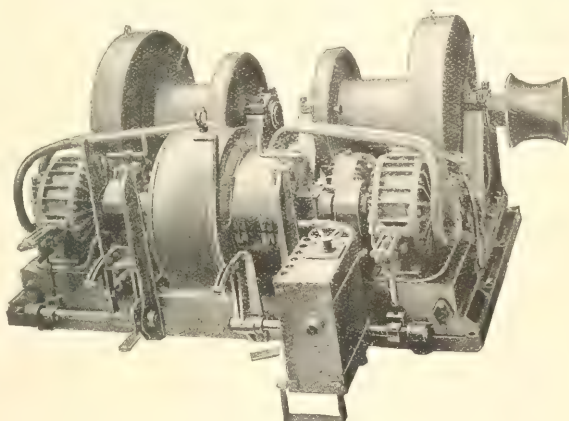
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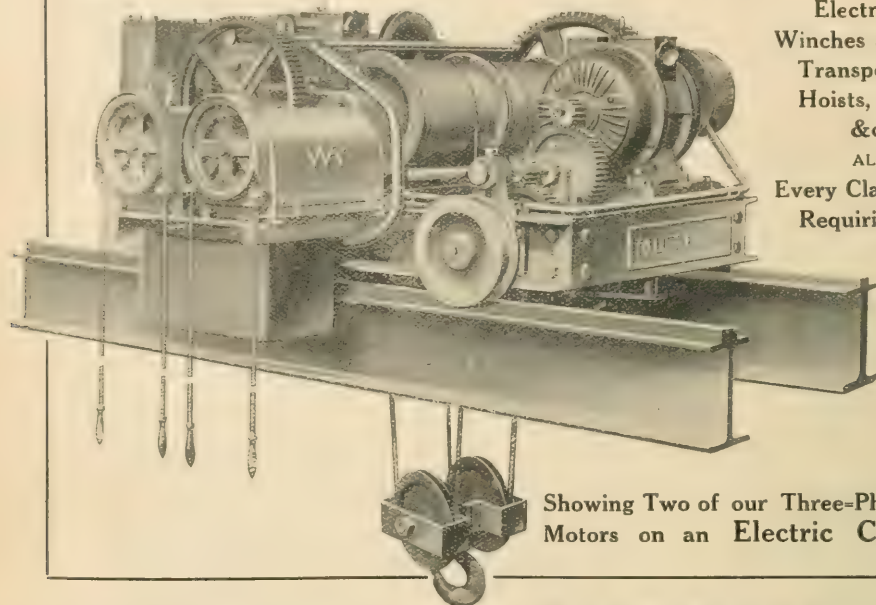
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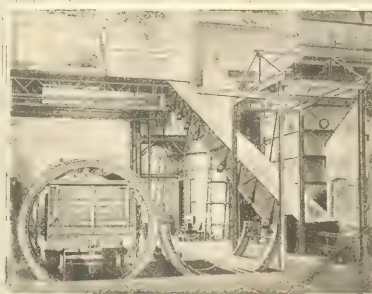
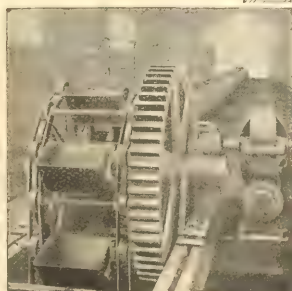
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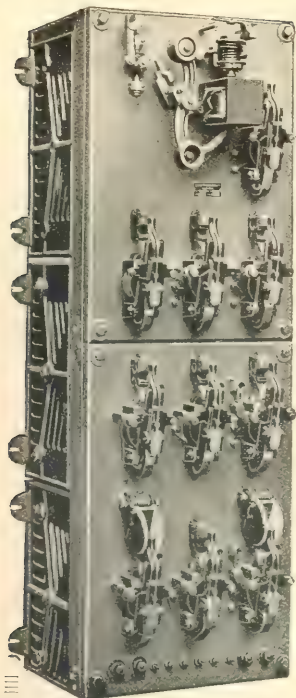
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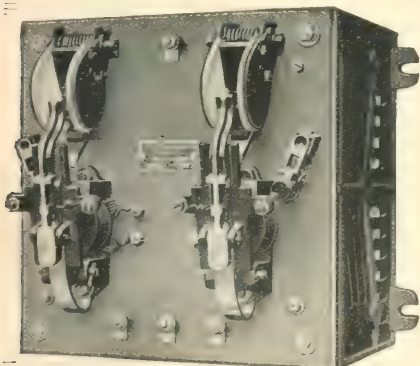
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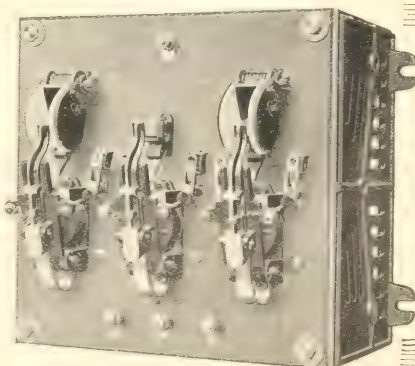
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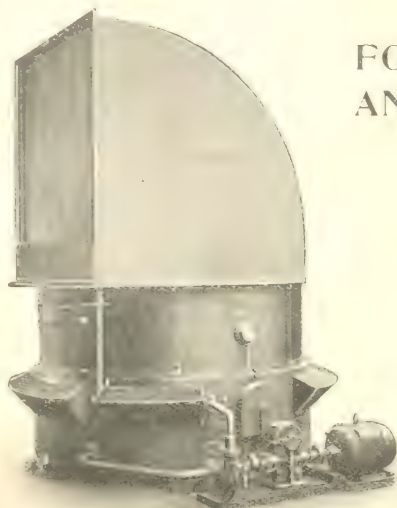
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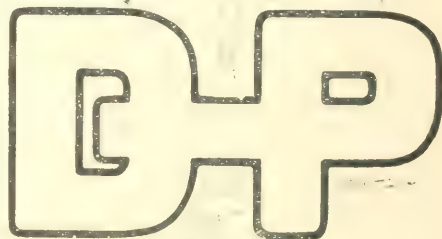
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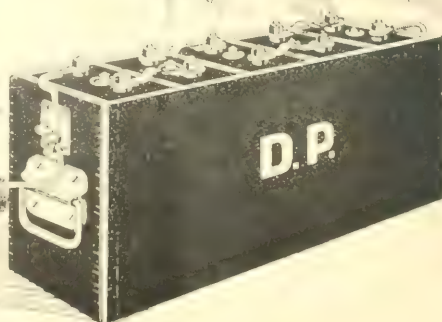
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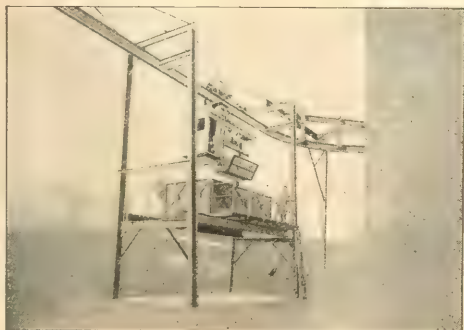


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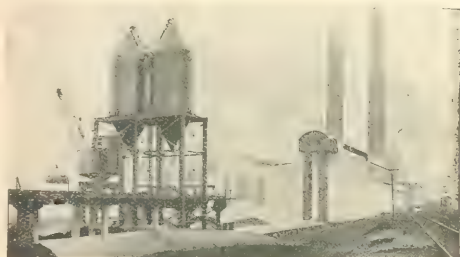
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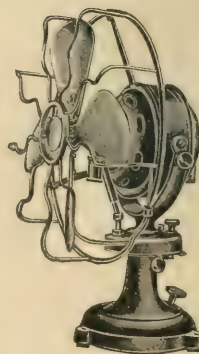


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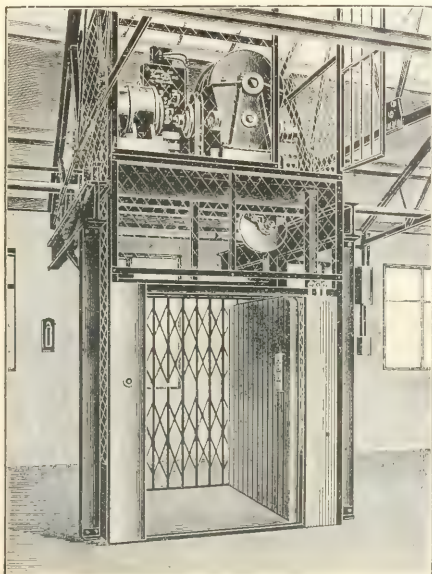
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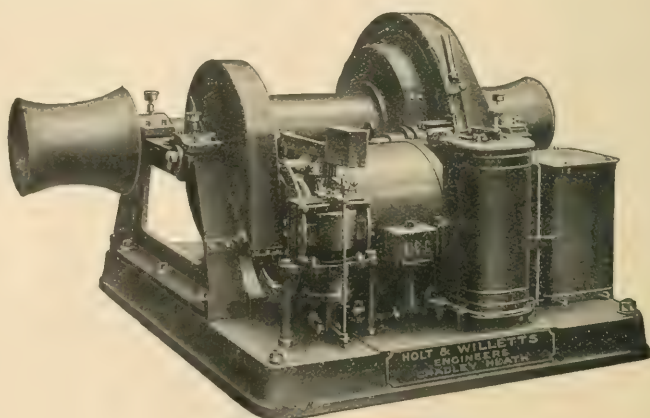
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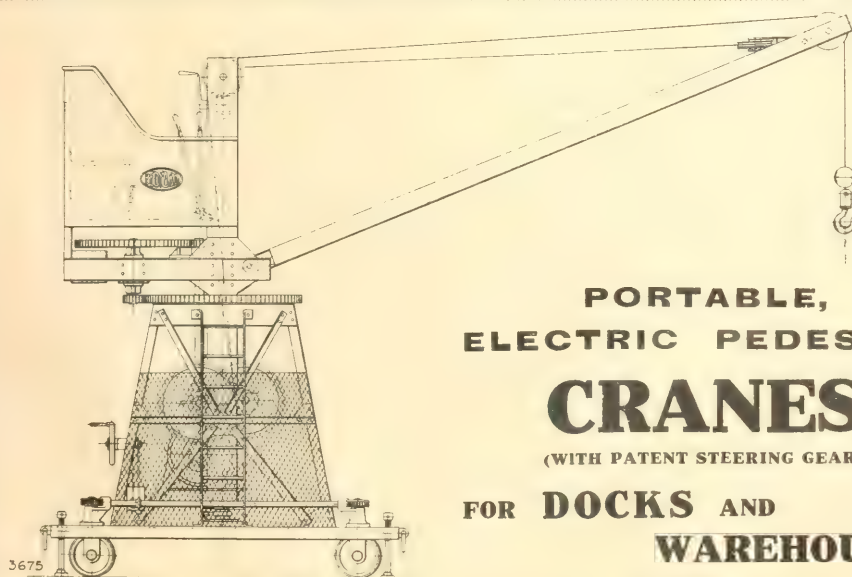
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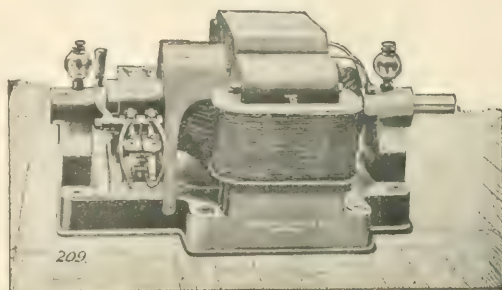
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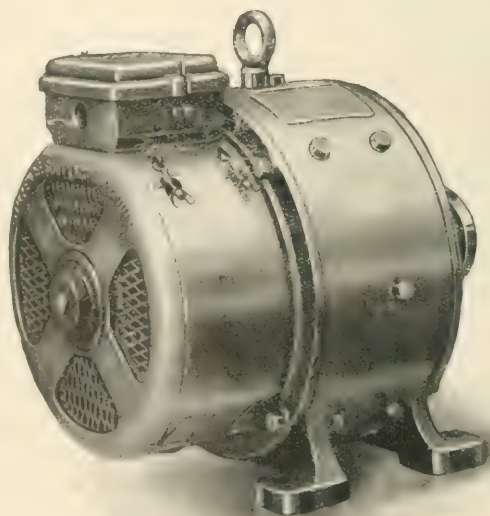
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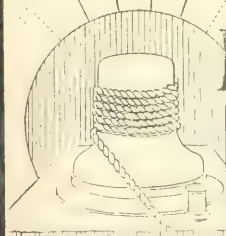
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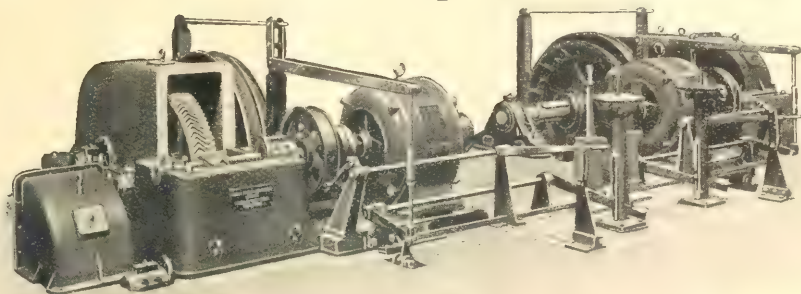
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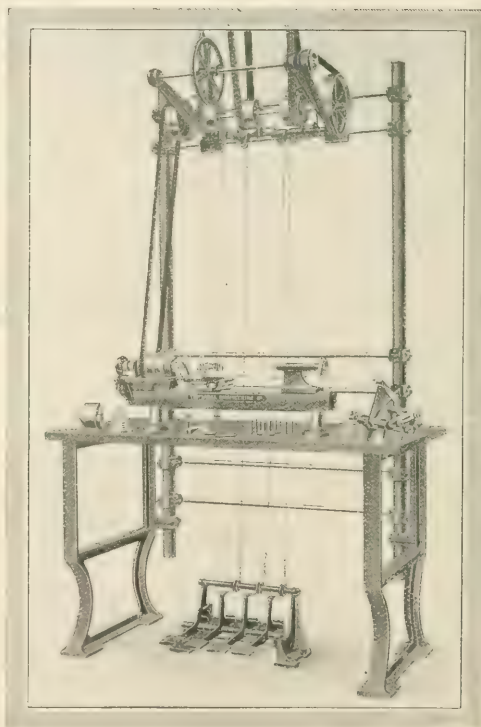
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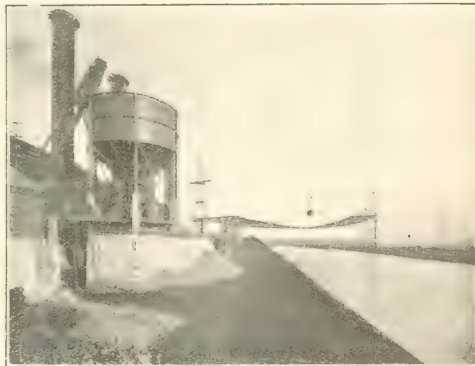
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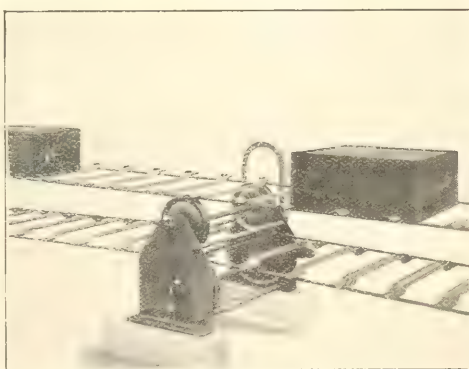
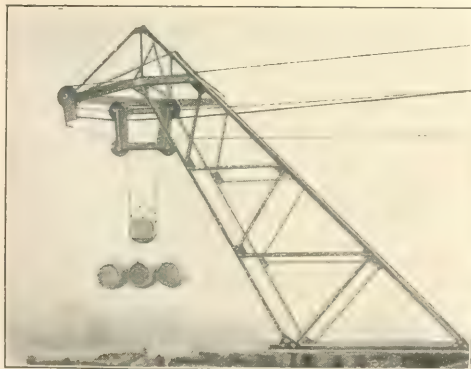
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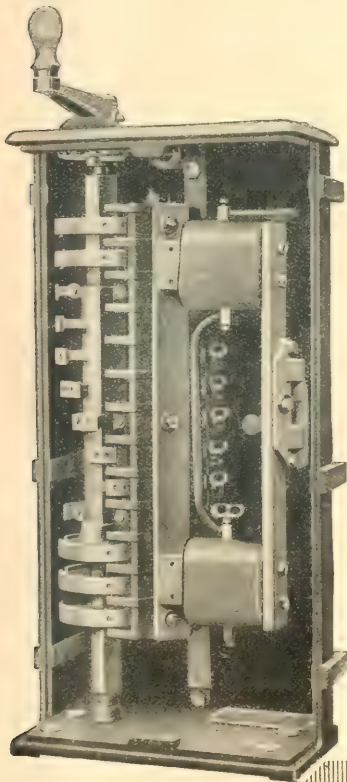
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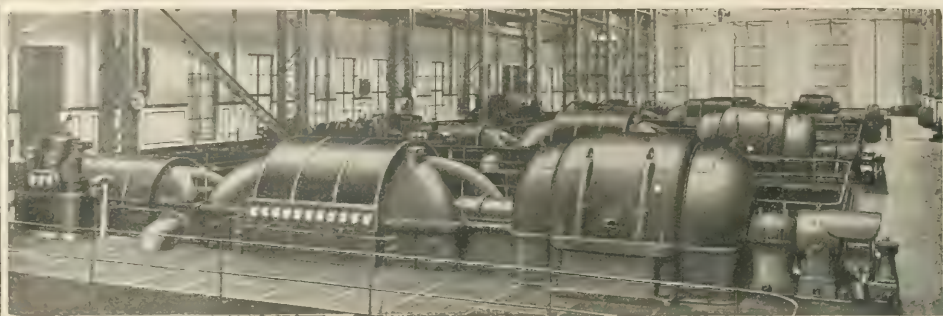
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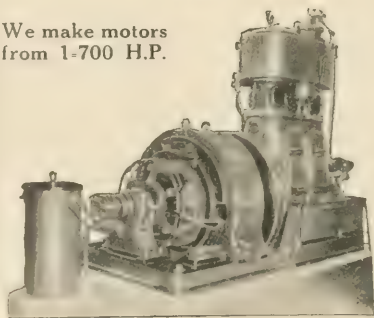
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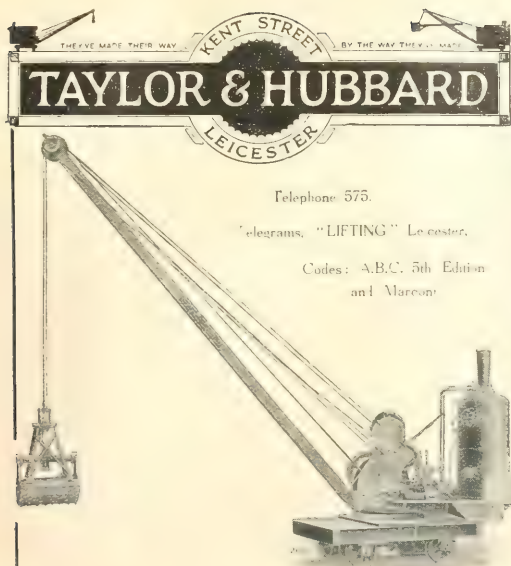
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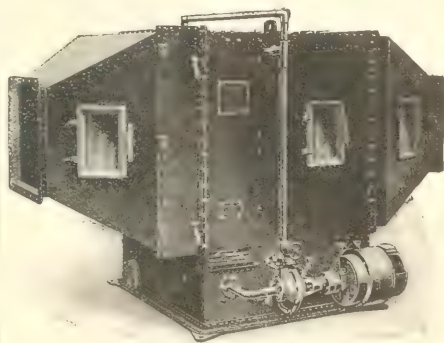
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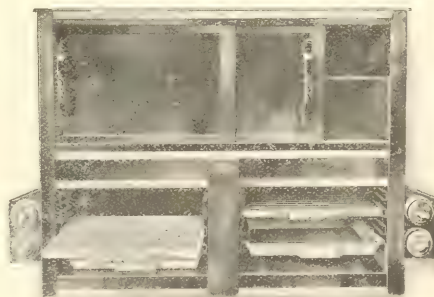
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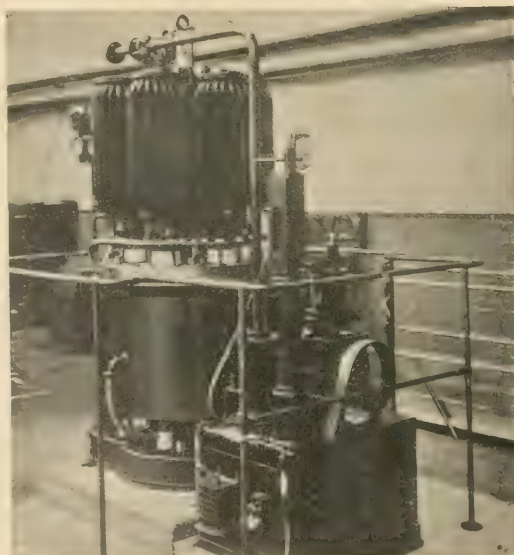


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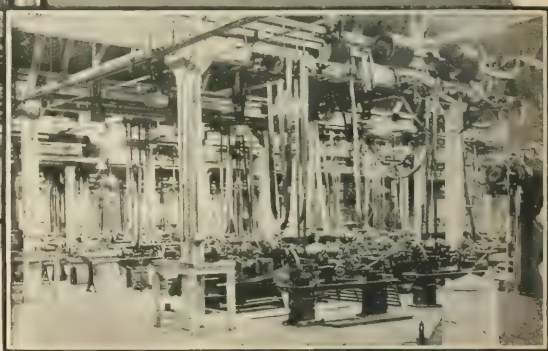
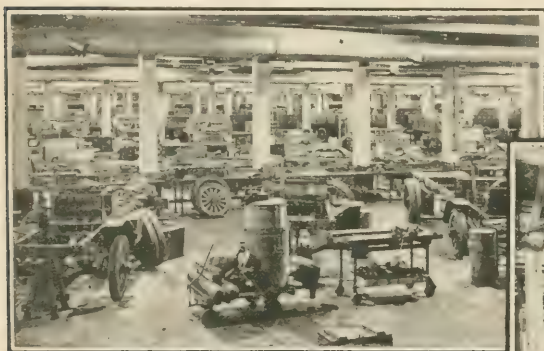
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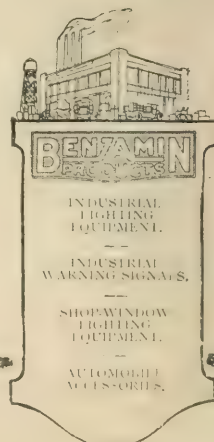


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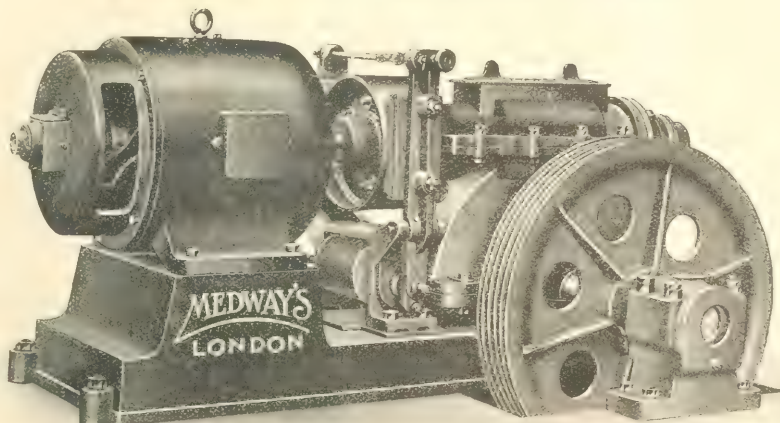
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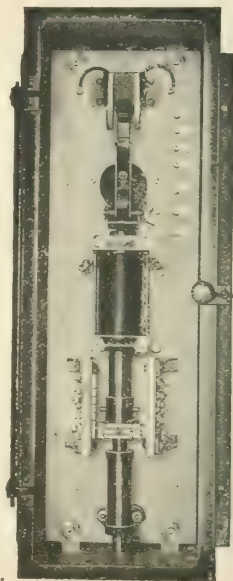
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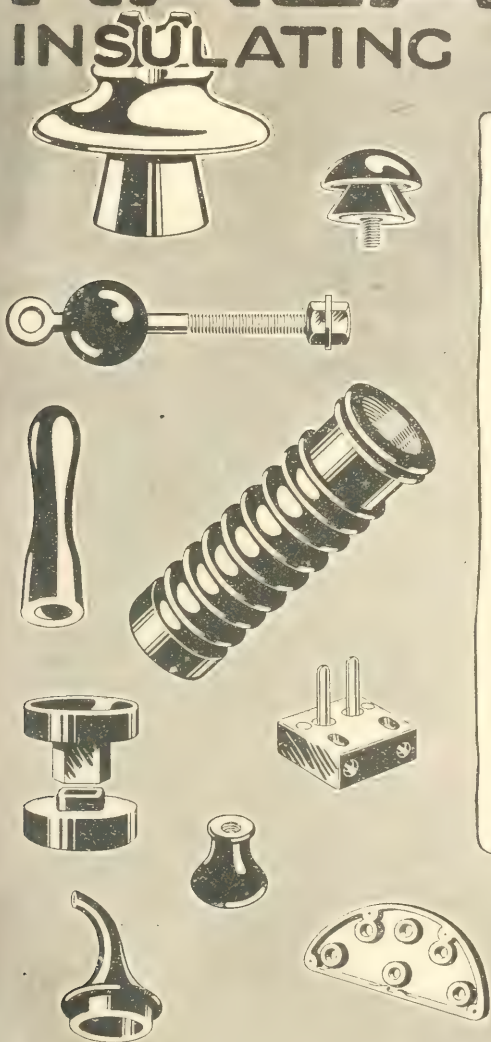
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Note: A polarity test is not carried out as all our transformers' coils are always wound in the same direction, viz. clockwise. If the coils were wrongly connected up or assembled, such defects would become manifest when making the ratio test.

The above tests, with the exception of No. 8, are briefly described and illustrated for three phase transformers in the following notes. The procedure is generally identical for single phase transformers. As there are several alternative methods of carrying out heat runs, test No. 8 will form the subject of a separate memorandum.

1 *Ratio Test* The diagram of connections for this test is shown in figure 1, which illustrates a star-star connected transformer ready for

test. The test is usually made with the transformer out of its tank and in air, in order to facilitate access to the various tappings, and the method used is known as the ratiometer method. The ratiometer itself consists of a single phase, double wound transformer, having a constant primary winding and a variable secondary, the pressure variation being effected through the intermediary of adjusting tappings and two dial switches. A certain number of the secondary tappings are arranged to give fine regulation, and the remainder, coarse regulation. In carrying out the test the H.T. winding of the transformer under test is connected in opposition to the primary winding of the ratiometer, while the L.T. winding of the transformer is connected to the two free terminals of the dial switches through an ammeter. A single phase pressure, not exceeding 2,000 volts, is applied across the primary winding of the ratiometer, and the two

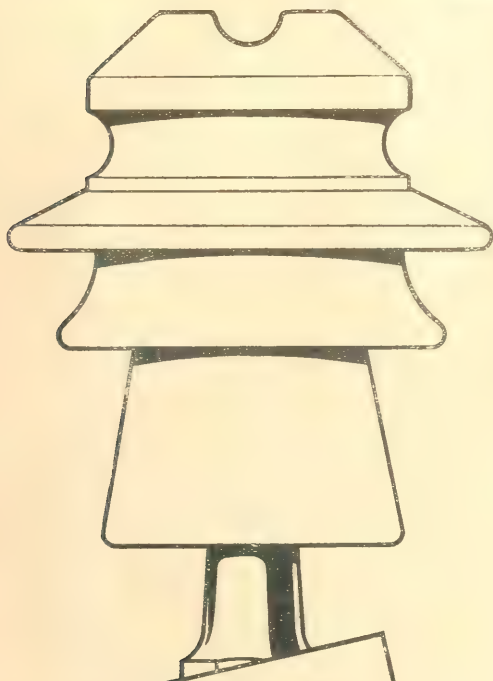


dial switches are adjusted until the ammeter registers zero. This means that the pressure across the L.T. winding of the transformer under test is equal to the pressure across the effective part of the secondary winding of the ratiometer, i.e., that part of the winding between the two dial switch



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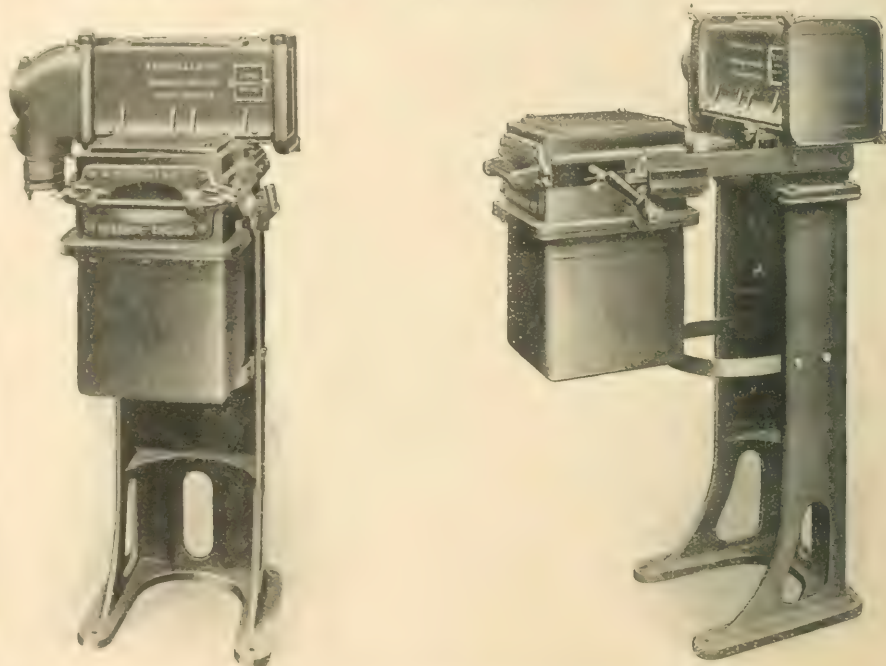
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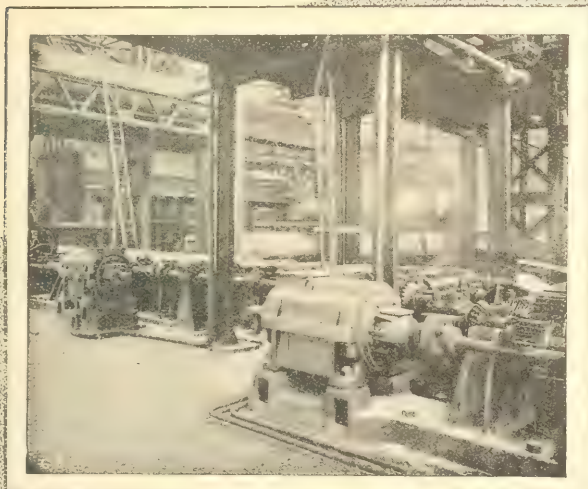
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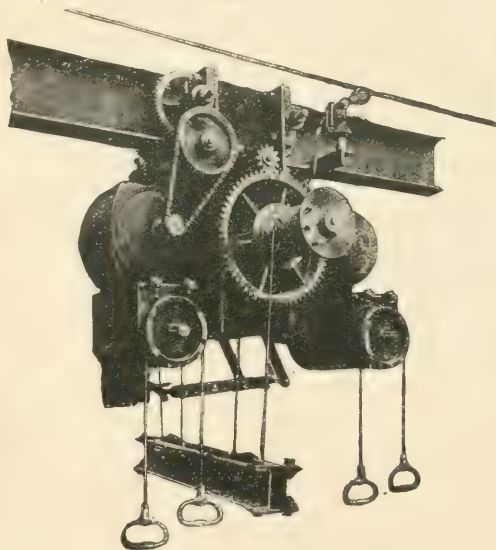
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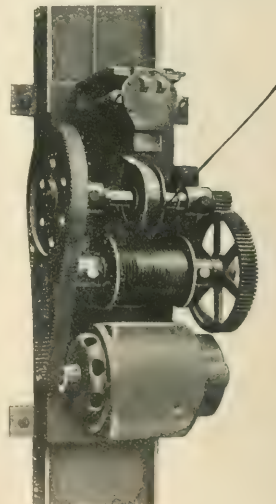


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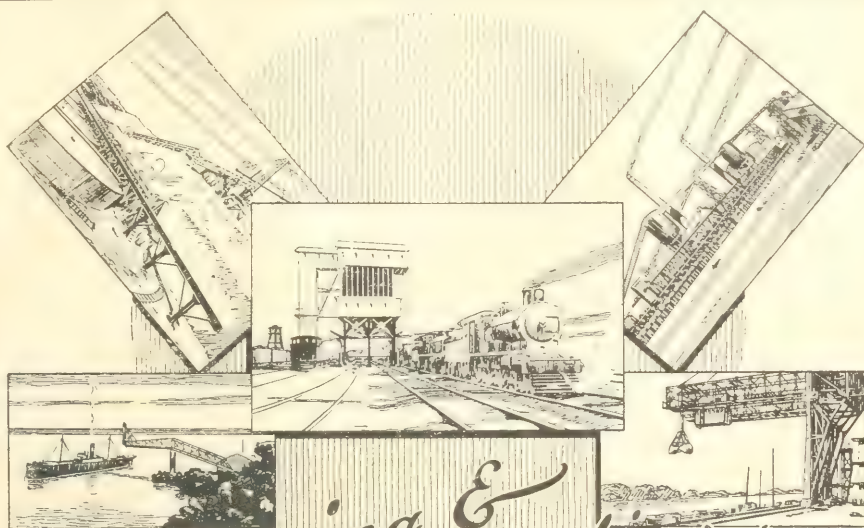
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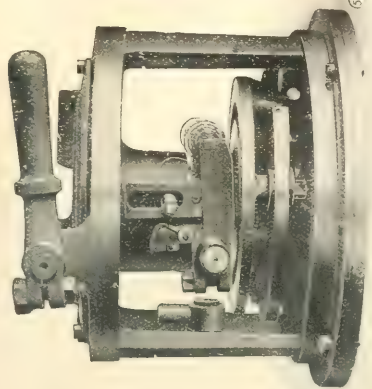
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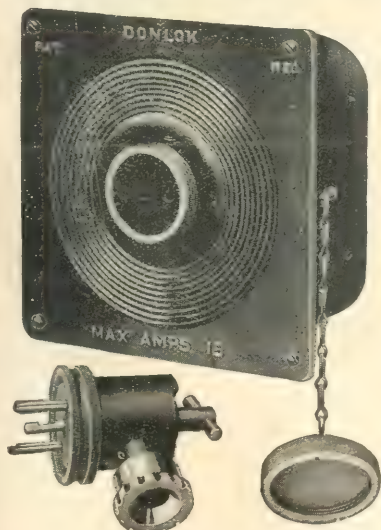
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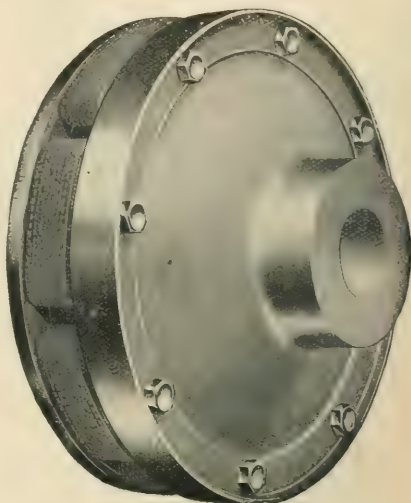
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By Order

C. EUSTACE WILSON, Town Clerk.

Town Hall, East Ham, E.6.
Dec. 16th, 1921.

CITY OF LEEDS.

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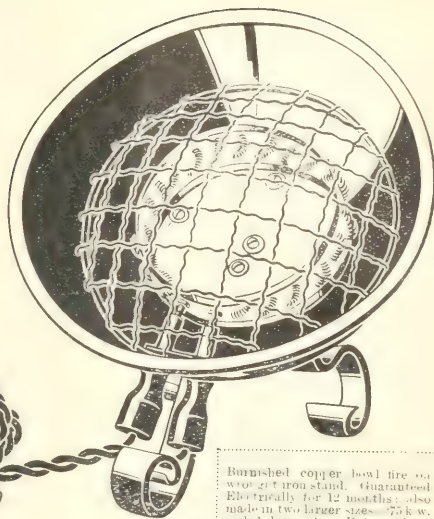
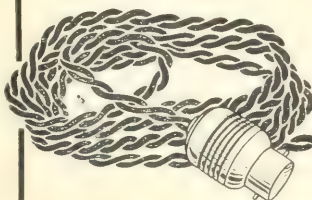
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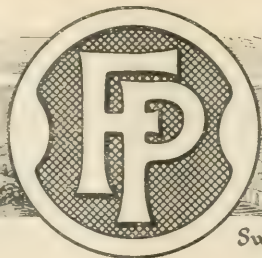
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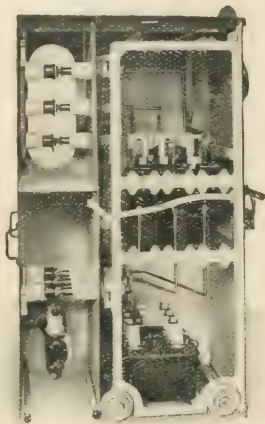
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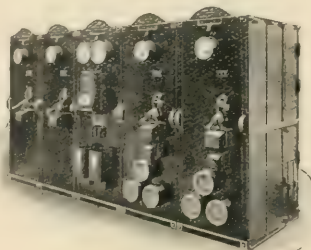
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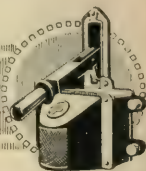


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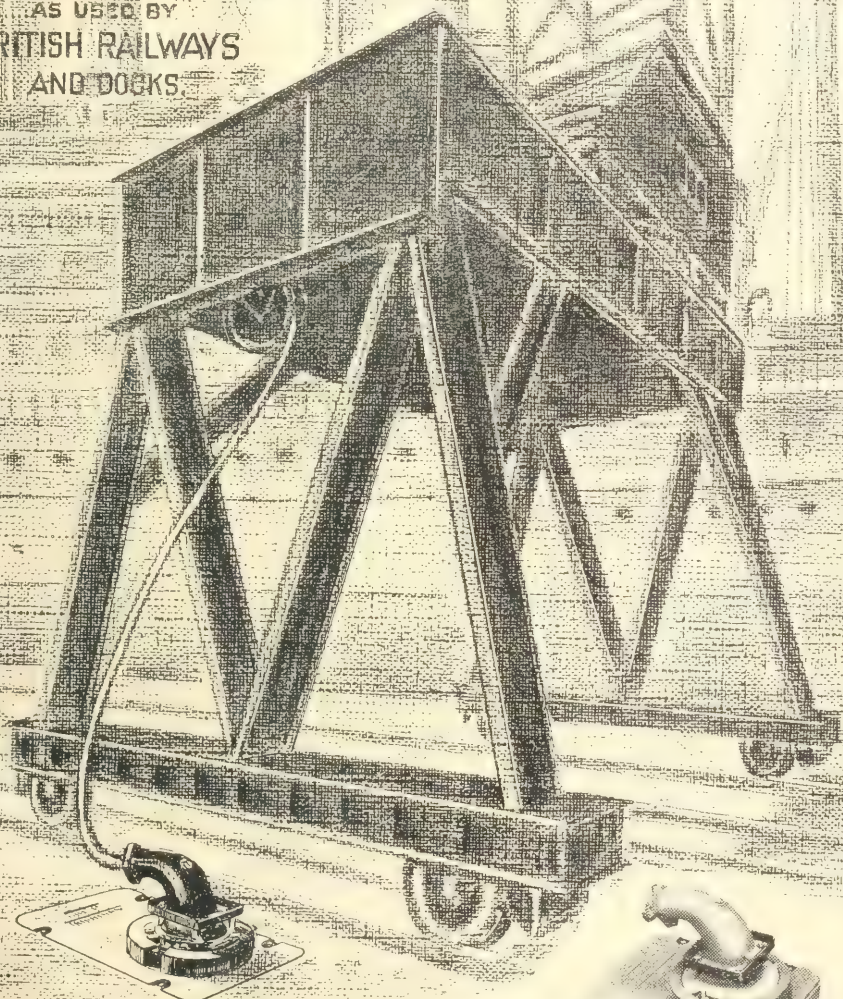
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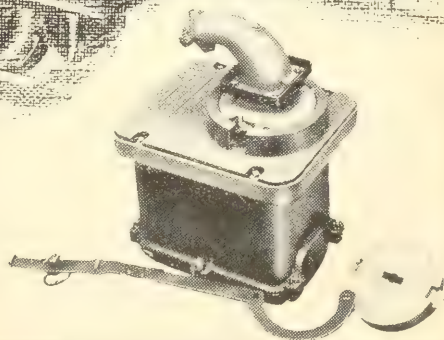
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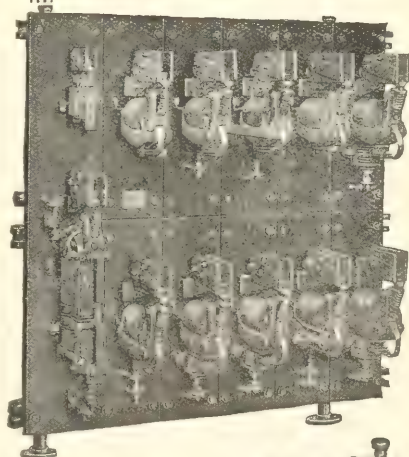
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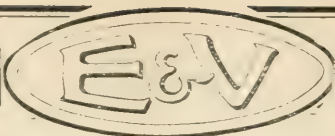
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Notes of the Week.

The Engineer of To-morrow.

IN an address to a joint meeting of the North-Eastern Territorial Centre Students' Section of the Institution of Electrical Engineers, the graduates of the North-East Coast Institution of Engineers and Shipbuilders and the students of the Newcastle Section of the Institution of Mining Electrical Engineers, Mr. J. R. BEARD gave some useful advice to those who are now trying to be engineers and who will inevitably be the engineers of to-morrow. The engineering student in 1921 is starting upon his career at a very difficult period, when, economically at least, nearly all the old landmarks have disappeared, and there seems at first sight little use in relying on past experience. Disadvantageous as this is in many ways, it should be of real advantage to the enterprising and should eventually bring the engineer much more closely into relation with the problems of human life and stimulate his skill and interest in dealing with the growing activities of engineering in the broadest sense. It has long been the engineer's boast that he is the man who can do a certain piece of work much more cheaply than anyone else. But nowadays we know that the real difficulty is not in making the product at any cost, but in selling it after it is made, and it is this difficulty that calls for fresh qualities in the young engineer. We must, indeed, strive, as Mr. BEARD says, for a maximum efficiency, for improved methods of production, for an encouragement of foreign trade, for a husbanding of capital, and for reduced standards of living if once again the wheel of progress is to run normally.

Cause for Optimism.

AMONG all these difficulties it is as well to point out that the electrical engineer is in a relatively fortunate position

and has every cause for optimism. In expanding itself electrical engineering makes a general expansion of all other forms of engineering possible. It also makes possible the distribution of energy contained in coal or water in the most economical way, and until, and even when, the electrical engineer has succeeded in harnessing the internal energy of the atom it is this class of the community that must be relied upon more than any other to help industry and the population generally back to their pre-war position of comfort and efficiency. Those who are working in this field would therefore do well not to neglect their general education and business ability and to beware of too much specialisation, though together with this must go a study of the art of administration and the development of all faculties to the full, so that opportunities may be seized as and when they arise.

British Trade with India.

WE are not surprised to learn from Mr. T. M. AINSCOUGH's General Review of the Conditions and Prospects of British Trade in India for the two years 1919-21 that although the first year witnessed a remarkable trade boom, a severe reaction set in during 1920-21. This seems to have been the experience in every country, and we should not expect India to be an exception to the rule. Mr. AINSCOUGH is quite candid in his explanation of this trade depression, and it is refreshing to read such an admission in an official report. It appears that India is dependent on Europe and the United States for the sale of her produce, but owing to the internal disorganisation and financial chaos in Central Europe the trade in jute, cotton, hides, oilseeds, and other Indian exports almost ceased. The deflation of prices in Great Britain and the United States entailed heavy losses on stocks of tea and other commodities, and, owing to the trade depression in Japan,

there was a falling off in her consumption of Indian cotton. The combined effect of these causes was to lessen India's purchasing power and to produce a period of acute economic depression, from which it is now slowly recovering. We have here one of the most striking examples of the interdependence of countries, and it is to be hoped that the lesson will be taken to heart by our statesmen.

Rapid Recovery of Britain's Position.

THOUGH Mr. AINSWORTH'S review covers 362 pages and contains much useful information about trade conditions and industrial prospects in the Indian Empire, it is disappointing to discover the meagreness of the particulars about electrical engineering progress. However, details are included of the imports of electrical machinery, and we are gratified to find that Great Britain has practically recovered her pre-war position in this as in most other branches of industry. The accounts of the progress of the Hydro-Electric Survey and of the utilisation of water power have already appeared in these columns. Although trade depression may interfere with some projects, there is a prospect of a good demand for hydro-electric plant, transmission lines, motors, and other electrical equipment, and British firms should watch developments closely and be ready to take advantage of opportunities as they arise.

Stimulation of Native Production.

ONE of the effects of the war has been to stimulate the demand for native productions and to encourage the erection of factories and works so as to make the country less dependent upon imports. This movement is stimulated by the Government in various ways, and several British firms have already established branches in India in order to meet the altered conditions. Though there are limits beyond which it is inadvisable to go in this direction, the present tendency should be carefully watched in order that all industrial opportunities may be seized. The development of local industries has had a serious set-back owing to the present depressed condition of trade, but when this passes away there may be a revival of the demand for local manufactures. In regard to Government stores, these are, as our readers know, usually obtained through the Stores Department in London. Recently this Department has been placed under the direct control of the High Commissioner for India, and certain relaxations of the old rules as to the importation of stores have been made in order to encourage indigenous production, but the alterations will also enable the branches of British firms in India to quote for the requirements of the Central Government, and this should be to their advantage.

Safety Requirements in Electric Lifts.

A USEFUL technological paper (No. 202), giving the results of a survey of accidents occurring in connection with electric lifts has recently been issued by the Bureau of Standards, Washington. It is interesting to note that the work was conducted jointly by an electrical engineer, Mr. C. E. OAKES, and a mechanical engineer, Mr. J. A. DICKINSON. The inquiries related to three sets of equipment, *i.e.*, lifts devoted to heavy service with and without maintenance, and light service lifts with no maintenance provided. The statistics show that the greatest proportion of accidents are those involved in persons falling down the shaft. The next most prolific cause of mishaps is crushing between lift and the edge of the landing floor or door frame. Great importance is attached to the use of well-designed interlocking arrangements, and it is computed that about

three-quarters of the accidents that occur might be prevented by the installation of such devices. In Philadelphia, where the use of interlocks is compulsory, there was not a single fatal accident during 1918. At the conclusion of the report the nature and functions of interlocks are defined and some requirements which should be embodied in specifications are given.

Interlocking Requirements

INTERLOCKS serve to prevent normal operation of the lift unless the door opposite which the lift is standing is locked in a closed position, or, alternatively, every hoistway door is locked in a closed position. They should also prevent the opening of a hoistway door (except by the use of a key) from the landing side when the lift is passing a landing. Among the requirements embodied in specifications are that the interlocking agency must not be dependent on the action of springs in tension, nor solely on the completion or maintenance of one electrical circuit; that locking of the door and lift-control shall be accomplished by interconnection between parts of the device; that locking of the door opposite the lift must be completed before the lift can be moved. Emergency releases to render electric contacts or interlocks inoperative must be plainly visible inside the lift and reasonably (but not too easily) accessible to the attendant. The release must be such that it must be held in the emergency position and incapable of being readily tampered with or "plugged" in the emergency position. Rods, connections, and wiring must be similarly enclosed to prevent their being tampered with too readily. The suggestions appear sound and might be studied with advantage in this country, though it seems probable, from an examination of the statistics, that with us the number of fatalities in lifts is considerably less than in the United States. Thus, in the State of Massachusetts there were 2592 non-fatal and 67 fatal accidents during the four years 1913-1917. On the other hand, lifts are doubtless much more widely used in American cities. In any case there can be little doubt that the great majority of such accidents should be preventable by proper safety devices.

The Cure for Smoke and Fog.

ONE of the greatest and almost the only advantage of the recent coal strike was the enjoyment of a clearer atmosphere, especially in the neighbourhood of large towns, that it allowed. It is true that some of this clearness must be ascribed to the prevailing east wind, but even so we had for some weeks a demonstration of what this country's atmosphere was like before factories existed, and of what it might be like when factories are all driven electrically, and when the steam and fuel necessary for carrying out certain processes is reduced to a minimum. The benefits to the general public which would thereby be attained are rightly made the most of in the final report of Lord NEWTON'S Committee on Smoke and Noxious Vapour Abatement. The report emphasises the fact that smoke pollution is mainly due to the indiscriminate and wasteful use of raw coal for all purposes, and that this pollution can only be overcome by the Government and municipalities taking joint legislative action. We can suggest a better solution, which, as a matter of fact, is being gradually and automatically adopted—the use of electric power. We are willing to admit, however, that to allow things to take their course would mean but a slow transformation, and that something further must be done. In this connection the Committee make certain recommendations, among them that the Ministry of Health should be given

power to deal with local authorities who fail to administer the law with regard to smoke emission, that it shall be a legal obligation on all manufacturers to avoid air pollution by smoke or other emissions, and that the existing legislation on the subject shall be consolidated. We need hardly say that we hope these recommendations will be carried out with the least possible delay. And the hope is not merely a selfish one, for the increase in the general health which must thereby ensue, and the large amount of money which is now wasted on unnecessary painting and cleaning, which would thereby be saved, are not matters that can be lightly disregarded in these economical days.

The Domestic Hearth as a Smoke Producer.

THE Committee also turned their attention to the domestic fuel problem. Here the solution is not so easy. For while to a large extent the problem lies along the same lines as in industry, there remains the psychological factor that the open fire is warm and cheerful, if not efficient, and will therefore continue to be used for the comfort it exudes, altogether apart from its thermal qualities. The Committee very wisely recognise this, at least by implication, and though they recommend that the use of electricity and gas for heating purposes should be encouraged, at the same time they advise that attention should be given to the production of a smokeless fuel that can satisfactorily be used in the domestic grate. To facilitate smokelessness they also recommend that control be exercised over the heating arrangements in such new buildings as hotels, clubs, and offices. We feel, however, that the whole question can better be dealt with by education than by legislation. Something in that way is already being done. The factory chimney is disappearing because, as Alderman WALKER recently said, electricity supply is an essential in our large towns. Domestically the same tendency is evident. Convenience, cleanliness, and efficiency are warring against the open range; it is for the forces of progress to assist them.

Procedure by Special Order.

WE have frequently called attention to the hard position of those provincial supply companies which are unable to increase their charges so as to admit of a reasonable return upon the capital. Several of the provisional orders under which they are operating were transferred from local authorities many years ago, and they do not contain the usual clause as to the revision of prices. As our readers are aware, the maximum prices are regulated by orders made by the Ministry of Transport under the powers of the "Temporary Increase of Charges Act" of 1918. Consequently the companies are now either precluded from paying a dividend, or they are limited to a mere nominal return on the ordinary shares, because they were paying no dividend or only a very small one in pre-war days. This is a most undesirable state of affairs and is not calculated to assist in that development of electricity supply in the urban and rural areas of the country which is so necessary for industrial progress.

The Electricity Supply (No. 2) Bill.

OF course, a remedy would have been provided by a clause in the Electricity Supply (No. 2) Bill, but as the fate of this measure is still uncertain, the directors of Edmundsons Electricity Corporation are wisely endeavouring to obtain relief in another way. They have applied for six special orders, which, if granted by the Electricity Com-

missioners, will confer the power to deal with the necessary revision of the maximum prices of undertakings established under 21 provisional orders. No actual variation of the permitted maximum charge is sought at present, but only the bare authority to enable the Ministry of Transport to take the matter into consideration. We need scarcely add that we hope the company's application will be successful, as it represents a most desirable amendment of the law relating to electricity supply. The present position as to the variation of prices is too rigid, and a more reasonable, flexible rule is required.

Special Orders in Place of Bills.

INCREASING use is also being made of special orders in order to obtain powers which could formerly only be secured by means of the expensive method of promoting a private Bill. For instance, Stepney Borough Council are seeking an order to enable them to acquire compulsorily and use additional land for their Limehouse generating station and also to exempt them from indictments and proceedings for nuisance on account of the working of the station. This is also an amendment of the law which we hope the Council will secure; in fact, we consider that all electricity undertakers should only be liable for nuisance caused by vibration or the emission of grit or smoke, if they are guilty of negligence in carrying on their business by not adopting up-to-date methods and the most modern machinery and appliances.

Criticism and Progress.

IT is characteristic of the human being to discover in the possessions of others pleasing qualities which are not indigenous to his own goods. It is not an attractive trait, but, even allowing for that, it is a trait which is sometimes unduly criticised. For the ideas and thoughts of others, as reflected in their actions, sayings and possessions, are not without their use in shaping our own course and are, for that reason, worthy both of study and emulation. And these dicta are as true in their application to industries as to individuals. This being so, it is not surprising to find in the electrical industry those who discover in activities other than our own all the good qualities which we ourselves, in their view, have failed to achieve, and those who fiercely resent any criticism of either our policy or our products. Both these attitudes are a little illogical. The one is carried so far as to bring forgetfulness of the fact that conditions in our own industry may preclude the use of methods that have been found successful in competing industries, while the other conveniently ignores the fact that one of the best methods of advance, especially in a young industry like ours, is a constant criticism of what is being done. This criticism to be of the greatest use must not be destructive, but rather instructive; but, in any event, it is of the greatest value, and those who fail to realise this miss a great deal that might be helpful to them.

The Design of Electric Light Fittings.

IT is from this instructive point of view that we should like to criticise the workmanship of many of the ornamental electric light fittings that are now to be found on the market. A large number of these fittings are wanting in the quality of their mechanical details, such as threads and joints, so much so that it is obvious that the tools and methods of production of twenty years ago are still being used. There is not the least real reason for this, and it is, therefore, to be hoped that the defects to which we have

called attention will be remedied without delay. That we can and do turn out apparatus in accordance with the best engineering traditions is one of the best of reasons why our industry should not be neglected.

Traffic Regulation at Tramway Stopping-Places.

THE question of traffic regulation at stopping-places has been agitating tramway undertakings for about ten years without much result. It was recently revived by the Highways Committee of the London County Council on the human side, and from a report issued by the Committee on accidents due to vehicles passing on the near side of tramcars at stopping-places we learn that this type of mishap is increasing. This being so, the County Council is again urged to make further representations to the Ministry of Transport on the matter with a view to a by-law imposing a speed limit of six miles an hour on all vehicles passing on the near side of stationary tramcars when taking up or letting down passengers being obtained. It is very doubtful if the Minister of Transport has power to make such a by-law, and it is equally problematical whether, if he did, it would be effectual in reducing the number of accidents.

Some Serious Figures.

THAT these are serious enough is evident from the following figures. In the year 1920-21 there were 199 accidents on the County Council tramways, against 145 in the previous year, but over 80 per cent. were due to light motor vehicles or bicycles. This would seem to indicate recklessness or carelessness in driving, and as it is an offence to drive a motor car in a manner which is dangerous to the public a more rigid enforcement of the existing law might do good. Of course, it is poor consolation to the relatives of the dead to punish a reckless driver, but it may have a salutary effect on the others. It is, however, a serious matter to make such a regulation as that demanded, and in the only place—Glasgow—where a restriction of this kind is imposed the Corporation were obliged to obtain special statutory authority for the purpose. But even when this is done force of public opinion may render such a regulation a dead letter.

What is Undue Preference?

THE question of undue preference in the supply of electricity is, we understand, to be raised once more, and on this occasion a cinema proprietor is the origin of the trouble. There is probably no more fruitful cause of controversy, nor a greater source of litigation in the supply industry than the interpretation of Sections 19 and 20 of the Electric Lighting Act, 1882. As is well known, by clause 19 every company or person within the area of supply is entitled to a supply "on the same terms on which any other company or person in such part of the area is entitled under similar circumstances," and clause 20 lays down that "the undertakers shall not, in making any agreements for the supply of electricity, show any undue preference."

Distinction and Difference.

IN the present case the cinema proprietor claims that he should obtain his supply at the power rate, and he also alleges that, by giving a supply through a motor generator to a neighbouring cinema at about half the rate which he is paying, the supply authority is giving an undue preference to his rival. We think that the claim to have a supply at power rates is not well founded, for the bulk of the current, even though it be supplied through a motor generator or a transformer, is used for lighting purposes, and the decision of a Divisional Court, in the case of

Linsdell v. Paignton Electric Light Company, was to this effect. Indeed, it would seem that unless all the circumstances are similar, agreements may be made for different terms and at different rates. Nevertheless, the cinema load is so good that many supply undertakings have a special rate, intermediate between the power and lighting charges, for this class of customer, and we believe it would be good business if this practice were more generally adopted. On the allegation of undue preference it is more difficult to give a definite opinion without a full knowledge of all the facts. It is, however, difficult to justify a difference of 3d. a unit between the two rates.

Electric Safety Lamps.

AS might be anticipated, the demand for improved lighting in mines has caused a great increase in the number of electric safety lamps. The total employed in 1920 was 245 900, compared with 197 722 in 1919. In the Yorkshire and North Midlands division there are 107 111 electric lamps, in South Wales 94 358, and good progress is also being made in the other mining areas. The magnetic method of locking is employed for 228 459 electric lamps, against 181 925 in 1919, and the lead rivet for 17 342, against 15 689. There was a drop in the flame safety lamps from 636 158 to 635 127, but lighting by electricity was used for 422 167 against 418 344 safety lamps in the previous year. These figures are significant of the progress of electricity in all branches of mining work, and we have no doubt that as the mining industry becomes more normal the progress will be still more rapid.

A History of Handling.

THE fifth Materials Handling Number of THE ELECTRICIAN, which we publish to-day, deals specifically with a subject which is becoming of greater and greater importance. It has been said that the handling of both raw and finished products is at present a dominant factor in the problem of economical production; and the electrical engineer, both at his place of work and in his domestic life, does not need to seek far for examples which prove the truth of this statement. So evident indeed has this truth become that a Press campaign is being vigorously conducted to obtain a reduction in railway rates, though it is equally clear that economically this reduction cannot be justified unless the present methods of handling goods in transit are also changed. The whole problem therefore resolves itself into an examination of ways and means with a view to discovering how this can best be effected. To show the progress that has been made is the main purpose of the articles which we publish in to-day's issue.

Primarily an Engineering Question.

IN considering this subject, even in a technical electrical journal, it is necessary to take the broadest possible view. The problem of efficient materials handling is primarily an engineering question in which the electric drive figures as an important incident, it is true, but still as an incident. For the fundamental consideration is how to deal best with the products that have to be handled, and though this can often be done better by using the electric drive than in any other way, this is by no means always the case.

Steam and Magnets.

THUS Mr. F. P. OVERSTALL describes an interesting installation in Gambia for handling ground nuts, an installation which for obvious reasons is steam driven, but which, as it could easily be adapted to the electric drive in more civilised regions, is worth the attention of our readers.

There are many ways in which similar installations could be used in this country. Again, even that inefficient machine the steam crane can, for similar reasons, still find a useful application and can, as Mr. F. A. HOOPER shows, be combined with a lifting magnet with considerable success, by installing a relatively small generating plant on the equipment.

Coal Handling in the Future.

Mr. C. P. KININMONT's article on the pneumatic handling of coal is well worth study by electrical engineers, quite apart from the system of drive, as it describes a means of dealing with a most important problem. Mechanical methods of dealing with coal and ashes in generating stations are likely to receive an ever increasing application, especially where the size of these stations makes coal delivery and ash disposal almost continuous operations.

While, therefore, we do not wish in the least to minimise the part the electrical engineer can play in all these applications (indeed some of them are only possible by the use of electrical apparatus) it is still as well to reiterate that both from the technical and the economic points of view this question, even on the engineering side, is one with the broadest of aspects.

The Problem Historically Considered.

To trace the development of materials handling apparatus from the earliest times to the present day is another side of the question which is not uninteresting. Such a survey shows on the one hand, as might be expected, how very much we have advanced since the time when the machines that Mr. ZIMMER describes were in limited, not in general, use. On the other hand, it shows how very little we have advanced. In fundamental engineering practice we are still doing the same things in very much the same way as our ancestors were two thousand years, or more, ago.

We have, it is true, a wider choice of materials and we have, it may be presumed, a great deal more knowledge of the strength, the structure and the manufacture of these materials. It is also to be hoped our design is better and that we are more nearly approaching that simplicity which is no less true economy than true architecture. Yet we still depend on such fundamental machines as the pulley and the screw, the windlass and the pump, the conveyor and the hook. And it may be said that, taking Mr. ZIMMER as our guide, our chief advances are in the means of driving and in the development of various forms of application which more efficient driving has made possible.

Credit to the Pioneers.

It is, therefore, to WATT and to FARADAY (to mention two names which must be allowed to stand for a host of remembered and forgotten workers in the steam and electric fields) that we must give the credit for making possible the advances which are evident in the design and manufacture of machinery for handling materials. The steam engine and the electric motor between them are now practically exclusively used for driving purposes, and of these the latter is receiving an ever-increasing application in cases where convenience, compactness and labour saving are essential.

Full Advantage of Inventions Not Taken.

It is certain that without WATT and FARADAY our industrial progress to its present point would have been quite impossible. It is becoming equally certain that we have not taken full advantage of the advances in efficiency and economy in the methods of dealing with materials that their inventions have made possible. The reason for this

is well known. When unskilled labour was "cheap and abundant" the capitalisation of assets in machinery was hardly likely to commend itself to manufacturers and commercial men. The result, as those who have studied the history of the early industrial era well know, was a decline rather than an advance in civilisation. Man in the bulk became for the time being a poor and inefficient machine working under conditions that made for poorness and inefficiency and under a system which was only justified because it was cheap.

An Alteration for the Better.

In recent years the movement for better wages and working conditions which has been accelerated by the war has happily altered this for the better, though it has brought with it other evils which we hope are only temporary. For the first time in history machinery is now cheaper than labour. It is also much more efficient. Hence the greater interest that is being taken in its application to operations which it was once thought could only be performed by hand; an interest which is reflected in the numerous papers which are read before the various technical societies and in such issues as that we publish to-day.

A Beneficial Change.

This change from every point of view is a move in the right direction. It is being watched suspiciously and resentfully by Labour as being antagonistic to their interests; but though it may cause some upheaval the ultimate result must be beneficial. For man in the factory will become less and less a machine, and more a human being, whose efforts will be concentrated on the really difficult work of design and planning.

A great advance has been made in this direction. It is already economically possible to handle goods in bulk, such as margarine, coal and grain, by conveyors and cranes so that the minimum of human labour is necessary; but, as Mr. BULKELEY shows, the handling of miscellaneous goods such as those with which a railway company has to deal is more difficult. Yet here again much improvement over existing arrangements is already possible and the electric truck can give advantages in speed and economy which are not obtainable in any other way.

The Chance for the Electric Vehicle.

It is indeed in the directions of improving the design and extending the use of the electric vehicle and truck that electrical engineers might well turn their attention. The position of the electric drive with regard to other handling machinery is secure. But further effort is necessary in this field. The electric vehicle has not proved itself to the satisfaction of those who are prejudiced against it and will remain prejudiced until they are driven from their position by the inexorable pressure of facts. We do not make the mistake of putting forward a universal claim for use of this electrical application, but there is no doubt that it will be much more widely used when its possibilities are known.

The lesson to be learnt from a discussion of this question will not become less true as time goes on. Machinery is an excellent servant. Its increasing use will cheapen production and increase trade. The greater employment of electricity by providing more efficient methods will assist in obtaining a greater output under conditions much better than those which usually exist at present. The employment of machinery instead of human beings on many tasks will lead to an improvement in health of the workers and a general building-up of the well-being of the human race.

The Evolution of Mechanical Handling Devices of the Continuous Type.

By G. F. ZIMMER, A.M.Inst., C.E.

Mechanical handling devices, now and at all times, are only justified theoretically if, by their use, a reduction in handling cost can be secured. Practically, we have to take into consideration

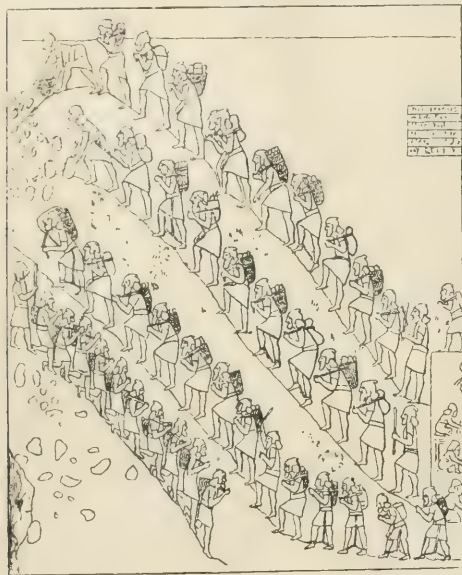


FIG. 1.—ANIMATED BUCKET ELEVATOR. ASSYRIAN METHOD, ABOUT 700 B.C.

the fact that a man works as fast as he wills, while a machine works as fast as it must.

So far as the theory is concerned, it is obvious that when labour is cheap and plentiful, mechanical devices are unnecessary. Since such conditions obtained in antiquity, we look in vain for mural representations of mechanical devices in the pictorial records which lay bare the daily life of the Ancients. The illustration, Fig. 1, should be a convincing proof that a bucket elevator would be a waste of expense under such circumstances; the illustration is taken from an alabaster slab in the British Museum, which was once a part of the palace of Sennacherib, where thousands of men were available at no expense beyond that of feeding them with radishes and onions.

We will now see for what purposes mechanical handling devices were first used. Work of a transitory nature hardly justified the use of machinery, unless it were portable; this rule applies also to-day. Such work as the building of fortifications, for instance, does not appear to have called into being, in days gone by, much in the way of handling devices, except ropes and blocks. We see, therefore, that the field open to mechanical handling devices for receiving and delivering material in an unbroken stream, is generally confined to industrial activity.

Agriculture and Early Mechanical Appliances.

Agriculture was the first industry practised by primitive man, and the few mechanical handling devices he employed were those for raising water for irrigation purposes. Flour mills were closely allied to agriculture, and milling in its incipient stages was carried

on as a domestic drudgery, but whenever it became an industry, and where, therefore, larger quantities had to be handled, mechanical devices in mills are the first we find on record, following upon those for handling water. Whether the mining industry flourished sufficiently long before the milling industry, to justify the introduction of mechanical handling devices, it is hard to tell, for while in one locality milling had the chronological advantage over mining, the reversal of that order was probable in other localities. However this may have been, mining and quarrying were some of the earliest occupations of man, where it paid, even in the very early ages, to employ mechanical handling devices. This will be apparent when we consider that minerals are so much heavier and therefore more difficult to handle than wheat and flour, or rather, meal. With mining and quarrying occupations we must also couple military and fortification works which have played a most important part in the history of quarrelsome man.

Water-Handling Devices.

Since mechanical devices for handling water were the first man ever built, we will deal with this subject first. These naturally applied to the spheres of man's first civilisation—Egypt and Mesopotamia—where, in order to secure a continuous succession of crops, the fields must be irrigated during the intervals between the flooding of the rivers.

It has been stated, broadly speaking, that the use of machinery was not justified if labour were cheap, but it must be understood that the cost of the machine is also an important factor in the case. Now, in antiquity two methods were employed for raising water, one being intermittent and consisting of a bucket which was lowered into a well and raised when full, the other being continuous and consisting of an endless chain of smaller receptacles which dipped and delivered water in an unbroken succession. The first method, which is of minor interest in this inquiry, was the "Shadoof," which is still in use to-day—a device which every peasant can make for himself at trifling or no cost at all. It consists of two posts or mud walls, with a long slender pole operated from a cross axle, similar to the well-sweep of our grandfathers. The "Shadoof" lifted water only a few feet, so that in the southern part of Upper Egypt, where the banks of the Nile are high, four and even five "Shadoof" are used,



FIG. 2.—THE "SHADOOF," AS USED ON THE BANKS OF THE NILE FROM 1500 B.C. UP TO THE PRESENT. THE ILLUSTRATION SHOWS THE DEVICE IN USE AT THE PRESENT DAY ON THE LOWER NILE.

one above another (see Fig. 2). The same device was in use for the field of the peasant or the garden of the noble. The engine mentioned by Herodotus was most likely the "Shadoof"; it may, however, have been the more complex machine known as "Sakya," or "Chain-of-Pots," to be dealt with later.

Opponents of Progress.

In June, 1815, shortly after his arrival in Egypt, the versatile Belzoni tried to introduce to Mahomet Ali Bashaw a pump of his

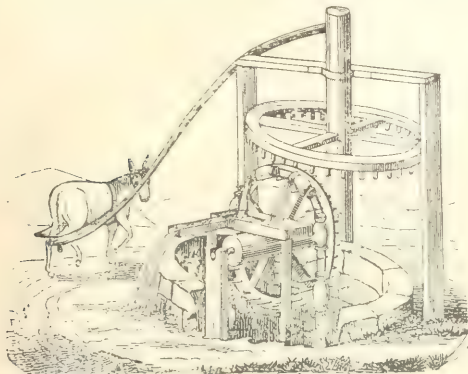


FIG. 3.—"CHAIN-OF-POTS," "SAKYA," OR PERSIAN WHEEL

own invention to supersede the numerous primitive water-lifting devices which have been in use on the banks of the Nile from time immemorial. He hoped to raise, by one of his pumps, as much water as the primitive devices did with four oxen, thus dispensing with many thousands of cattle, as at that time over 5 000 such appliances were in use. Belzoni saw, however, that he was not a welcome visitor to the population, who feared that his introduction would throw many of them and their animals out of employment. Belzoni here refers to the "Sakya," or "Chain-of-Pots," or the "Taboot," since the "Shadoof" is driven by man-power.

The Application of Primitive Methods To-day.

In his book, "Egyptian Irrigation, 1884," Sir W. Wilcocks, M.I.C.E., Inspector of Irrigation in Egypt, expresses the opinion that primitive methods of water-raising which have been practised with eminent success these 5 000 years, might with advantage be

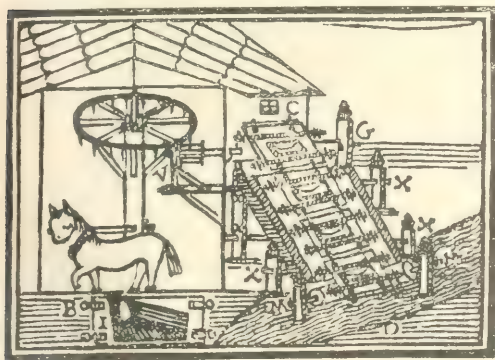


FIG. 4.—PRIMITIVE FORM OF BUCKET ELEVATOR FROM GALLI, 1894.

copied, even to-day, in those countries where the rainfall is insignificant. He mentions that the "Sakya" as still in use is generally employed for raising water to a height of 3 metres and over. Lieut.-Col. Justin C. Ross, R.E., C.M.G., Inspector-General of Irrigation in Egypt, says, in his introduction to Wilcocks' book:

It is certain, that in the old days there must have been native engineering talent of the very highest order, and when we read of such and such a king restoring public works in a long and glorious reign, there must have existed a continuous supply of good engineering talent which had *carte blanche* from the rulers of the day.

A Biblical Allusion.

From the above introductory remarks, most of which refer to the "Chain-of-Pots," the progenitor of our present-day bucket elevator, it is clear that, primitive as the device was, it was a good machine. It is believed to be of Egyptian origin, although there is no proof of this. It must have been long in use at the time of Moses and familiar to the Israelites, for it is referred to in the poetical allusion symbolizing man's life, in the twelfth chapter of the Book of Ecclesiastes:

On such the silver cord be loosed, or the golden bowl be broken, or the pitcher be broken at the fountain, or the wheel broken at the cistern.

The "Chain-of-Pots," which was a familiar sight in those days, is certainly referred to here. "The silver cord" refers to the bleached condition of the fibre ropes; the "golden bowl" is an allusion to the colour of the earthenware pots, both ropes and pots, dripping with water and glistening in the bright sunlight, represented to the vivid imagination of the Oriental a striking resemblance to burnished gold and silver. If the cord broke, which

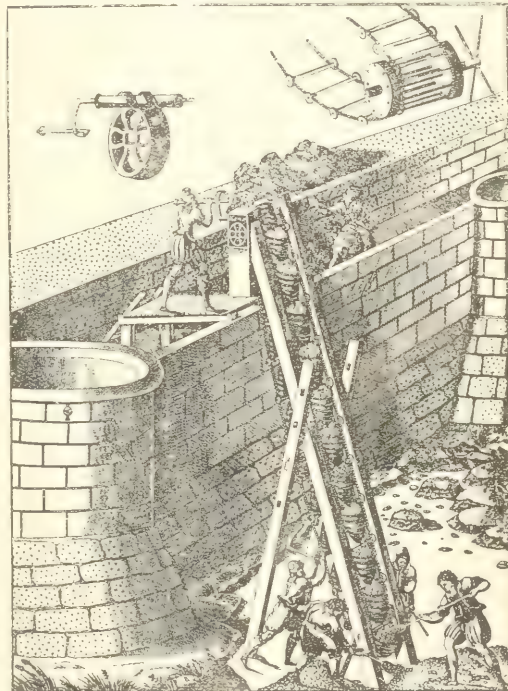


FIG. 5.—BUCKET ELEVATOR FOR SOLIDS. DESCRIBED BY JACQUES BESSON, 1578.

was probably not an infrequent occurrence, the whole "Chain-of-Pots" would drop into the well, breaking the pitchers and also the terminal driving wheel, owing to its revolving either contrary to its wont or at a speed for which it was not intended.

Whether the device was too intricate to be represented in the mural records, or whether it did not come into use in Egypt before the time of the lady Pharaoh, Hatshepsu, of Eighteenth Dynasty, 1587 to 1562 B.C., is not clear. At any rate, there are but two illustrations of water-raising machinery in existence dating from this reign, and they are both of "Shadoofs," and in the same tomb at Thebes.

The "Chain-of-Pots"

This device was also known as the "Persian Wheel," which title is seemingly justified, as it is supposed to have been introduced into Egypt by the followers of Cambyses after the Persian invasion, before 250 B.C.

The "Chain-of-Pots" consists essentially of an endless chain of earthenware pots strung together by fibre ropes which pass over an upper terminal wheel, which is rotated by animals; it has sometimes also a lower terminal beneath the water level. A primitive device of this type, as still in use, is shown in Fig. 3.

The "Chain-of-Pots" is mentioned in Coptic manuscripts*; while this and other water-lifting devices are dealt with by the Arabian philosopher, Ibn Sina (Ibn al-Haytham), 1007; also by Agdabi, another Arabian savant. The ropes used for the "Chain-of-Pots" were, according to these writers, made of leather, cotton, wool, and even of silk. The hair of camels, goats and hares was sometimes used, and also the bass of palm-trees; of the latter, cocoa-palm fibre is stated to furnish very suitable ropes. "Chains-of-Pots," similar

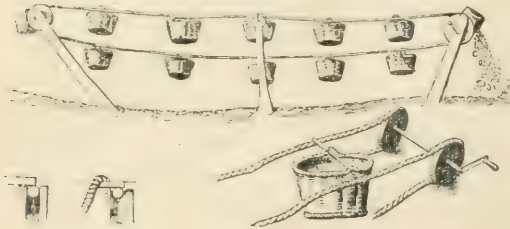


FIG. 6. PRIMITIVE GRAVITY BUCKET CONVEYOR. DESCRIBED BY DR. ROBERT HOOKE, 1692.

to those described in these Arabic manuscripts, are still to be found in their unaltered form. In some Arabic manuscripts at Oxford, including one by Gazari (who lived at Diyar Bekr, on the Upper Tigris, about 1200 A.D.), five different methods of raising water are illustrated and described, one of which is the "Chain-of-Pots." Colonel Chesney in "Euphrates Expedition," and Sir Henry Layard, also describe similar devices which are in use on the banks of the Euphrates and Tigris.

A Primitive Bucket Elevator.

A good account of a rather primitive bucket elevator for water is given by F. Marco Galli. This is of interest because it conveys the idea that the author had a close and practical acquaintance with such devices, which many of the ancient writers had not, judging from their descriptions and illustrations. This elevator is illustrated in Fig. 4, taken from Galli's work, "Miscellaneo Matematica Opera," Parma, 1694. The elevator is composed essentially of an endless chain, consisting of a series of boards hinged together by a few links of chain at their four corners. To each of these boards a slightly smaller receptacle is attached; one such link is shown in the foreground. Two terminals of triangular cross section, and of wood, support this chain in either a vertical or an inclined position. One of the latter type is represented in the illustration here given; Galli also depicts one of the former type. The inclined run of the chain is supported by rollers.

Bucket Elevator for Solids.

So far as we have seen, the development and the application of the bucket elevator has only been for the raising of water, and it is little wonder that as soon as the need arose for handling solids the needful trifling modifications to an already well-developed machine were soon accomplished.

Perhaps the first attempt in this direction was that dealt with by Buonaiuto Lorini, of Florence, in his well-known book, "Della Fortificatione," 1597. In Chapter VIII. of the work he shows an endless chain manipulated by a pulley, with which baskets of earth, attached at the lower end, are raised and detached at the upper end; while the empty baskets are attached to, and returned by, the descending chain.

A further development, though published at an earlier date, is that of Jacques Besson, for moving earth and building materials for repair work on top of city walls, &c. It is illustrated and described in his book, "Theatre Des Instrumens," 1578, from which the accompanying illustration, Fig. 5, is reproduced. The upper terminal is shown on the left, and is driven by worm and worm gearing, to assist a man in turning the machine. A very similar device, and for the same purpose, is that of Capitano Agostino Ramelli, mentioned in his book "Le Diverse et Artificiose Machine," 1588.

A Primitive Form of Gravity Bucket Conveyor.

A relatively modern variety of the bucket elevator is the gravity bucket conveyor; so well known in these days and so extensively used in power-houses, which has also been anticipated, so far as its fundamental principle is concerned. For what is undoubtedly a progenitor of this handling device is a contrivance, the description

of which was communicated to Dr. Hooke, in September, 1692, by Sir Robert Southwell, who saw it at work in Brandenburg for the speedy (*sic*) conveyance of earth, raising of gravel, &c.

The following account of this interesting device is taken from "Philosophical Experiments and Observations of the late Eminent Dr. Robert Hooke," Derham, London, 1726. The appliance consists of an endless chain of receptacles (see Fig. 6), in this case, baskets which are filled at the receiving terminal on the left, then conveyed to the delivery terminal on the right, where they come in contact with a tripper, the driving shaft of the machine in this instance; where they are discharged and returned in an upright position ready to be refilled. There are here all the essential features of a gravity bucket conveyor, the suspension of the buckets above their centre of gravity so that they always retain their normal position in whatever part of the length of the conveyor they may be; likewise their ability to be tipped over in contact with a tripper which might be at any part of the conveyor. It is probable that the device in question was manipulated by two men—one filled the baskets and the other turned the crank. In this case it is obvious that the con-

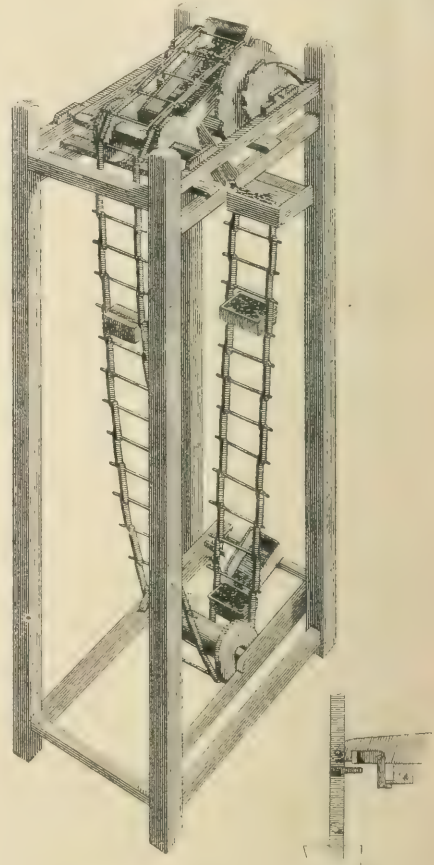


FIG. 7.—BUCKET ELEVATOR FOR USE IN MINES, AS INVENTED BY THOMAS ARKWRIGHT, 1802.

veyor was running very slowly and the man who turned the handle had time to rest while the next basket was being filled.

Arkwright's Early Conveyor.

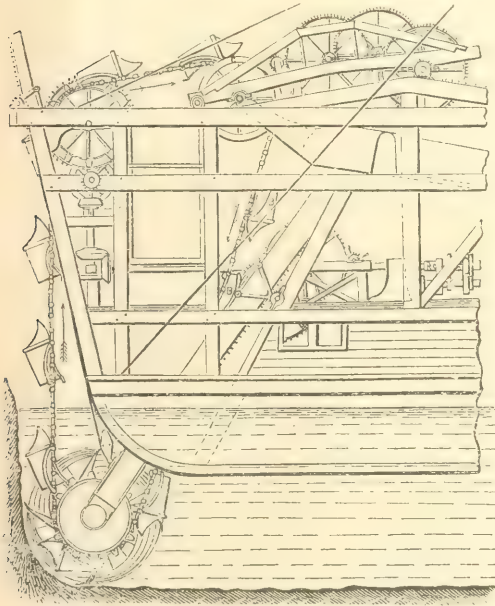
From this extremely primitive device we now come to the more mechanical solution—that of one Thomas Arkwright, of Kendal, a Westmorland engineer, who, in 1812, invented a gravity bucket elevator for raising ore from mines. In recognition of his inventive ability, he was awarded a bounty of twenty-five guineas by the Society for the Encouragement of Arts, Manufactures and Commerce. The device (see Fig. 7) consists of an endless chain, composed

* According to W. Spedelberg, Abh. d. W.G.d.W. in Göttingen, Phil. Hist. Class II, Vol. 16, p. 77, 1917.

of long links joined together by pins which project slightly beyond the lashes of the chains; these projections engage with notches in the terminal driving wheel. There are but few buckets on this chain, which passes over wheels and drums. It is naturally imperative that the receptacles of a gravity bucket conveyor should be suspended above their centre of gravity and this appears to be the case here, although it is not certain, since the descending bucket is shown upside down. What leads one, however, to the impression that they are so suspended is justified by the slightly inclined path between the two upper wheels, where the buckets are apparently kept in an inverted position by guides upon which they appear to slide. The descending bucket, being inverted, might be a mistake on the part of the engraver, since there is very little difference in the appearance of the receptacles whichever position they are in.

Safety Devices.

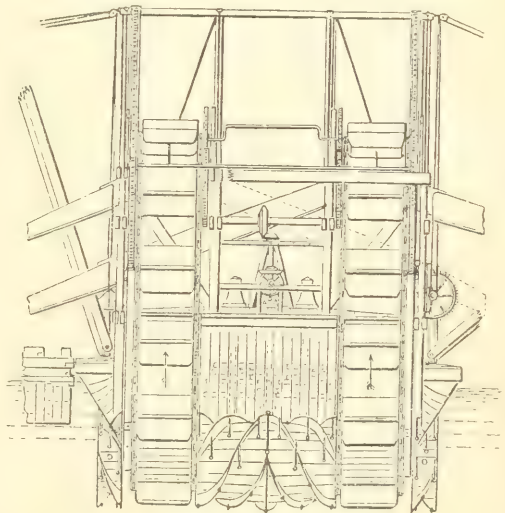
A safety device such as is now frequently employed on elevators and inclined conveyors, to prevent the machine from running



Link Belt Company, of Philadelphia, also by a German firm, who have obtained letters patent for the invention within the last few years. This invention was patented and applied to a dredging machine by D. S. Howard, and was illustrated and described in "The Artizan" of May 1, 1869, pp. 102-103. A portion of the dredger is shown, in two views, in Figs. 8 and 9, and, although the machine is used for excavating under water, it is to all intents and purposes a bucket elevator, and undoubtedly anticipates the two more modern inventions above mentioned.

The Chinese Chain Pump.

As the "Chain-of-Pots" is the progenitor of the gravity bucket conveyor, so likewise is the Chinese chain pump that of the modern chain elevator. This device was used for irrigating in China, and is of practically the same antiquity as the agriculture of that country, which was in an advanced state of development early in the thirteenth century B.C. We find the earliest records of this device in a Chinese book, entitled "K'ien Lung K'eng Tsch' t'u"—the literal translation of which is "Pictures of Ploughing and Weaving," or, more freely translated, "Agriculture and the Silk Industry." The first name of the title of the above book was that of the emperor who reigned from 1650 to 1743, at whose order an



FIGS. 8 & 9.—Two views of Bucket Dredger with Helical Feeding Devices, 1869.

in a retrograde direction in the event of the chain breaking, is already in use in this early example of 1842 (see ratchet wheel).

The buckets are filled instantaneously from the feed-box; this also implies a relatively slow speed of the chain of buckets, but it was probably faster than in the previous example, dating from 1692. All gravity conveyors are slow-running machines, even at the present day, and their speed is rarely more than 45 to 50 ft. per min.

The inventor gives a description of the loading device, and also a larger scale detail in the smaller illustration (see Fig. 7). An iron spigot projects from the end of the chain and depresses a catch beneath the feed-box, and thereby causes the end of the box next to the chain to tilt suddenly so that the contents slide into the bucket just then ascending. As the full bucket ascends it lifts the box into its former position again.

An Early Feeding Device for Bucket Elevators.

In connection with bucket elevators attention may be drawn to a type of portable machine used both for unloading coal trucks and for reclaiming coal from a stock heap. In this device a helix is attached to each side of the projecting lower terminal spindle of an elevator; these helices, which revolve with the spindle, are right and left-handed, and produce a gathering action, feeding the buckets of the elevator from an area about three times as wide as the size of the buckets. Such extremely useful devices are built by the

earlier book was re-issued, the author of which was Lou Shou, and the date of publication the middle of the twelfth century A.D. (probably Anno Domini 1145). The illustration (Fig. 10) has been reproduced from one of the plates in this work, and shows the Chinese chain pump in the form in which it practically remains to this day. Like many illustrations of antiquity, the one here reproduced suffers from a draughtsman's error. The shaft which is rotated by the four men is shown above the terminal wheel of the conveyor, whereas in reality it passes through the centre of the same, as correctly shown in the later illustration, Fig. 11, taken from Staunton's Embassy to China, 1796. The illustration, Fig. 10, incidentally shows in the background that the water-lifting method effected in early days in Egypt by the "Shadoof" was also in use at a very early date in China.

A Widely-Used Machine.

The "Chinese Chain Pump" is so universally distributed over China that every small holder is in possession of a portable machine of this kind. It is believed to have been introduced into Holland in the seventeenth century, probably by wandering Jesuits. It was there employed not only for raising water, but also mounted on a pontoon for removing silt from harbours and docks. In 1785 such a machine was also used at the Hull docks for clearing away the mud.

This Dutch device is a development of the primitive "Chinese Chain Pump" of the twelfth century. While, however, the latter is

entirely of wood, even to the chain itself, and is for handling water, the Dutch machine, with more careful attention to details and the partial use of iron, can handle semi-solids such as silt.

The push-plate conveyor which can be seen to-day in most up-to-

rather, slightly inclined band-conveyor in his automatic flour mills; he called it a "Descender." It was mounted within a wooden box on its two terminal wheels and, being placed in an inclined position, it ran by gravity, hence the name he gave it. It is not without interest to learn that Fraser & Chalmers erected a most up-to-date band-conveyor, for loading iron-ore into vessels, in Spain only a few years ago, which, owing to its inclined position, also works by gravity.

The credit of the introduction of the band conveyor, as we know it to-day, is due to the late Percy G. B. Westmacott, who designed and erected an extensive band-conveyor installation at the granaries of the Mersey Dock and Harbour Board in 1868. His band-conveyor was so carefully thought out in details, even to the throw-off carriage by which the load can be withdrawn from the band at any point, that it is practically in use to-day as he gave it to the world.

A Reversal of Conditions.

In conclusion, it must be apparent to the reader of the foregoing that from the earliest ages man was always able to provide himself with mechanical labour-saving devices when or wherever he had any need for them. In fact, it is more than probable that the first machines man ever built were such devices. Not only was the fundamental idea of practically all conveying devices we employ to-day well understood hundreds of years ago—in some cases, millenniums ago; they were, moreover, built of a quality and with a finish sufficient for their early use—the handling of water. If, then, such elevators and conveyors were not more universally used in the industries of the last few centuries it was due to the moderate demands of the labour classes for wages. In the present century a complete reversal of conditions has been brought about. The cost of labour has risen, and the machine has automatically been

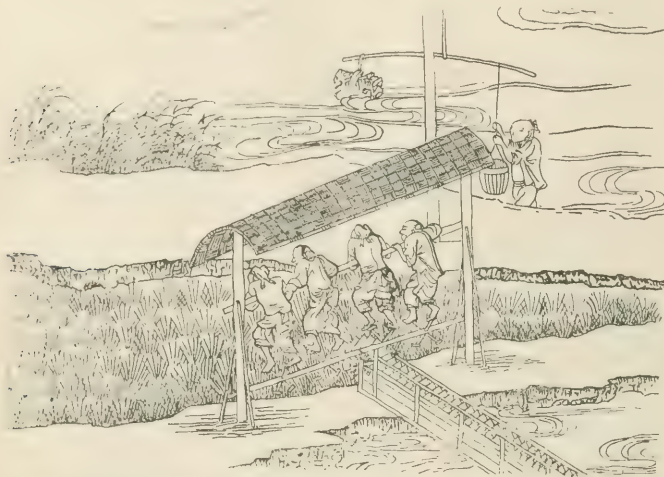


FIG. 10.—THE EARLIEST REPRESENTATION OF THE CHINESE CHAIN PUMP. 1145 A.D.

date gas works is composed entirely of iron and steel, including the trough, and is but a development of the same primitive idea. This particular machine conveys coal to the bunkers over the retorts. Many other varieties of construction are now in use in the modern development of the scraper conveyor—probably a greater number than in the case of any other continuous type of conveyor. In addition to the common form so largely used in gasworks and power stations, variations of the push-plate conveyor are the push-bar conveyor, used for hot coke and ashes—the principal representation of the type being the De Brouwer; other types consist chiefly of a wide endless chain running through a trough, which chain partly pushes and partly carries the load; such devices are also used for hot coke and ashes, also as coal-face conveyors in mines, for which purpose they were introduced about 1900.

The Band-Conveyor.

The band-conveyor, one of the mechanical handling devices more universally used in these days than in any other, is of relatively modern origin, but it is a strange paradox that it was first used in a vertical direction for handling water in which respect it shares its conception with all continuous-working devices such as the "Chain-of-Pots," "Chinese Chain Pump," and the "Archimedean Screw."

This vertical band-conveyor was that termed by Ewbank, "A hydraulic belt for raising water." It consisted of two endless bands sandwiched together and running over two terminal pulleys in a vertical direction at a speed of 1 000 ft. per min., the lower terminal dipping into the water, which was absorbed between the two belts and carried up and discharged at the top by centrifugal force. This device was mentioned in the Proceedings of the Newcastle Meeting of the British Association for the Advancement of Science, September 15, 1838. Such a machine was used for some time for a well 140 ft. deep in Portman Market. During the discussion it transpired that a very similar machine had been seen some fifty years earlier; it is therefore evident that some such machine was in use about 1788, perhaps before; it is, however, more than likely that this earlier device was confounded with the "Vera Rope Pump," the invention of a Paris postman of that name in 1781. In this device a number of ropes are used instead of the bands. Amongst others, one such pump was erected at Windsor Castle before 1783.

The Descender.

Oliver Evans (1755 to 1819) employed a primitive horizontal, or



FIG. 11.—THE CHINESE CHAIN PUMP AS STILL IN USE AT THE TIME OF STAUNTON'S VISIT TO CHINA, 1796 A.D.

developed and built to suit modern requirements. The only reason, then, why the modern handling machine dates back practically only two decades is entirely due to the demands for ever-increasing remuneration in return for an ever-decreasing manual performance, and it is thus no reproach to the progress of our civilisation. The importance attached by Ruskin to hand labour has reverted, by the men's own attitude, to an impossible theory.

The Future of Ship-Discharging Appliances for Bulk Materials.

B. C. P. KININMONTH.

A Paper* read recently before the Institution of Mechanical Engineers aroused considerable interest in the general question of the loading and unloading of cargoes of bulk materials, and has given rise to some speculation as to the future development of mechanical appliances for ship-discharging. Without venturing far into this realm of speculation, the present writer would like to put forward some considerations likely to affect the line of progress in this matter and to make some suggestions which seem to follow from the considerations adduced.

Facility of Discharging as a Factor in Ship Design.

It is natural to think that there will in the first place be a more marked tendency to design ships with special reference to facility of discharging particular classes of cargo, and possibly to fit some such ships with self-discharging machinery. The grain and ore steamers of the Great Lakes, with engines and boilers in the extreme stern and one large hold in all the forward part of the vessel, indicate possibilities in this direction, but the obstacles in the way of adapting such vessels to ordinary ocean-going work are considerable. It has been stated that the few Lake steamers that crossed the Atlantic in the early part of the War did not prove very satisfactory, and their trans-oceanic voyages were soon discontinued.

To imagine the time when any considerable part of the world's

of the Hulett unloader, one of the most interesting and significant of the appliances of this type. This unloader is a machine of great power, lifting as much as 17 tons at a time, and the grab is suspended not by ropes or chains, but by a rigid bar lowered and hoisted by means of a balanced parallel motion from a carriage capable of being traversed both along the quay and transversely. A 17 ton machine has a maximum capacity of 900 tons per hour, and seven machines working together are said to have completely discharged a cargo of 11 000 tons of iron ore in just under three hours, at a average rate of 525 tons per hour each. Fig. 1 shows four of these appliances at work.

It will be seen that though, in this machine, the weight of the grab and parallel motion are balanced, it involves accelerating and decelerating in hoisting, traversing and returning some hundreds of tons of mechanism, structure and counterweight every 50 or 60 seconds for every 17 tons of material removed from the ship. The success of the machine is indisputable, but the writer is convinced that still greater success awaits other forms of plant.

The Bucket Elevator as Cinderella.

The bucket elevator is the Cinderella of ship-discharging appliances. Its success in its original field was so great that the grab has never been a competitor in the discharge of grain cargoes. Its mechanism

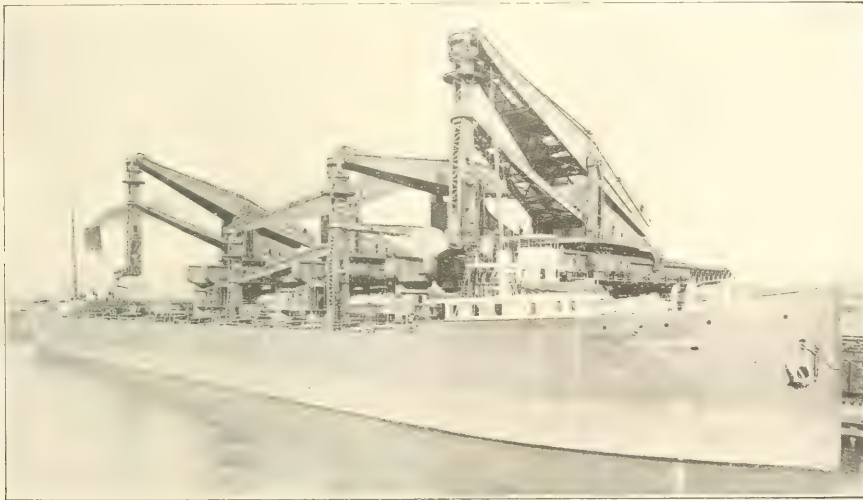


FIG. 1.—HULETT UNLOADER (WELLMAN-SMITH OWEN CO.).

trade will be carried in ships specially adapted for the discharge of particular materials is to look further into the future than is the purpose of this article. For the discharging of ordinary ocean-going vessels the main line of development must be in the improvement of the three existing types of special appliances, namely: (1) The grab; (2) the mechanical or bucket elevator; and (3) the pneumatic elevator.

The Crane and Grab as an Unloading Appliance.

Of these types, the crane and grab, including the numerous forms of transporter and telfer and including also the Hulett unloader, to be referred to later, are the most highly developed, and remarkable feats of rapid unloading have been achieved by their means. It would appear, indeed, that comparatively little room for further improvement in these devices exists; nevertheless, the present writer cannot feel that the future lies with the grab. The engineer, seeking steadily for the ideal mechanism for the purpose, will not rest content with an intermittent action such as the grab necessarily involves, and he will dislike the necessity of hoisting with every load of material an equal or greater load of container.

It is true that this last feature is, in a measure, removed in the case

is simple and efficient, but very little effort has been made to improve it in the direction of enabling the elevator to reach all parts of the hold. The ingenuity of inventors in this field has been mainly directed to improving the means for getting the machine into and out of the ship's hold. As a consequence, the bucket elevator is being driven from its original field by the pneumatic plant and no effort appears to have been made to adapt it to the handling of those materials which the pneumatic plant cannot handle, in spite of the deduction which must be drawn from experience with grain, that once mechanical difficulties are surmounted, the bucket elevator is superior to the grab. That the mechanical difficulties involved in adapting the machine to the handling of such materials as, for example, iron ore are by no means insuperable, is sufficiently evidenced by the fact that greater difficulties of a similar kind have already been overcome in the bucket dredger and the chain bucket excavator. For small coal, bucket elevators have already been used, but not extensively.

How the Elevator may be Improved.

First let us consider the possibility of rendering the machine more effectual as a means of reaching all parts of the hold. Among the devices introduced to enable an elevator to be safely withdrawn from an unloaded ship floating on high water, is the telescopic

* H. J. Smith: "The Mechanical Loading of Ships."

erator (Figs. 2 and 3), the lower portion of which can be telescoped within the upper. When fully extended this lower portion is commonly capable of being canted away from the vertical towards the side of the ship. It has to be pulled away from the vertical by means of ropes or tackles and falls back when released unless resting on the bottom of the hold, but there is no reason why

limits permitted by a spring member in the raising and lowering gear.

It is not necessary here to go into greater detail regarding the design of this machine, to which, however, the writer, recognising that success depends largely on the perfect adaptation of detail, has given a great deal of attention. But imagine the elevator at work.

The driver in his cabin, suspended pendulum-wise near the bottom of the "leg," brings the machine opposite the hold to be discharged; the attendant starts the elevators and conveyors, and the driver sets the leg with its shafts lying athwartships. He then brings it forward and lowers it down on to the mass of ore or coal, as the case may be, close to one corner of the hatch. Once the buckets are in contact with the material he adjusts the position of the secondary balance weight until the buckets are seen to be filling nicely without excessive load on the driving motor, and then slowly traverses the under carriage until the leg reaches the other end of the hatch. He then moves the upper carriage forward the width of the buckets, at the same time turning the leg through 180 deg., and travels back to the end of the hatch from which he started. Repeating this process, he gradually excavates a wide fosse to the bottom of the hold, banked round by material lying under the decks at its natural angle of repose. When he reaches the bottom, the arrangement for adjusting the vertical pressure of the buckets will enable him to scrape the bottom of the hold practically clean. He will then set the elevator with its shafts parallel to the ship's keel, cant up the lower part of the leg, lower until the buckets are again practically scraping the bottom, and drive slowly forward into the bank in the wings, repeating this all round the hold. This process is modified in the after holds on account of the tunnel, but the method is similar.

In carrying out all these movements and adjusting their speed, the driver has the action of the buckets close before his eyes and he can ensure that they are kept full from start to finish, and maximum capacity can be attained throughout—a result impossible with any other form of appliance. From time to time the lip of a bucket may encounter a large lump about its middle, and this may require to be thrust forward or lifted, according to its position. Immediately the bucket meets this obstacle the pressure of the oil in the hydraulic motor will

plunged into a mass of iron ore as it can into a mass of grain; it must operate by scraping the mass as a dredger or excavator does (see Fig. 5), and it will have heavy jarring stresses to meet on encountering a large lump firmly embedded in the mass. Here a ship-discharging elevator has an advantage not possessed by the dredger, for the drive can be applied to the lower sprockets or drums which can engage directly with the buckets so as to relieve the chains of all but the mere elevating load. The development of hydraulic transmission also offers a useful aid to meet this difficulty. A hydraulic drive can be fitted with a proved appliance, which, when unusual resistance is encountered, automatically decreases the speed and increases the torque up to the limit of the strength of the parts without overloading the prime mover; the use of such a device for the purpose in view almost suggests itself.

Special Problems in Ore Unloading.

It will, of course, be obvious that a bucket elevator cannot be plunged into a mass of iron ore as it can into a mass of grain; it must operate by scraping the mass as a dredger or excavator does (see Fig. 5), and it will have heavy jarring stresses to meet on encountering a large lump firmly embedded in the mass. Here a ship-discharging elevator has an advantage not possessed by the dredger, for the drive can be applied to the lower sprockets or drums which can engage directly with the buckets so as to relieve the chains of all but the mere elevating load. The development of hydraulic transmission also offers a useful aid to meet this difficulty. A hydraulic drive can be fitted with a proved appliance, which, when unusual resistance is encountered, automatically decreases the speed and increases the torque up to the limit of the strength of the parts without overloading the prime mover; the use of such a device for the purpose in view almost suggests itself.

The Control Arrangements.

Another point which, in the writer's opinion, might make a very great difference to the practical value of such an elevator—which will be working a great part of its time under the decks of the steamer—is that the movements should all be controlled from a cabin placed near the boot of the elevator, and, amongst the controls within the power of the driver, there should be control of the pressure of the elevator on the mass of material by means, possibly, of a movement of a part of the counterbalance acting within the

rise, and act on a piston, which will reduce the output from the pump and so diminish the speed, while the pressure continues to rise until the obstacle is removed or, in a very extreme case, the machine is stopped, when the lump must be loosened by hand.

It will be noticed that though the balanced parallel motion is similar in appearance to that of the Hulett unloader, it makes only



FIG. 2. PORTABLE TELESCOPIC ELEVATOR (HUNTER SIMON, LTD.).

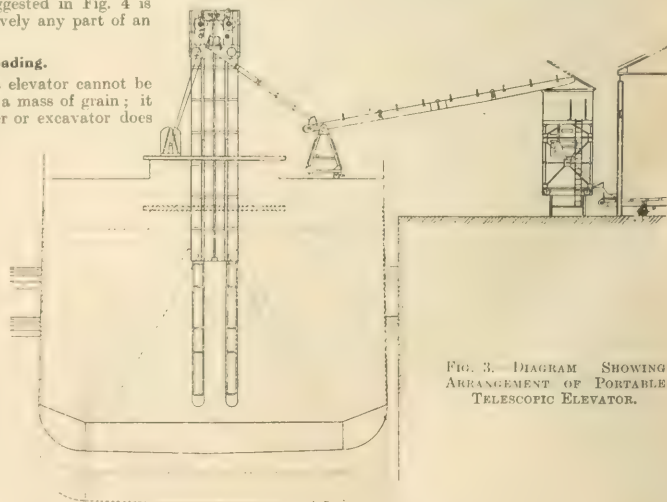


FIG. 3. DIAGRAM SHOWING ARRANGEMENT OF PORTABLE TELESCOPIC ELEVATOR.

small adjusting movements instead of swinging through its whole range at immense speed every minute.

The whole structure is very light in comparison and the cost of the machine would probably not exceed half of that of the other. No spilling of the material on decks and quay can occur, and the output is quite steady throughout. The power consumption will be much smaller than that of any grab type of unloader.

The Pneumatic Elevator.

These are suggestions towards that development of the bucket elevator which the writer looks upon as bound to come in some

The pneumatic plant has now been used successfully for discharging small coal from barges (see Fig. 6), and there is every probability that the near future will see the extension of this system to discharging colliers. It becomes necessary, therefore to consider what improvements are possible in this type of apparatus. In the present writer's opinion there is very little room for improvement in the mechanical efficiency of pneumatic elevators and future development must be in the direction of labour saving. At present even the most modern plants with elaborate electrical gear for raising, lowering, and slewing the pipes, cannot make use of pipes larger than 8 in. in diameter, because the flexible extremity

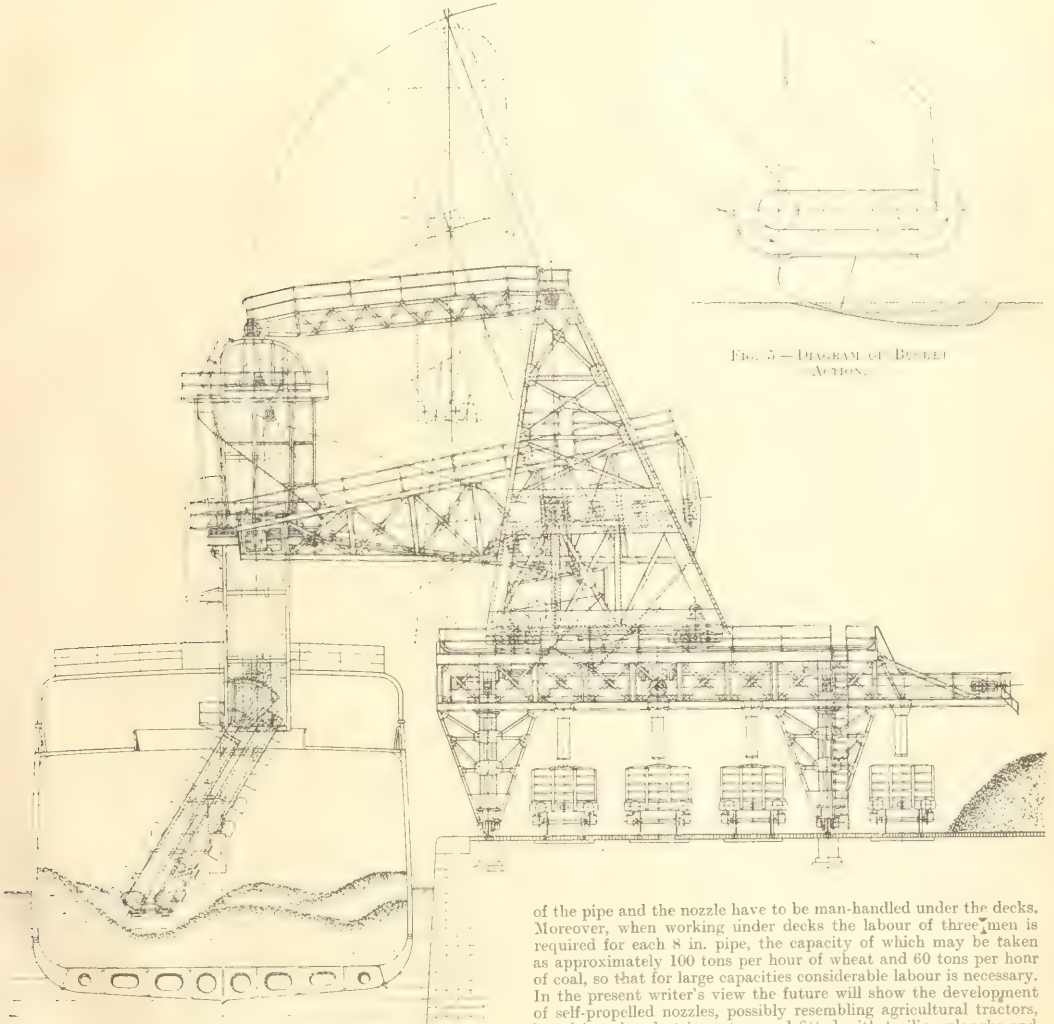


FIG. 4.—NEW TYPE OF ORE AND COAL ELEVATOR.

form or another. Turning now to the third form of plant—the pneumatic elevator—we are faced at the outset with certain marked limitations. In the first place the pneumatic plant is capable of handling only small materials and, secondly, it is very wasteful of power. This latter disadvantage is however, so overbalanced by the advantage of flexibility permitting effective use under decks, in 'tween decks, peaks and bunker-holds, &c., that for grain discharging it is almost universally preferred to the bucket elevator. It is noteworthy, however, that this does not at present apply to the Great Lakes where the form of ship permits the ordinary bucket elevator to be used very efficiently.

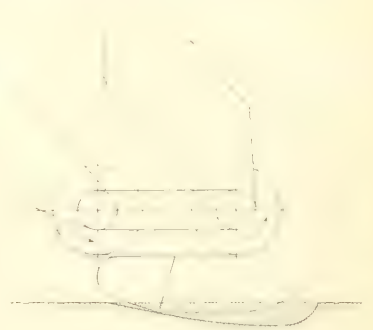


FIG. 5.—DIAGRAM OF BUCKET ACTION.

of the pipe and the nozzle have to be man-handled under the decks. Moreover, when working under decks the labour of three men is required for each 8 in. pipe, the capacity of which may be taken as approximately 100 tons per hour of wheat and 60 tons per hour of coal, so that for large capacities considerable labour is necessary. In the present writer's view the future will show the development of self-propelled nozzles, possibly resembling agricultural tractors, but driven by electric motors and fitted with trailing ploughs and brushes to clean up behind.

A Self-Propelled Suction Nozzle.

Fig. 7 shows a proposal for a pneumatic coal discharging plant on these lines, fitted with a 16 in. pipe. This plant will discharge coal direct to wagons, or to the dump, or it will transfer from the dump to wagons, weighing automatically in all cases. The writer believes that there would be no obstacle to the use of a 24 in. diameter pipe in this way, having a capacity of 1 000 tons of wheat or 600 tons of coal per hour, and manipulated by one man in the hold of the ship.

The self-propelled nozzle will be of advantage even if only an 8 in. pipe is required, and Fig. 8 shows an example of such a small nozzle, rather different in type, which is being constructed at the

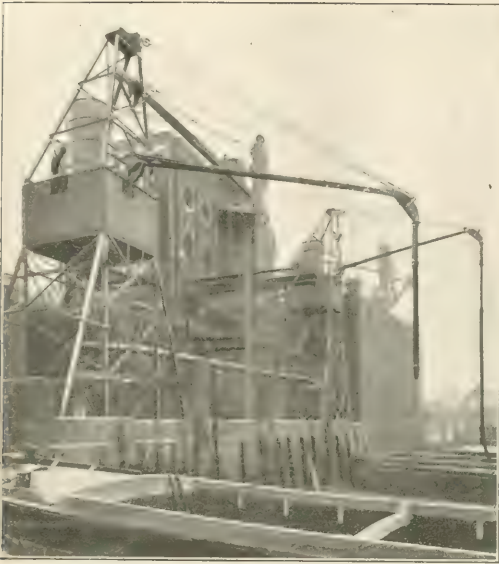


FIG. 6.—PNEUMATIC COAL HANDLING PLANT AT THE CITY OF LONDON ELECTRICITY WORKS.

present time, preliminary experiments having already demonstrated the advantages. The development of this appliance will render the pneumatic plant superior to the bucket elevator, even for the discharge of grain from Lake steamers, where the bucket elevator has hitherto been unapproachable.

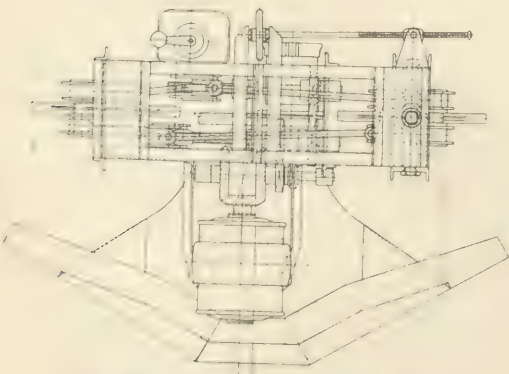
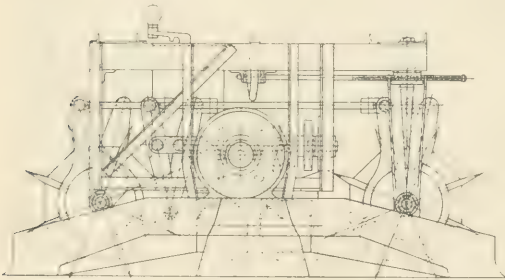
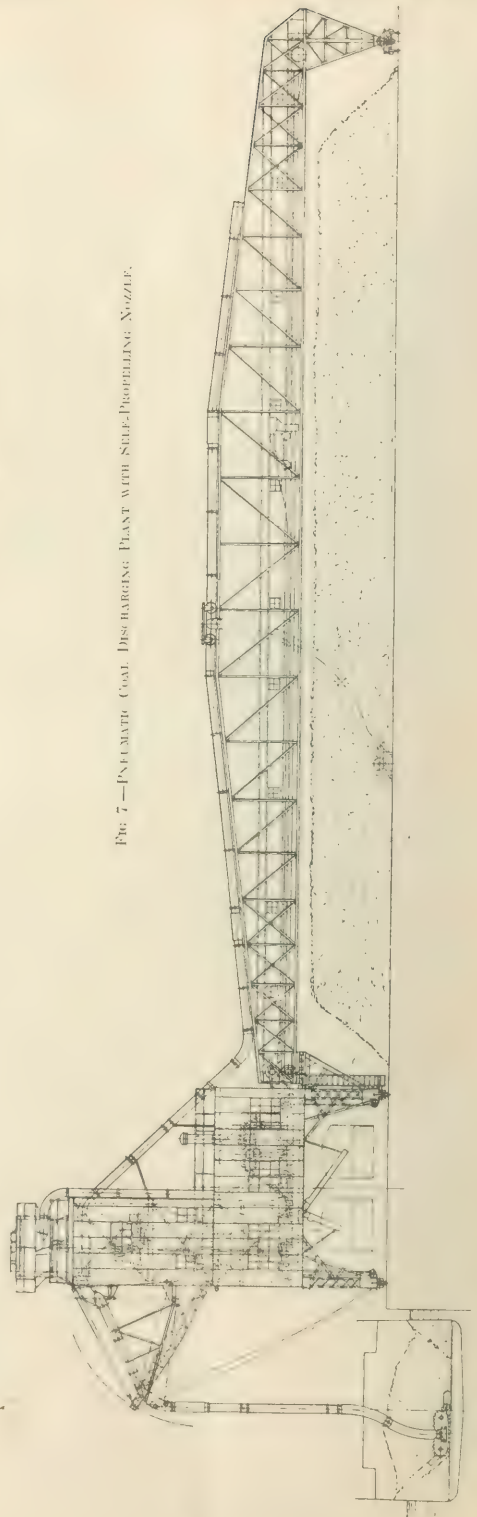


FIG. 8.—SMALL TYPE SELF PROPELLED NOZZLE.

FIG. 7.—PNEUMATIC COAL DISCHARGING PLANT WITH SELF-PROPELLING NOZZLE.



Electrically-Operated Apparatus for Handling Railway "General Goods."

By GEORGE BUTKLEY, A.M.I.Mech.E. (Great Western Railway).

The fundamental difficulty with which the engineer is faced when he wishes to utilize mechanical means for dealing with railway freight traffic is the latter's infinite variety.

A visit to a shell factory in wartime, or the same metamorphosed into a margarine factory in peace time, where the apparatus for handling and conveying the finished product (working so precisely and seemingly almost thinking for itself) may delight his mechanical mind and raise in him the spirit of emulation; but on visiting a railway goods shed the next day, he may be pardoned a feeling of some perplexity when the first rail waggons he sees unloaded disgorge something like the following: Bacon, linoleum, spades, belting, rope, iron gutters, a mailcart, cheese, wire netting, gas fittings, brooms, margarine, a writing-desk, canvas rolls, hand-pumps, bicycle tyres, pulley blocks, paints, trays of jampots, tin ingots, and tubes of various lengths. How can such a medley of stuff be mechanically handled to any precise degree?

The Man and the Horse.

Now the system which has performed the work of conveying general goods between rail wagon and trader ever since the inception of railways still prevails to a very large degree. It is based on the undoubted fact that the only mechanism which can think for itself so as to deal with a stream of such varied freight as the foregoing (and whose complication is increased by some of the articles being fragile) is the human machine—to which has been added a sack truck.

So that across the platforms of all railway goods sheds may be seen a stream of mankind, each individual pushing a sack truck and depositing his load on (or taking it off) a road vehicle, usually drawn by one or two horses. *In one direction, between cartage vehicle and freight train, each man pushes an empty sack truck, save in exceptional cases.*

Here, then, we have that age-old combination, "the man and the horse," dealing with goods which have been (or are to be) hauled by the last word in railway locomotives over a track replete with every scientific signalling and train-controlling device. This is an anomaly, but can it be altered?

This Can be Improved On.

The answer is in the affirmative for, at any rate, a percentage of the work, which percentage a steady application to the problem and constant progress in its solution must improve. When a man pushes a sack truck he is both the brains and the motive power of the appliance he uses. In the future, he must be the brains of the machine only; for other more convenient, more economical and infinitely more powerful motive power is now available.

Here, at the outset, it may be said that until the development of electrical apparatus (and the advent of the petrol engine) little or no progress could be made from the "man and horse" proposition. Railway engineers of past generations used to erect avenues of fixed hand-worked jib cranes along shed platforms. When there was something too cumbersome for even a number of men to prize out of or into the wagon, and the latter happened to be within the radius of the crane, or a shunting engine was handy to move the whole train conveniently for it—then the crane would be employed; but more often they were used to hang hats and coats on, or were buried beneath piles of "wait-order" goods. In some few cases hand-cranes were installed which could travel to their load, but the travelling was by hand-power and they were seldom moved.

With the development of the electric motor, however, the aspect has changed. It is true that the first step was to merely substitute for the avenues of fixed hand-cranes similar rows of fixed electric ones, which, in the main, represented a capital outlay which did not earn its living, because it is a lengthy process to find an available shunting engine from the yard and push or pull a whole train in order to get one wagon of it under a fixed crane. Moreover, this shunting is also a dangerous and time-wasting proceeding; because the hinged doors of the waggons will be lying back on the shed platform (see Fig. 1), and will sweep along it when the train is moved. So all concerned must cease work and stand back.

The Basic Principle in Goods Handling.

The now recognized principle on which is based the provision of any kind of apparatus for dealing with railway goods is that it must be mobile and able to travel to and from any rail wagon or cartage vehicle concerned. The first effect of this principle has been the special development of the overhead travelling gantry-crane, having an underslung swivelling jib carried on its cross-traveller.

Such cranes are now usually installed so as to span the rail tracks between two shed platforms, the platforms themselves and (the swivelling jib being made of such a radius that it can be poked between the shed roof columns) and also to plumb cartage vehicles standing in the adjacent roadway (Fig. 1).

For yard-working, the same basic principle is followed; but whereas the shed columns form a convenient support for the overhead crane tracks, this arrangement would necessitate the erection of a double row of special crane columns if such cranes were installed for yard working. What is known as a "Goliath" crane has therefore been developed, in which the whole structure travels longitudinally along rails which are laid at ground level. An objection to this type of crane is that it must be, by its nature, somewhat cumbersome and slow in travel. The possibilities of a more agile substitute for it will be dealt with later. It is at once obvious that arrangements of mobile overhead cranes such as are described above avoid a lot of shunting, and this is one of the principal aims and objects in providing machinery to deal with railway goods.

Limitations of the Overhead Gantry Crane.

An inherent limitation of the overhead travelling crane of the gantry type is that it can only make one lift from a train of waggons at one time. In doing this, however, it occupies the whole cross



FIG. 1.—1-TON OVERHEAD TRAVELLING GANTRY-CRANE WITH UNDERSLUNG SWIVELLING JIB (BARROCK & WILSON, LTD.) AT G.W.R. GOODS DEPOT, CARDIFF.

space between its carrying rails and blocks the way of another crane. In very long sheds or yards, two such cranes are sometimes provided in series, but any greater number would be likely seriously to interfere with each other's movements. Even with two such cranes it is impossible to make two diagonal movements from end to end of a shed or yard at the same time.

Before considering the problem of providing hoisting and carrying apparatus which might accomplish more rapid loading or unloading of a train, it is advisable again to bear in mind the miscellaneous nature of railway general goods. The most rapid and mobile crane made or conceived can, when provided with a hook and sling only, deal with but one article at a time, except in the case of barrels or such-like handy things which can be readily bunched together in the sling. Were every article in a trainload individually dealt with by an overhead travelling crane, the day's work of a goods shed or yard could never be got through.

We therefore come down to the alternative of dealing with the bulk of goods (which are generally of a manageable size) either individually or in twos and threes by men with sack trucks; or by the use of some kind of containers or trays, which can themselves be craned or otherwise mechanically placed in or removed from the rail waggons; together with the use of such types of mechanical

appliances as afford sufficient area of loading and conveying surfaces to accommodate mixed articles and packages of various classes.

Scope of Containers and Trays.

Containers are a very fascinating proposition and, where such traffics as butter, baskets of fruit, &c., are passing, can be very beneficially employed and undoubtedly save both labour in handling *en route*, and also claims for damaged goods. Containers are not, however, the universal panacea for all railway transport difficulties that some of their advocates would have us believe, and can indeed only be used to a limited extent so long as the practice of traders in Great Britain remains what it is—i.e., the forwarding of small consignments only of one class of article or package. Also there are of necessity a great variety of articles which can be economically and snugly stowed away in an open waggon and sheeted, but which could not be conveniently got into a rigid container.

Trays of various sorts seem to offer more general scope than containers, especially if they could be fitted with small wheels or sunk rollers, so that they would be easily movable under load for stowing, &c.; or if they were constructed with suitable bases, to use in connection with jack-trucks. Here again, as with containers, a very large outlay would be involved in an attempt to deal with a large proportion of mixed traffic by this means, and it might possibly be justified. It appears to be largely a matter of common sense aided by numerous practical experiments. While certain traffic is obviously suitable for containers or trays, an attempt



FIG. 2. MONO-RAIL TELPHER RIDING ON TRAVELLING GANTRY (HERBERT MORRIS, LTD.).

to force such a system on railways as a whole would be very much a leap in the dark and largely against reason. What is needed is that every possible opportunity of utilizing containers and the like shall be experimentally exploited, when the knowledge so gained would without doubt enable the scope of such appliances to be gradually extended.

Eliminating the Human Load-Carrier.

In the writer's opinion the widest field for improvement offers in connection with the transfer of general goods between rail wagon and cartage vehicle. If such goods could be mechanically conveyed between these points of their journey at both sending and receiving stations, the human machine being only employed on such actual loading and unloading at the vehicles in question and doing no trolleying by hand-power between them as now—a very substantial saving in labour costs per ton handled, with a resultant and corresponding increase in the speed of working and tons handled per working day, would certainly accrue.

The Electric Platform Truck.

One of the most useful mechanical appliances that have been recently developed is undoubtedly the electric platform truck. These little vehicles are now made of from $\frac{1}{2}$ to 2 tons carrying capacities, while the area of their load platforms is such that any type of packages or article can be carried by them or drawn behind them in suitable trailers. On the passenger platforms of large termini they have already come to stay and are invaluable for dealing with the parcels traffic carried by passenger trains. On the narrow platforms of a goods shed their scope is not at first so obvious, though their usefulness there can certainly be extended if the right size and type of truck is developed and all concerned co-

operate in organizing their efficient use. These trucks are made in great variety of forms on some of which a self-contained electric jib crane can be fitted.

For certain work, noticeably that of loading and unloading steamships, these trucks present the last word, and for such service the jack-truck variety is the most useful. With this type each truck serves a number of bridge-section trays, which can be loaded in the quayside warehouses or in the vessel's holds; the electric trucks pick them up and convey them between the warehouses or other points and the ship's side, where either the quay cranes or the vessel's derricks transfer them between shore and ship.

The writer recently watched a ship being unloaded; her forward holds were served by electric jack-trucks and their trays, and fourteen men were employed; the after-holds were dealt with by net slings delivering to men with sack trucks, and required thirty-nine men. Both ends of the ship were unloading the same class of traffic.

Advances in Crane Design.

In connection with craning the trays which these jack-trucks handle, or for transferring loads slung in netting, a great advance on the original type of derricking jib crane has been achieved of recent years by the invention of the level-luffing jib crane as standard equipment for harbour and dock quays. There are several designs of this type of crane.

These level-luffing cranes, by reason of their balanced mechanism, whereby a harmonic movement of the jib and of its top mechanism cause a load to be horizontally traversed, consume very little electrical energy—about one-twentieth of that required to manipulate the jib and slew a crane having a derricking jib—while the traversing is accomplished at a much greater speed.

There seems no reason why level-luffing jib cranes of this type cannot be advantageously utilized for handling certain railway traffics, apart from harbour work—notably, by providing a more agile, faster and more economical mechanism for yard working than the somewhat cumbersome "Goliath" crane. It might even be feasible to provide an open steel structure running down the centre of a busy yard, whereby two such cranes could operate on the same trains of goods waggons, the rail-track of one crane passing completely above the second one.

Mechanical Apparatus the only Economical Method.

Where a traffic is of a constant nature and is passing regularly in large quantities, mechanical apparatus offers what is at the present day the only economical method of handling, and no railway can afford to go on handling such traffics by hand-power in the old way.

A case in point was a canal basin and goods shed adjoining several large metal-workers' premises whose traffic consisted of non-ferrous ingots, spelter, strip and bar-iron, and tubes. The original nineteenth-century apparatus for handling this traffic consisted of two fixed 2-ton hand-operated jib cranes, into the radius of which all barges and rail waggons which contained traffic too heavy for man-handling were brought. Both barges and waggons were consequently badly delayed as the traffic grew, and mechanical apparatus was clearly called for.

The two old 2-ton cranes were removed and a steel structure built on which were mounted two 2-ton electrically-operated travelling gantry cranes, each with an underslung revolving jib (as shown in Fig. 1). These two new overhead cranes can each travel along and traverse over a considerable area of canal basin as well as over several rail tracks.

Traffic Increase by Electric Working.

The result of the conversion from hand to electric handling was an instantaneous success; the traffic handled increasing 57 per cent. during the following two years, while the cost per ton of handling it decreased 25 per cent. on the same wages basis. Did the traffic consist of a less percentage of non-ferrous metals, the addition of lifting magnets to the cranes would bring about a still further economy in working.

There seems no doubt but that in districts where ferrous metals and their scrap bulk large in the railway traffics handled, and electric current is readily available, considerable economies can be realised by fitting old hand-cranes with electric motors and hanging lifting magnets from their hooks.

The Mono-Rail Electric Telfer.

For both shed and yard-working the mono-rail electric telfer offers some special advantages which are not obtainable by travelling overhead gantry cranes, useful and comprehensive as the working of these can be made in skilled and interested hands, and where they are fitted with underslung swivelling jibs. Telfers, by reason of their mono-rail tracks and consequent design, can travel round sharp curvatures, run off one travelling gantry across a shed or

yard, and get on to another gantry—in short, go anywhere (Figs. 2 and 3); while a travelling gantry crane must needs travel up and down over its own longitudinal area only, and can only make one lift at a time in that area. Its more agile contemporary, the telfer, on the other hand, can be here, there and everywhere; while a number of telfers can work at the same time over an area if their mono-rail be suitably track-circuited to provide a safety-space interval, and convenient passing loops, &c., are provided. In a goods shed this would also mean that the same telfers employed over "inwards" trains in the morning could work over "outwards" trains in another part of the shed during the afternoon and evening, and no machinery would stand idle.

The principal obstacles to comprehensive telfer installations for railway work are, (a) the cost of providing a roof structure strong enough to carry them and their loads, and (b) their limitation, as usually designed, in being able to only plumb a point directly beneath them. As regards (a), it has been practically demonstrated that telfer tracks capable of carrying 2 ton telfers can be safely slung from ground supports in the shape of a question mark (?), and which take up no more floor or ground space than a lamppost. To meet difficulty (b), telfers have been constructed which have short swivelling jibs and which are free to balance at their own natural angle, when loaded, on the mono-rail carrying them; also telfer engineers have under consideration schemes whereby the tipping action of such jib telfers would be taken care of by a

termini. The result is a flexible six-wheeled combination which is, in effect, a "mechanical horse and cart."

Bringing the Power to the Freight.

There seems little doubt but that this century will see the gradual demise of many of the older mechanical systems and their replacement by constantly improved and refined electrically-operated ones. Had storage battery progress kept pace with that of the line transmission of current we should probably be even further along this road now than we already are.

For handling railway traffic in sheds, yards and at ports, electricity's only rival is hydraulic power, the weak point of which is the non-flexibility of the pipe line as compared with the means by which electric current can be transmitted to a moving piece of apparatus such as a crane.

The slogan for the designer of any type of mechanism for dealing with railway traffic must be: "*Bring the power to the freight and not the freight to the power.*" And that spells Electricity.

The "Brooklite" Lighting Plant.

The illustration given below shows the 1 kW "Brooklite" self-contained electric light and power plant for yachts, bungalows and country houses, the latest production of J. W. BROOKE & COMPANY, of Levestoft. The firm were urged to design this plant at the request of some of their foreign agents, who informed them that several of the American plants which were on the market were not giving satisfactory results. To compete, however, they would have to produce a very efficient and reliable little plant, and it would be necessary to produce this at a price which would compare favourably with the American prices. They set to work twelve months ago to manufacture this plant, and they have now got it, to all intents and purposes, perfect; in fact, they would not place it on the market until it had reached this point. The tests have all been of a very exhaustive nature, and any little troubles that originally occurred have been entirely eliminated.

Specification.

The engine is of the two-stroke type, developing 2 H.P., at a speed of 900 revs. per min., water cooled, and direct coupled to a dynamo through a flexible coupling. It is controlled by an efficient governor, which is totally enclosed, and acts directly on the throttle. Ignition is by high-tension British-made magneto, and the petrol is induced through a special Brooke carburettor. The dynamo has



FIG. 3.—MONO RAIL TELFER (SHOWN IN FIG. 2 LEAVING TRAVELLING GANTRY AND ABOUT TO CROSS BUILDING.

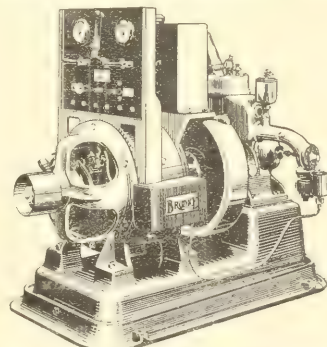
horizontal roller located at the apex of a vertical arm and running in an inverted channel laid along immediately above the telfer-carrying rail.

Road Cartage Problems.

Coming now to the road cartage of general goods as between railway goods centre and the trader (and *vice versa*), electric road vehicles are certainly increasing in favour and usefulness, one railway company even using them to the exclusion of all other types of motor vehicle. Generally speaking, however, the petrol lorry is more useful as a medium between a rail depot and such traders whose premises are some distance away, or whose traffic is most economically carted at as high a road speed as the legal limit allows, and which an electric vehicle of the same carrying capacity cannot attain.

Within the economic limits of their battery capacity and average road speed, electric lorries have a widening future; they also offer real advantages in that, for a given length of load-carrying platform, an electric is a much shorter vehicle over all than either a petrol or steam one of similar carrying capacity, and this feature counts when manœuvring in a goods depot yard packed with road vehicles; also the simple and inexpensive mechanism of an electric lorry results in their repair and maintenance being a much simpler matter than any other type of road vehicle. If only some genius would come along and give us the long-looked-for light, cheap storage battery of improved mileage capacity, the electric lorry would be hard to beat.

A type of electric road vehicle combination lately developed consists of an electric tractor with a short fixed wheelbase, while the two-wheeled trailer has its front end resting over and centrally pivoted above the rear wheels of the tractor and can accommodate a large bulk load, such as railways transfer traffic between large



VIEW OF 1 KW "BROOKLITE" LIGHTING PLANT.

a capacity of 1 kW, with a voltage of 25 V. It is shunt wound, but fitted with series coils, enabling the engine to be started up from the battery. The shaft is slightly extended, and fitted with a pulley for driving other plant, such as pumps, churns, chaff cutters, &c.

In designing the switch board, simplicity of construction and operation has been the predominant consideration, and the electrical complication of some of the American plants has been entirely eliminated. The enamelled slate board, which it will be noted is mounted over the dynamo, is very plainly marked with permanent ivory labels, so that it is not possible for any mistake to be made either in coupling up or operating, and an automatic cut-out is provided, so that in the event of the engine stopping, the battery will not discharge through the dynamo. Should the engine be required for charging whilst light is being taken from the battery, a special arrangement is provided whereby the lighting is run off twelve cells only whilst the engine is charging the whole of the thirteen cells. Excessive voltage on the lamps is, therefore, avoided, with consequent economy. Owing to the high efficiency of the engine and dynamo, fairly large batteries are considered advisable, and the firm recommend batteries of 180 Ah. These batteries will comfortably run twenty-five 20 W lamps for twelve hours continuously. J. W. BROOKE & COMPANY, LTD., 10, LEVESTOFT, LONDON, E.C. 1.

Electrically-Equipped Railway Truck Tippers.

By E. H. ROUSHAM.

The mechanical handling of railway mineral wagons at the point of discharge has of recent years received considerable attention from engineers engaged in the transport problem of the great output from our mines, and the progress made forms an interesting and valuable factor in our efforts towards industrial efficiency. The apparent lack of enterprise shown by our engineers in the past is frequently alluded to in somewhat unflattering terms, especially when comparisons are drawn between the coal-handling plants in this country

hundreds of tons of coal per week at one point was a task demanding an efficiency and rapidity which could only be obtained by mechanical means. In the spring of 1912 arose another factor affecting power-houses, both large and small, throughout the country. The miners laid down their tools and the mines stood idle while the wheels of industry slowed down. A recurrence of the trouble in the present year found a great many of our concerns prepared and the lesson of 1912 well learnt, while others, without any reserves of coal to fall back upon, were compelled to shut down within a few days. The industrial unrest has therefore had a definite influence on the design of recent coal-handling plants, and, where circumstances permit, the arrangement most favoured is the installation of a coal store encircled by a conveyor and so disposed as to form a floating reserve for stock or current use.

The advantages of such a scheme are that coal for firing may be drawn either direct from the wagons at the unloading point or from the store. Alternatively, the coal on arrival at the siding may be deposited by the conveyor either into the hoppers above the boilers or retorts or direct into the store. It will thus be seen that a stock maintained at a given minimum, but being constantly drawn upon and added to, is practically immune from serious fire by spontaneous combustion and free from deterioration by loss of hydrogen, which occurs in stocks set down for use in emergency and which may be undisturbed for years. A detailed description of such a plant is, however, beyond the scope of this article, which is limited to describing the principles and application of railway truck tippers which now form an essential unit in all such modern coal-handling equipment.

The class of wagon-tipping plant generally adopted in this country for discharging at rail level may be divided into two types:

- (1) The ram type, styled a tipper, designed to raise one end of the wagon and discharge through the end door.
- (2) The cage type, or tippler, which empties the wagon by partial or complete inversion.

Electric Tipping Rams.

In Fig. 1 is shown in detail the electric tipping ram manufactured by Babcock & Wilcox, Ltd., to suit British standard wagons, and in Figs. 2 and 3 alternative arrangements of the rams in relation to the receiving hopper. It will be observed from Fig. 1 that it is necessary for the wagons to be of the end-door type, and, further, that they must enter the siding with the end door foremost unless facilities are provided for turning the wagon round as in Fig. 3, or a duplicate set of rams is installed as indicated in Fig. 2, for tipping in either direction. It should also be noted that while little difficulty exists in arranging for coal to be delivered in end-door wagons, it is rarely possible to ensure the wagons entering the siding with the end door foremost. If a turntable already exists in the siding a single type ram (Fig. 1) is all that is necessary, but

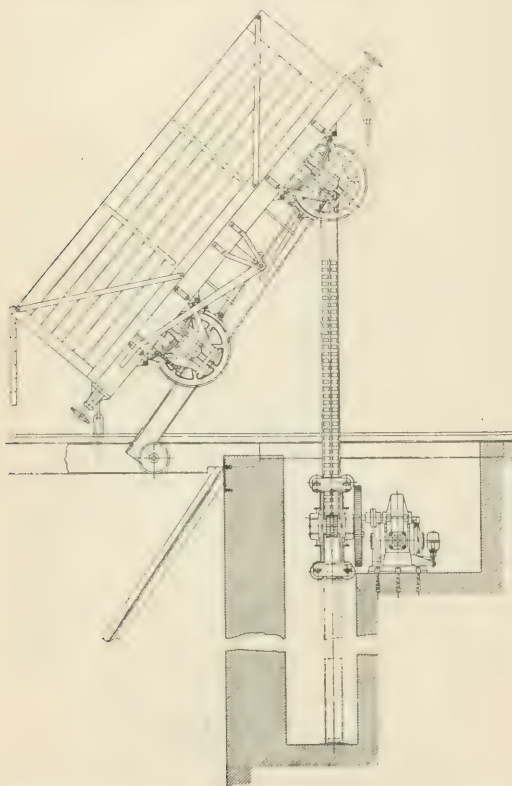


FIG. 1.—BABCOCK & WILCOX ELECTRIC TIPPING RAM WITH CRADLE.

and the ambitious schemes that are typical in the United States. This attitude, however, is rather ungenerous, as it has not been a case of indifference or neglect on our part.

Two Different Sets of Conditions.

It must, in fact, be realised that the fine mechanical plants to be found in the industrial centres of America are the logical result of their geographical position in relation to their sources of supply, for if a comparison is made of the coal areas of the two countries, it will become obvious that our coal-consuming industries lie relatively at the pit-head while those of the United States are frequently at remote distances. Again, the elaborate and expensive truck tippers characteristic of the United States are rarely met with in this country, because the average capacity of British railway wagons happens to be but one-fourth of those in use on the American railway systems. Assured of a continuity of supply to meet current demands, our consumers were able to limit their coal stocks to cover a few days only and man-handle the low-capacity wagons on arrival.

Electricity Supply as a Factor.

The last two decades, however, have brought other factors into consideration. With the growing demand of power users for electricity in bulk, and the subsequent tendency to centralise our generating stations, it was found that the unloading of many

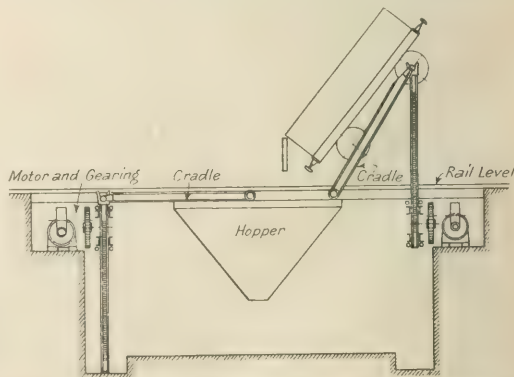


FIG. 2.—ARRANGEMENT OF BABCOCK & WILCOX ELECTRIC TIPPING RAMS IN DUPLICATE.

if there are no convenient means of reversing a wagon a turntable should be provided, arranged for preference in conjunction with the ram (Fig. 3). The alternative scheme, shown in Fig. 2, of a duplicate set of rams is the more rapid and convenient method of meeting this difficulty of the end doors, as a wagon can at once be placed in

position over the receiving hopper irrespective of the position of its end door.

The B. & W. Tipping Ram.

The Babcock & Wilcox tipping ram (Fig. 1) comprises a rolled steel joist held rigidly in position laterally by roller guides, the vertical movement being obtained by means of a specially designed rack engaging with the driving pinions. Mounted on a common bedplate in the covered pit is a reversible motor with worm reducing gear and a magnetic brake. This brake is arranged to come into play at the discretion of the attendant and brings the ram almost instantly to a standstill at any intermediate position of its stroke. It is, however, primarily designed to operate automatically by top and bottom self-replacing limit switches, which are fixed in a suitable position and determine the limit of the ram's stroke in either direction. When running on a d.c. circuit, a series wound motor has a tendency to race on the return stroke of the ram, in which case the attendant would bring into action the magnetic brake should the speed become excessive, but it is preferable to provide a controller designed to prevent such racing, or to install a motor suitably wound but capable of starting up against full load. For an a.c. circuit, the slip-ring type of motor is used in order to meet the initial full-load torque, while the synchronous speed of the motor prevents undue acceleration on the part of the ram on its return stroke. After leaving the slow-speed shaft of the worm reduction gear, the power is transmitted through one train only of spur gearing before reaching the driving pinions mentioned above as engaging with the rack.

Power Requirements.

The power allowed for in the design of gearing varies from 15 H.P. upwards according to the gross weight of the wagons to be handled, and a speed reduction is effected to give a movement of about 12 ft.

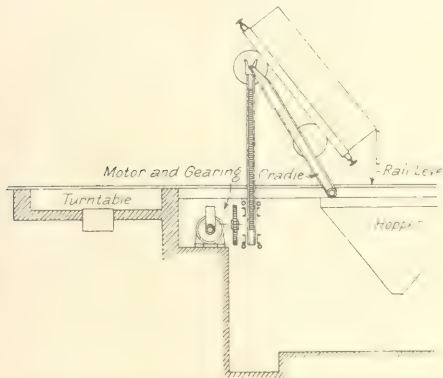


FIG. 3.—ARRANGEMENT OF BABCOCK & WILCOX ELECTRIC TIPPING RAM WITH TURNTABLE.

per min. on the ram. At the head of the ram is a massive cast-iron crutch engaging the rear axle of the wagon, to which is pivoted one end of a mild steel "cradle." It will be noticed from Fig. 1 that the effect of this "cradle" is to lift the forward axle a distance of 2 or 3 ft. and thus provide an effective clearance between the rails and the forward buffers. If the cradle is omitted, the maximum angle to which the wagon can be tipped is insufficient to effect a clean discharge of its contents, and hand-trimming must be resorted to. The speed at which the wagons are handled naturally depends on the disposition of the siding and the rate at which the wagons can be fed to the ram, but an average of ten to twelve trucks per hour is generally obtained, giving a total capacity of 120 to 150 tons per hour.

Another Type of Tipper.

Another end-door tipping ram of approximately the same capacity is that manufactured by Ed. Bennis & Company, Ltd., and illustrated in Fig. 4. It differs from the "Babcock" type in several features, the most noticeable of which is the arrangement whereby the ram follows the are prescribed by the rear axle of the wagon. The ram itself is a solid steel round bar, having a screw thread cut thereon throughout its entire length. Power is transmitted from the motor or adjacent line shafting, first through a single train of spur gearing, and thence through a gear box containing a worm and worm wheel running in an oil bath. The worm wheel, which lies in a plane perpendicular to the ram, has its centre bored and threaded to correspond to the screw thread on the ram, and the vertical lift is effected by the revolutions of the worm wheel upon its thrust bearing in the gear box. The secondary movement of the ram, which takes

place simultaneously with the lift, is provided for by mounting the whole, with its gear box, upon trunnions, thus leaving the ram free to follow the course prescribed for it by the wagon axle.

Overhead Winch Type.

An important departure in principle from the ram-type tipplers above described is illustrated in Fig. 5, which consists of an electric

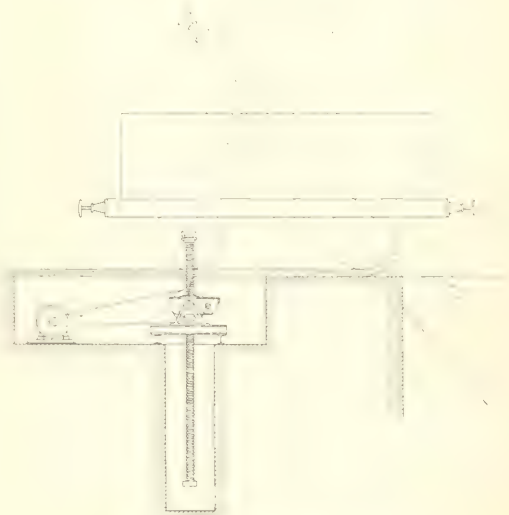


FIG. 4.—BENNIS ELECTRIC END TRUCK TIPPER

winch with winding drum and wire rope, housed in a position above the wagon. This arrangement is only recommended where local conditions, such as the presence of water, places a limit on the depth of excavations, or where advantage may be taken of an existing overhead structure to accommodate the hoisting winch.

Hydraulic Tipping Rams.

Hydraulic power for the operation of tipping rams is frequently employed where high-pressure mains exist in the vicinity of the unloading point, and, even if the normal town pressure only is available, a storage tank with hydraulic pressure-pump may be installed as

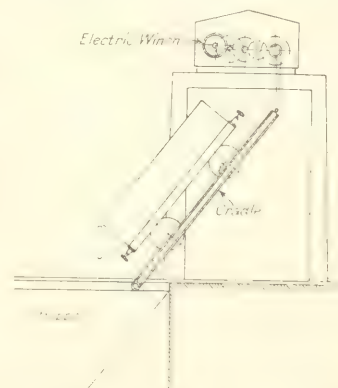


FIG. 5.—OVERHEAD ELECTRIC WINCH WITH CRADLE

an accessory to the tipper where circumstances favour the use of water-power. From Fig. 6, illustrating a typical hydraulic ram, it will be seen that no change in principle is involved. A cast-iron ram contained within a cylinder is rigidly supported on cross bearers in the pit, and a single ported piston valve with hand-lever placed in a convenient position adjacent to the tipper. Two pipes for inlet

and exhaust are led to the control valve, and one pipe only from the valve to the ram, as pressure for exhaust is provided by the dead weight of the lifted wagon. The ram is fitted at the head with a crutch similar to the electric type shown in Fig. 1, and may be

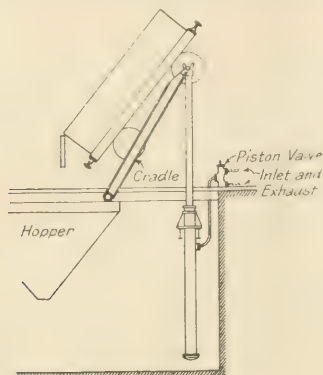


FIG. 6.—HYDRAULIC RAM WITH CRADLE.

arranged to give either a direct vertical lift or be suspended on trunnions in order to conform with the arc described by the wagon axle.

Special Types of Tipplers.

Although the types above described and illustrated are those most commonly employed where end-truck tipping is permissible, there exist other devices designed to effect economy in power by lowering the forward end of the wagon instead of raising the rear end, or alternatively of lowering the forward end and raising the rear simultaneously on a balanced platform. In the former type the interesting feature is the arrangement whereby the emptied wagon may be lifted to its normal position by the energy stored through the depression of the loaded wagon. Its use, however, is not general, owing to the excessive excavation required, and is therefore limited to cases where advantage may be taken of the elevated position of the siding. The "balanced platform" type, which is operated electrically through quadrant and pinion, requires a minimum of power to operate, but is also at a disadvantage owing to the amount of excavation necessary.

Electric Rotary Tipplers.

Although the types of wagon tipplers above described have a very wide application and cover most of the required conditions,

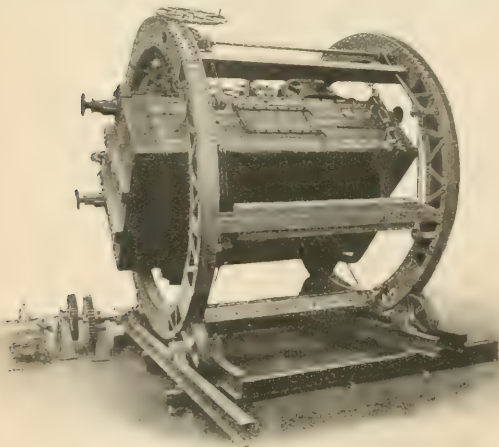


FIG. 7.—VIEW OF THE BABCOCK & WILCOX ROTARY TIPPLER.

it must be remembered that each is limited to the handling of end-door wagons only. The selection of a suitable type of tipper must therefore depend primarily upon the certainty or otherwise of

obtaining deliveries in wagons having end doors, and, if this condition cannot be assured, it will be preferable to install a rotary wagon tippler. This equipment is wider and more elastic in its scope than the end-tipping type, and is capable of handling all classes of open mineral wagons without regard to the position or the existence of end doors.

Fig. 7 gives a clear idea of the Babcock & Wilcox type of rotary tippler, and shows the clamped wagon inverted to its tipping position. It will be seen that the cage comprises two mild steel rings of built-up section, suitably stiffened longitudinally and carrying rail bearers with rails extended to the outside faces of the rings. The rotary movement is obtained by friction only between the surface of the rings and the four roller bearers, two of which are seen to be idle and the other two mounted on a common driving shaft. The driving gear is almost identical with the gear described for the electric tipping ram, Fig. 1, with the exception that no magnetic brake is necessary, and the power required is considerably less owing to the centre of gravity of the loaded wagon coinciding approximately with the centre of the rings. Consideration must be given in selecting a suitable tippler as to whether or not locomotives would have to pass the unloading point, as this fact will influence the diameter of the rings, although in the case of Bennis's

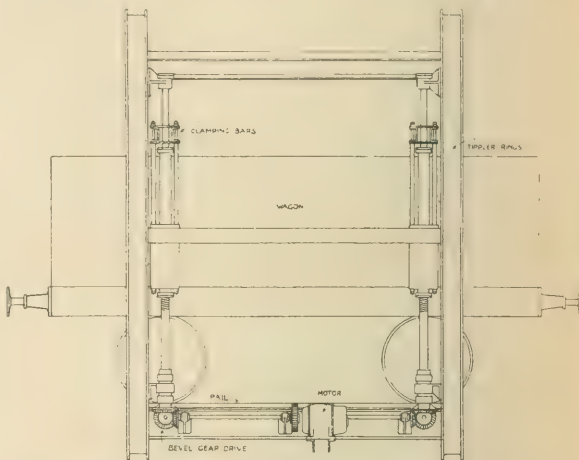


FIG. 8.—SIDE ELEVATION OF BABCOCK & WILCOX ELECTRICALLY CLAMPED TIPPLER.

design, which is similar in principle to that above described, the tippler is made in halves if required, with facilities for easy removal of the top half.

Clamping Methods.

A wide diversity of method exists in the arrangement for clamping the loaded wagon within the tippler rings, the choice of which is determined by local conditions and the rapidity required in handling the wagons. The following is a brief description of the various clamping methods employed in rotary tipplers.

A type of hand clamping gear is indicated in Fig. 7, the wagon being clamped in position by a few turns of the hand wheel, which lowers by means of wire ropes the clamping bars fitted with hardwood pads to engage the wagon top. A light compression only is required to hold the wagon rigid, and this is effected by screwing up the turnbuckles attached to the clamping chains.

A very distinct advance in tippler design was marked by the introduction of electric clamping. It is far more rapid in action than hand clamping, and the labour involved is reduced to a minimum.

Fig 8 shows a side elevation of the Babcock & Wilcox patent electrically clamped tippler. A small reversible motor with spur reduction gear is housed against one of the rail bearers within the tippler rings, and power is transmitted through bevel gearing to four vertical shafts having a screw thread cut thereon for lowering or raising the clamping bars. The motor is automatically cut out by limit switches immediately the requisite pressure is brought to bear on the wagon top or, when running in the opposite direction, as soon as the clamping bars are raised sufficiently to clear the wagon.

Both hydraulic and pneumatic clamping have been adopted with considerable success where local conditions are favourable to their

use. A little less rapid in their action, perhaps, than electric clamping, they possess a flexibility which allows them to adapt themselves to wagons where spring defects have made the top uneven. A half-end elevation of a tippler fitted with hydraulic clamping gear is shown in Fig. 9.

Automatic Clamping Gear.

Considerable attention is being given to the development of automatic clamping gear in tippler design, and future progress will almost inevitably be in this direction. In each of the types previously described the action of clamping and inversion is separate and distinct, whereas in automatic clamping the aim is to embody these into one operation. The problem presents many difficulties, and a number of ingenious designs have been put forward and patented by firms specialising in the handling of materials. A diagram showing the principal features of Spencer & Company's patent tippler with automatic locking gear is given in Fig. 10, and a

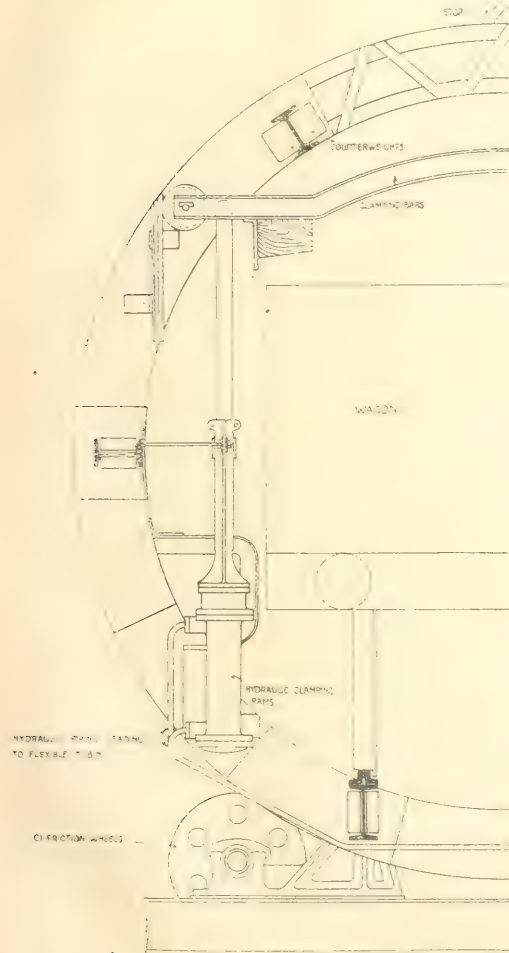


FIG. 9.—ELEVATION OF TIPPLER FITTED WITH HYDRAULIC CLAMPING GEAR.

brief description of its operation is as follows: The platform carrying the track rail within the tippler rings is supported on rollers which permit of a slight lateral movement as the tippler commences to revolve with the object of bringing the side of the wagon into contact with the cushions, and thus providing an effective support during the process of inversion. A secondary movement takes place simultaneously, which permits the clamping bars to descend and rest first on one side of the wagon and subsequently on both sides, so that, in effect, the wagon wraps about itself the clamping

gear during the process of tipping. When the tippler is in its normal position these clamping bars are suspended clear of the wagon by links and a lever at one end, and by a wire rope with counterweight at the other. It will be seen from the diagram in Fig. 10 that the balance weight automatically increases to compensate for the

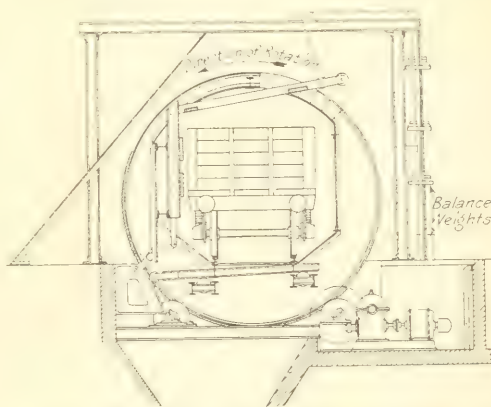


FIG. 10.—SPENCER'S PATENT TIPPLER WITH AUTOMATIC LOCKING GEAR.

increasing load thrown upon the clamping bars by the wagon in the process of tipping.

The varying widths and heights of our mineral wagons; the dispositions of their end doors; the necessity for the utmost economy and rapidity in unloading and releasing the wagons, are all factors which point to a plant embodying the principles of automatic control as being the nearest approach to the ideal, and it is in this direction that efforts are being directed.

In conclusion, the writer desires gratefully to acknowledge the assistance rendered him in the preparation of this article by Babcock & Wilcox, Ltd., Spencer & Company, Ltd., and Ed. Bennis & Company, Ltd.

Panama Radio-Communication System.

FROM THE "Panama Canal Record" we learn that the system of RADIO COMMUNICATION operated by the Navy Department on the Panama Canal zone stations. The only other named station on the isthmus is that of the United Fruit Company at Almirante, which has been specially licensed to operate. The laws of Panama and the Canal zone restrict radio operations to the control of the United States. The Navy stations consist of the high-power station at Panama, the stations at Balboa and Colon, at the two ends of the Canal; a station at Coco Solo, primarily for naval use in local operations; and three outlying stations—at Punta Mala, on the Western side of the entrance to the Gulf of Panama; at La Palma, diagonally opposite, on the Bay of San Miguel; and at Puerto Obaldia, on the Atlantic coast, about two miles from the border of Colombia. In present practice the Darien and Balboa stations are operated together, practically as one station. Messages are received at Balboa, but not at Darien; and all sending from Balboa is done through the Darien station. Outgoing messages are telegraphed from Balboa by land wire to Darien, where the electric impulses, operating through solenoid devices, actuate the transmitting mechanism. The three 600 ft. towers at Darien carry three sets of antennae. One set is for the "big arc" transmission to Arlington station, near Washington, to San Diego, and for other long-distance service; the other sets are "spark" antennae, for local use and messages to ships as close as 1,000 miles.

San Diego is about 3,000 miles from Darien, and this distance may be accepted as Darien's regular and reliable sending range. The stations at Balboa and Colon handle most of the communication with ships. The Balboa station works primarily with ships on the Pacific side, receiving their messages on the Balboa antennae and transmitting communications to them through Darien. As a rule, communication with vessels outside the Gulf of Panama is handled through the Punta Mala station; communication between the Cape Mala and Balboa stations is by either land telegraph or radio. The Colon station works with ships on the Atlantic side, and normally communicates with them direct throughout the Caribbean area. The Balboa station handles about 12,000 words of commercial traffic per month, Colon about 11,000, and Punta Mala about 3,500. The messages average about fifteen words each. No commercial traffic is handled by the Navy radio stations between the isthmus and points in the United States. The outlying stations at La Palma and Puerto Obaldia afford the only means of quick communication with the sections of Panama adjacent to them.

Electric Lifting Magnets : Their Construction and Application.

By F. A. HOOPER.

To-day the steel works which have not adopted electric lifting magnets are the exception rather than the rule, and, although it has taken fifteen years to arrive at this state of affairs, the lifting magnet has at last come into its own, and is now regarded quite as much a necessity for the efficient handling of magnetic materials as the overhead electric crane.

Historical.

In this country the commercial development of the electro-magnet for the handling of loose metal began, it is believed, in 1907 when the construction of circular lifting magnets was commenced at the Locksbrook Engineering Works, Bath, which shortly after this date transferred to Witton, Birmingham. After a year or so a Sheffield works followed suit, and, later, several other manufacturers entered this sphere of activity. Even previous to 1907 some works engineers had made magnets of their own, but these were chiefly of the horse-shoe type for handling rails and

which had not previously done so were forced to adopt magnet handling. They soon realised its possibilities and advantages, and thus, at last, the lifting magnet, from being a new idea of doubtful merit, came to be regarded as an essential part of the plant of any works where loose metal has to be handled in bulk.

General Features of Design.

Three types of lifting magnets have been evolved.

- (1) The circular magnet for handling loose metal.
- (2) The rectangular magnet for handling sheets and plates.
- (3) The horse-shoe magnet for handling sections and billets.

The distinctive features of these various types are described later, but the following general remarks apply equally to them all. The object of the magnet manufacturer is to produce a magnet which shall be practically indestructible. This does not present any great difficulty as far as the mechanical portions are concerned, as these consist entirely of high permeability and manganese steel, but the coil construction is not so simple. The insulation must be such that it is not affected either by heat or by moisture. The coil must be so fixed, that, whilst provision is made for expansion and contraction, there is no possibility of its shifting and rubbing on any portion of the shell, and thus endangering the insulation. These difficulties have been overcome in various ways. The insulation problem was solved by adopting asbestos in the form of tape and sheet and treating it with special compounds which have insulating properties and are, at the same time, heat proof. To overcome the fixing difficulty some makers first wind their coils on a magnetic former, which is placed directly into the shell, and, after this is fixed, the coil is made solid in position by means of an insulating compound, all moisture having first been removed by a vacuum process; others employ mechanical clamping only. The latter method has the advantage that, if it is desired to examine the coil, this can be done by simply loosening the clamping bolts and taking the coil out. The following description and the drawing shown in Fig. 4 apply particularly to the latter type of construction and to a circular pattern magnet, this being the type most generally adopted.

The Shells and Coils.

The shell is a high permeability steel casting of heavy construction, machined inside to receive the coil, the top being fitted with lugs to which the suspension chains are attached. The coil is wound in sections or layers of copper tape insulated between the turns by means of asbestos tape, which has been treated with a special varnish and rendered practically moist or damp proof and able to stand temperatures up to 400° to 500°F. without becoming denatured. After winding, the layers are built up between micanite plates, then lapped with pure mica, and, finally, firmly bound together by means of specially prepared tape. The most vulnerable point in the construction of the magnet coil is where the leads are brought out from the coil and lead to the connecting box. To protect them, pure mica is used as insulation where they pass over the top of the coil and thence they pass through a micanite tube of solid dimensions to the terminal box. The insulation of the centre pole also demands careful consideration, and here again pure mica is employed. The shell is lined with a special insulating board, and plates of this material are used to insulate the bottom of the coil from contact with the bumping plate. The coil is then firmly clamped in position by means of non-magnetic clamp bars. The base of the coil is safeguarded against damage by means of a protecting or bumping plate of manganese steel of great strength which has to stand heavy blows when handling loose metal, such as pig iron, which jump to the magnet and strike the plate with great force. In the earlier magnets phosphor-bronze plates were employed on account of the advantages of machining, but it was found they soon wore out and had to be replaced by a tougher metal.

In some magnets the outer and centre poles are used for fixing the manganese plate in position; in others they are solid with the shell, the bumping plate being fixed separately. The latter method has the advantage of eliminating magnetic leakage. The leads are brought from the magnet through a terminal box of solid design, to which the external leads are connected by means of heavy plug connectors.

Other Types of Magnet.

The construction of the rectangular magnet is very similar to that of the circular magnet, except that the shell and coil are rectangular in shape. The horsehoe magnet consists of a core on



FIG. 1. 66 IN. DIAMETER WITTON KRAMER LIFTING MAGNET HANDLING 10 TON BREAKER RAIL.

sections rather than scrap and pig, as, although the construction of the large circular magnet with its enclosed coil did not at first sight present many difficulties, it soon became apparent that to produce a magnet which could be relied on to remain in operation for long periods, even when dealing with hot metals, needed more concentration and specialised effort than it was in the power of the steel works engineer to give.

Difficulties and Opposition.

The task of the pioneers of magnet handling was rendered difficult even after they had reached a stage in the construction where the reliability of the magnet was undoubted, as a considerable amount of opposition had to be overcome from the steel works themselves. The system of handling was new, and many were antagonistic to its adoption; the dangers of the load dropping were exaggerated; the workmen were afraid of the magnet and its, to them, uncanny powers, and constant demonstrations had to be given to allay these fears.

The war period, however, finally decided the position the lifting magnet should occupy in the steel works plant, as the quantities of metal to be handled increased to such an enormous extent, and labour was so difficult to obtain and so costly, that many works

which the coil is wound solid, the pole shoes being firmly attached to the core by means of bolts. The coil shield is a circular non-magnetic casting which completely encloses the coil against weather or rough usage. The general principles of coil construction insulation and method of connection remain unaltered. In Germany a number of magnets are being constructed with aluminium instead of copper coils. The advantage claimed is



FIG. 2.—56 IN. WITTON KRAMER MAGNET HANDLING MISCELLANEOUS SCRAP.

that the oxidation of the outer skin of the aluminium forms sufficient insulation, thereby cheapening the cost of construction considerably. The difficulty of making a satisfactory joint and the increased space factor as compared with the copper coil are, however, disadvantages which seemingly outweigh the advantages, and copper coils are still retained by practically all British and American magnet makers.

Solidity in Control Apparatus Necessary.

The detail apparatus of a magnet equipment also necessitates special consideration. The types of controllers usually adopted are either the drum type, which is similar to an ordinary tramway controller and operated in the same way, or the contactor type having solenoid operated switches controlled by means of a master switch. Whichever type is used the most important point to consider is solidity. The magnet circuit has to be made and broken fifty or sixty times an hour, and great mechanical strength as well as electrical capacity are essential. The actual making and breaking of the circuit presents difficulties on account of the large induced voltage of several thousand volts which is created when the circuit is opened. Unless this is carefully dealt with the insulation of the magnet, and any other apparatus on the same circuit, may be endangered. A non-inductive resistance is, therefore, placed in parallel with the magnet circuit at the moment of breaking, to absorb the inductive kick. Series resistance steps are provided for regulating the lifting power of the magnet, and a reversing or demagnetising step is fitted in order to ensure the load being released instantaneously. For taking up the cable slack as the magnet is raised and lowered by the crane, several devices have been tried; the earliest consisted of a series of compensating pulleys and counterweights, but these cause undue wear on the cables, and sometimes got mixed up with the hoisting ropes. This method was therefore replaced in most instances by a winding drum, either operated by a separate motor driven from the main crane gearing, or by means of a clock spring. Some drums of the latter type have the further feature that, instead of being arranged for one double-core cable, two single-core cables are utilised, obviating any possibility of the cores rubbing together through constant coiling on the drum and wearing away the insulation, thus causing internal shorts. The cable is generally of the hard cord braided or cab tyre type. The connection to the magnet is usually made through a solid plug and socket, and to the mains through the slip-rings contained within the drum.

Magnets can only be constructed for direct-current circuits, and where alternating-current circuits only are available it is usual to instal motor generator sets to convert to direct current.

Magnetic Applications.

Then comes the question of what will magnets lift, or, what perhaps is even more important, what they will save. Actual performances show that when lifting solid loads a magnet will lift as much as ten to twenty times its own weight (depending on the size of the magnet). For example, a small magnet weighing 6 cwt. will lift a block of steel weighing 120 cwt., and a large magnet weighing 60 cwt. will lift a block of steel weighing 30 tons. When, however, light scrap has to be handled the capacities come down to 2 to 3 cwt. and 15 to 25 cwt. respectively, this being due to the great bulk and light weight and the fact that the scrap is usually so entwined that even if the top layers are attracted they are sometimes pulled off by the weight of the bottom layers. These are the two extremes, and such material as pig iron, billets and bars come between the limits.

As to the savings—all that is necessary is to lower the magnet on to the load and switch on the current, thus causing the material to be held securely; the simplicity of this operation, combined with the high working speeds of a modern overhead or jib crane, renders it possible to make as many as eighty to ninety trips per hour, loading from trucks into stock, this with a medium size magnet being equivalent to 50 or 60 tons of pig iron or scrap per hour. One actual instance may be quoted in this respect of a crane unloading 58 tons of pig iron in 57 minutes. Compared with the speed of a gang of labourers working with shovels and wheelbarrows, the savings become apparent. Numerous instances of magnets saving as many as ten men have been recorded.

The greatest savings are, of course, effected when handling loose materials, such as scrap, turnings, pig iron, crop ends and the like, as these could not possibly be slung; but material of regular shape, such as rails, plates and billets can also be dealt with efficiently.

A Variety of Uses Possible.

Taking an average steelworks, the uses to which a magnet can be put are surprisingly great, and the metal in most of the stages from the ore to the finished product can be dealt with. The ordinary English ore is not sufficiently magnetic to enable it to be handled with success, but Swedish ore, which is about 55 to 60 per cent. magnetic, can be lifted quite well, although, perhaps, a grab gives better results for general purposes; after the metal has been smelted the pig iron can be removed from the beds, either in combs for carrying to the breaker, or, if it is broken on the bed, can be picked up and deposited straight into the trucks. The sand question crops up here, but if large magnets are used the pig



FIG. 3.—56 IN. WITTON KRAMER MAGNETS LOADING CHARGING BOXES.

is attracted with sufficient force to knock off most of it, and, in one case the amount of sand loaded was only 22 lb. to the ton.

When a magnet is used for stocking the pig iron and scrap received at a steel works the time saved is very great, and with a speedy crane as much as 60 tons of metal can be dealt with per hour by one crane driver and one ground man. For breaking up skulls and heavy scrap, an equipment comprising an overhead gantry crane fitted with a magnet serves the purpose of first getting the material into position for breaking, then lifting and dropping the ball, and

finally removing the broken pieces. A circular ball is used so that no matter how it falls the magnet can lift it. A 66 in. diameter magnet will lift a ball weighing 8 to 10 tons (Fig. 1). Then comes the filling of charging boxes from stock. This is done by discharging a magnet load of scrap or pig over a series of boxes arranged on bogies in front of the furnace, the metal being raked level by a ground man. Many attempts have been made to dispense with the ground man, and various forms of loading chutes constructed, but the varied shapes and sizes of the material make any device of this nature hardly practicable.

All sorts and conditions of scrap can be dealt with, and Fig. 2 shows a magnet operating on different classes of material of this description.

The Heating Question.

Magnets can also be used for stacking ingots, and in this connection the question of heating arises. The magnetic qualities of steel vanish at about 762°C., but gradually increase up to this point. It is, however, not desirable to use magnets on metal above "red heat," which is equivalent to about 600°C.

Up to this stage the circular magnet is the most efficient, but when the ingot has been converted to the finished product the rectangular and bi-polar magnets have certain advantages. The circular magnet has a greater penetrating force, which is necessary for "sucking" quantities of loose pieces to the magnet, but for handling sheets and plates the lines of force are required to be distributed laterally, and in this case the rectangular magnet has greater advantages, unless numbers of thin plates are to be handled, when the circular magnet still is better on account of its greater penetration. Rectangular magnets can be lighter in construction, as they do not get the same rough usage as circular magnets, and have usually only to lift on regular surfaces.

Sheets and Rails.

Long thin sheets and plates have a tendency to peel off the magnet when the overhang is great, but this is counteracted by suspending two or three magnets on a beam and lifting the plate

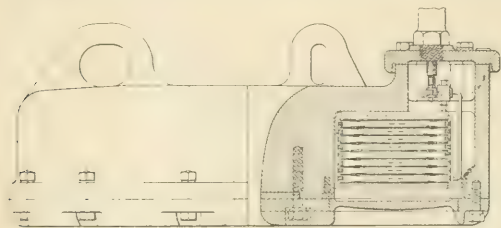


FIG. 1.—SECTIONAL ARRANGEMENT OF CIRCULAR LIFTING MAGNET.

on several points (see Fig. 3). It is possible when handling plates to pick up half a dozen from a pile, and, by means of special resistances in the controller, drop them off one at a time. This is being done regularly in several works.

For the handling of rails, bars and billets and tubes, the horse-shoe magnet is used and gives the best results, less power being required to handle this class of solid material. It also has an advantage over the circular magnet for handling "stacked" sections and billets, in that whilst the circular magnet pulls the load towards its centre pole, thereby causing a certain distortion of the pile, the bi-polar magnet, owing to the arrangement of the poles, exerts an equal pull over the whole of its lifting area and attracts the load evenly.

The Steam Magnet Crane.

As a general utility crane for use in a works where the amount of material to be handled is widely scattered, the steam magnet crane has been found very efficient. This steam crane is of the usual type, but special provision is made in the boiler capacity for operating a steam generating set which is fitted to the crane framing and supplies the current for the lifting magnet. A crane of this type can be used for all the usual operations performed by a steam crane, but in addition has a magnet for handling metal. In addition to the magnet, a grab for handling ore or limestone is sometimes also included in the crane equipment, and, as it is only a question of a few minutes to exchange these tools this type of crane is a very great labour saver. It is unwise to try to convert an ordinary steam crane into a magnet crane, as the boiler is usually only large enough for its ordinary duties, and will not stand up to the additional load, making it impossible to keep up the necessary steam pressure. Further, even with a crane specially fitted for magnet work, it is desirable to have a quick steaming boiler of the cross tube pattern.

In addition to the general handling of materials in iron and steel works, magnets are also used for working submerged; in one instance a London dock became choked with scrap iron that had fallen overboard when unloading barges, and, after mechanical means had been

tried unsuccessfully, a 36 in. magnet was lowered into the water and recovered something like 60 tons in a week. In another case a magnet was used for salvaging a cargo of pig iron in a South Wales Dock. In numerous instances magnets have been applied for recovering forgings, etc., which have been dropped in oil tanks during hardening.

When the Current Fails.

What happens if the current fails? This is a question frequently asked, and the answer is, of course, that unless some sort of safety device is installed the load must drop. With a modern electrical installation, however, the possibilities of failure are not very great, and, if the magnet is wired back to the main supply and not run off an auxiliary circuit, the occasions on which the main breaker comes out are very few and far between, and certainly not more frequent than a sling slipping or a chain breaking. Further, men do not usually walk about beneath a crane load, whether it is slung by chains or magnetically. It is believed that there is no case on record of a fatal accident, or, in fact, of any accident being caused by a lifting magnet dropping its load.

Safety Devices.

When, however, a safety device is desired, this takes the form of an accumulator battery connected in parallel with the magnet circuit and operated by means of a cut-in cut-out switch. It has been found that when once the magnetic field has been built up it is possible to reduce the supply voltage by nearly 50 per cent. without dropping the load, so that if a battery having a capacity of half the power required to energise the magnet when it is first put into circuit is employed that is all that is necessary. The automatic switch transfers the magnet from the main to the battery circuit immediately the supply fails, and *vice versa* when the main supply is renewed. However, unless the conditions are abnormal, and loads are continually being handled over men's heads, the need for a safety device does not appear to be very great. At any rate, this has been the opinion of most large users of lifting magnets.

In conclusion the writer would express his indebtedness to the Witton Kramer Electric Tool & Hoist Works, Witton, Birmingham, for the loan of the photographs which illustrate this article.

A New Tungsten Arc Lamp.

We understand that PHILIPS GLOWLAMPWORKS, of Enidhoven, Holland, have succeeded in manufacturing a new type of tungsten arc lamp, the smaller sizes of which are now ready for the market. A photograph of a lamp of this type, with a current consumption of 1A is shown herewith, and as it practically gives a point source of light, it is expected that it will find many applications, especially in projection, microscopy, and for general laboratory use.

In this lamp, for which patents have been applied, an arc discharge takes place between small tungsten spheres in an atmosphere of rare gas. The lamp has also the great advantage that it can be run on a 200 V a.c. circuit, and except for a series resistance, no auxiliary apparatus is necessary. The voltage on the arc itself is about 25 V. In order to ensure the striking of the arc a third electrode is mounted in the lamp (as shown in the photograph), and a high resistance in the cap of the lamp connects this third electrode to one of the leading-in wires. The material and form of this third electrode have been chosen in such a way, that a glow discharge sets in first between it and the electrode next to it, so starting the discharge between the small tungsten spheres.

The distance between the spheres and the glass wall may be very small (2 to 2.5 cm), so that a condenser with a short local distance can be used. The brightness of the tungsten spheres amounts to about 14 c.p. per mm². A funnel-shaped screen is provided, on which the evaporated and sputtered tungsten is deposited in order to prevent the blackening of the bulb. The spheres in the 1 A type have a diameter of about 1 mm., and in the 2.5 A type of nearly 2 mm. Lamps with a current consumption of 1 and 2.5 A are now available, larger sizes being in preparation. Experiments with d.c. lamps are now being made.



TUNGSTEN ARC LAMP.

The Electric Telfer Installation at Plymouth Gas Works.

By H. BLYTH, M.Inst.C.E.

The application of electricity in gas works has developed to a remarkable extent during the last ten or fifteen years—practically all modern plant for handling coal and coke being now electrically driven. A great deal of encouragement has consequently been given to inventors and manufacturers of electrical apparatus and machines having for their object: facility of control, increased efficiency, greater production, or the economical use of labour. In the face of these important advantages which are to be obtained by the use of electricity, it is rather surprising to find that some gas companies still adhere to hydraulic, pneumatic, or even hand-power appliances for charging and drawing their retorts. Surely it cannot be that electricity is regarded by some gas authorities as a serious rival to their industry or that it might be a dangerous policy to encourage its use in their works.

Electricity Means Increased Output.

However, a very large number of gas engineers are most progressive and have boldly applied electrical operation to the manufacture of gas and the control of its distribution, with the result that their output has advanced by leaps and bounds and, further—what is much more important to the country as well as for

in the technical Press, and it is, therefore, unnecessary to refer to it in detail here—the second installation for coke handling, which is on a much more extensive scale.

The coke is received by the telfer in an incandescent state direct from the horizontal retorts. The discharge from the retorts is effected by pushing a fresh charge of coal in behind it by means of the Fiddes-Aldridge machine, which is also electrically operated. The charge of hot coke falls into a skip of heavy lattice construction, which is then hoisted by the telfer and conveyed to one or other of the quenching tanks which are placed at each end of the retort house. The telfer lowers the skip into the tank for about 30 or 40 seconds, then rehoists and conveys the coke either direct to the water gas plant, which is a run of about 600 ft., or to storage bunkers which are situated parallel to the retort house. In addition to conveying coke to these two points, the breeze—which is subsequently separated from the coke as it is discharged over screens below the bunkers—has to be taken by the telfers to the three batteries of boilers. Ashes and clinkers have also to be conveyed from the boilers and the retort house furnaces to bunkers for loading into road wagons.

It should be mentioned that this telfer plant replaced drag links, conveyors and elevators, which were installed in 1912, it being found that in addition to excessive wear and tear the coke was badly broken up and a very large proportion of breeze was formed. The general arrangement of the new plant is shown in Fig. 1, from which the scope of the telfer operations will be easily understood.

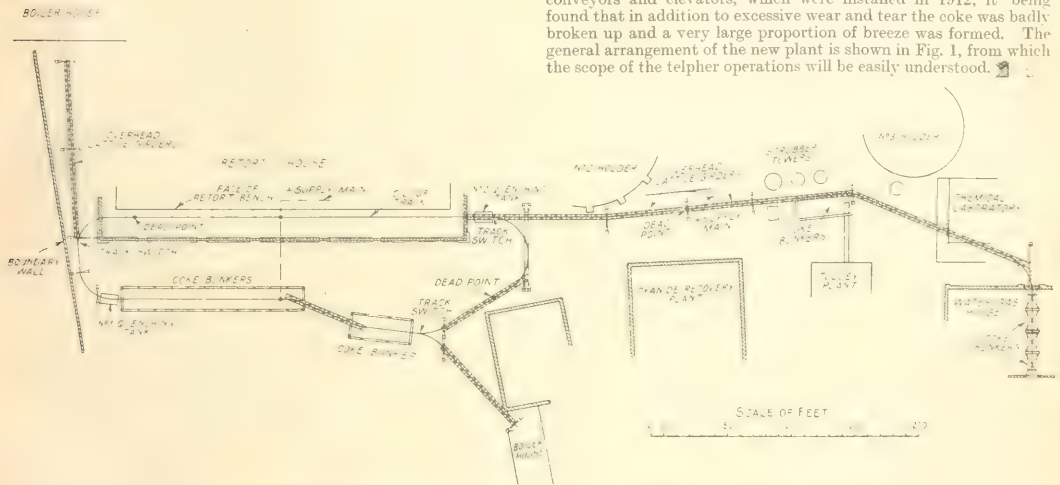


FIG. 1.—GENERAL LAYOUT OF TELFER INSTALLATION AT PLYMOUTH GAS WORKS.

themselves—the adoption of modern plant has enabled them to “carry on” through extremely difficult times and under the most harassing conditions that we have ever known. The gas industry has turned its competitor, electricity, to good account and has given a clear demonstration of the industrial fact, namely, that competition is the essence of progress.

A Progressive Undertaking.

THE PLYMOUTH AND STONEHOUSE GAS LIGHT AND COKE COMPANY is one of those fortunate concerns governed by a progressive Board of Directors and managed by a far-seeing gas engineer who early recognised the advantages of electricity. They have also had the good sense to appoint a fully-qualified electrical engineer to supervise the power station, electricity distribution, and all the electrical plant on the works—in this case, a considerable undertaking, comprising about eighty motors consuming an aggregate of about 1 000 000 kWh per annum. To cater for this load there are three steam-driven generating sets—one 138 kW Bellis-Siemens, one 150 kW Allen set, and one 250 kW Allen set. For it must be borne in mind that the conditions in a gas works are very trying as far as electrical plant is concerned, and special care is needed to keep it all constantly running without a hitch.

Coke Handling.

The telfer plant for coke handling is the latest electrical addition to these works, and it possesses several interesting features, the chief of which is the small amount of power consumed and renewals required compared with the considerable amount of work done. There are two distinct telfer plants at Plymouth: one for handling coal, which was installed in 1910—this has been previously described

Electrical Track Switches.

The available headroom in the retort house was not sufficient to allow of a level track being carried at a suitable height over the existing bunkers for the telfers to clear, and hence it was necessary to incline the track at 1 in 40 in order to deliver coke into the bunkers. The contractors found no special difficulty in this, but as several track switches were necessary in this particular plant for connecting up the branch lines, it was desirable to provide reliable safeguards to prevent a machine from running away down an incline towards an open switch. This was done electrically in the following manner, which has proved to be perfectly satisfactory. The current supply is brought to the machines by a single overhead line—the return being by way of the track rail. There is a switch in the overhead line which is connected by a link motion to the track switch, and therefore the two operate simultaneously—that is, upon opening the points on any one line to give a clear road for traffic on the adjacent line, the current is immediately cut off from that track which is opened for a considerable distance back from the open end. A shunt solenoid brake is fitted on each telfer. This brake is entirely independent of the control of the driver, and comes into operation automatically should the telfer enter a section approaching an open switch. Of course, any interruption of the line current causes the application of this travelling brake in the same way as the load is held by the hoisting brake when the current is cut off.

Overhead Line.

The overhead line of 4/0 section is figure “8” in shape, and is held up by simple split clips made in gunmetal supported by bell-shaped insulators bolted direct to the structure. The line is divided into a number of separate sections by special section insulators, and

is fed at different points as indicated in Fig. 1. This facilitates the independent operation of the plant at different points, and enables repairs to be carried out conveniently with a stoppage only of that particular section which may require overhauling. It will

negative cable from the switch board is coupled up to the rail at one point near the centre of the track.

There was very little existing structure of a suitable nature to serve as foundation or partial support for the telfer track. The

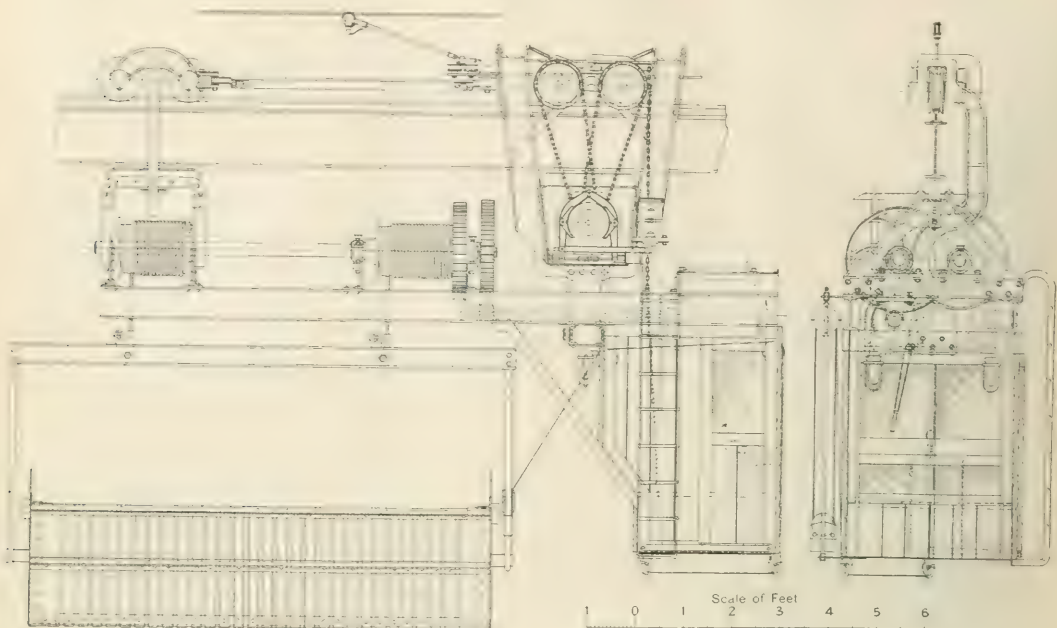


FIG. 2.—STANDARD 30-CWT. TELFER MACHINE.

be recognised that this is an important provision, but one which is not infrequently overlooked in the design of conveying plants of this nature.

Track Arrangements.

The track consists of a heavy rolled joist having a renewable bulb rail clipped to the top flange. The ends of the rails are bonded by copper rods of the same sectional area as the trolley wire, and the

coke bunkers in the yard, which have a length of 190 ft. and height 30 ft., and the bunkers in the water gas house, length 60 ft., height 35 ft., were the only structures which could be built upon, and, as the total length of the track is 1 600 ft., supports had to be provided over open ground for a length of 1 350 ft. of track.

Having regard to the necessity of keeping the ground free for traffic and clearing buildings, &c., the track had to be arranged in long spans varying from 50 to 90 ft.; thus substantial overhead girders had to be provided from which to suspend the track. The general construction of these girders and the towers for supporting them can be clearly seen in the accompanying photograph, Fig. 4. The girders are of lattice box construction and carry substantial "C" hangers at about 16 ft. pitch. Fig. 3 shows one of the track switches and gives some idea of the method of supporting the track at such points.

Telfer Machines.

There are at present two telfers (another is to be added shortly), each having a gross lifting capacity of 35 cwt. at a speed of 70 ft. per min. and capable of travelling at the rate of 600 ft. per min. The motors are of British Thomson-Houston make, totally enclosed series wound for direct current at 220 V. There are two motors for each telfer, one for hoisting and one for travelling—all motors are of the same size and interchangeable, each developing 11 B.H.P. at 520 revs. per min. on a half-hour rating with a maximum temperature rise of 50°C. These motors have cast steel frames and are of a compact box shape, which is particularly suitable for this class of work.

There is only one controller and resistance for operating both the hoist and the travel motor in each telfer—a change-over switch (Widlake's Patent) being used in conjunction with the controller.

This renders it necessary to operate the hoist and travel alternately (and not both together), which is an advantage in high-speed telfer work—where it is most desirable to hoist the load right up to its clearing position before commencing to travel. Fig. 2 shows the general arrangement of the telfer and also the most important parts of the machine in detail. It will be noticed that the hoist motor with its series brake solenoid is placed in the top of the cab and an extension shaft is brought out to the gear. The travel motor is connected to the running wheels by a double roller chain drive—the automatic shunt solenoid brake is also seen in the elevation.

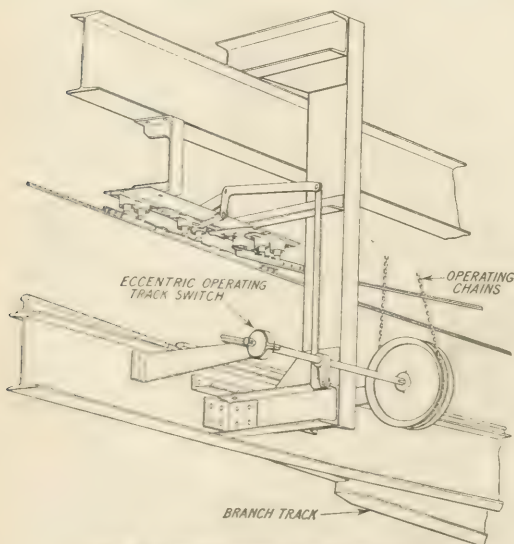


FIG. 3.—ARRANGEMENT OF TRACK SWITCH.

Electrical Connections.

The diagram of connections given in Fig. 6 will probably be of interest. It is nearly self-explanatory, but the following points are rather important. It is the common practice in telfer work to use the track as the return, the negative lead from the switch board busbar being connected directly to the track girder. It is, of course, important in such a system to avoid any possibility of a break on this



FIG 4.

"metallic earth," *e.g.*, there must not be any switch or fuse or any other means of cutting this return between the track and the negative busbar of the supply system.

The main advantages of the "track return" system are: (1) The cost of maintenance of the overhead line equipment is reduced to half that of a double line, which is generally used when the current is supplied from a source external to the works. (2) The arrangements at the track switches are simplified. (3) Any leakage, whether from the telfer line or from any other plant on the same system, will go to the telfer structure and be conducted directly to the negative busbar, instead of straying through the ground and probably setting up detrimental effects upon underground pipes and other plant, which may be of lower resistance than ground, and would therefore be traversed by such stray currents. (4) The earthed track return system naturally necessitates the maintenance of good insulation on all cables and plant—instances are not wanting of current supplies, with insulated returns, in which leakages are allowed to continue for considerable periods and gradually to become destructive, owing to the fact that weaknesses in the insulation are not always regarded with the same amount of concern as they are in an earth return system. In the diagram it will be seen that there is a single pole switch only on the positive side, and the current passes from the controller first through the armatures (hoist or travel according to the position of the change-over switch) then back to the controller, out through the series field (and brake solenoid in case of hoist motor) direct to earth, which, in this case, is the most convenient point on the framework of the telfer cab. The travel brake shunt solenoid is connected directly between the main switch and nearest convenient point on the frame of the travelling carriage which supports the solenoid pot; alternatively, the outward lead may be taken to the change-over switch. The travel solenoid is therefore permanently energised, holding the brake off, unless the line current fails or is cut off by a track switch being opened, or when the driver opens the main switch. This he is always supposed to do on leaving the telfer cab or when he is standing still for any purpose. The advantage of taking the outward lead from this solenoid to the change-over switch is that the travel brake is kept lively, as it would come into action whenever the travel motor is cut out to switch in the hoist motor. In addition to these electrical features, the plant possesses mechanical characteristics and possibilities which must not be overlooked.

Mechanical Features.

For instance, one of the most important items to consider when

selecting new plant for any duty, and particularly for coke handling, is the probable charge for maintenance and depreciation—this charge depends upon the ^{live machinery} ~~dead structure~~ ratio of the plant. Since the maintenance and depreciation of the "wearing" parts of a plant are far greater than that of its fixed structure, it is obvious that the greater the proportion of machinery in any plant the greater the maintenance and depreciation charge. In the plant under consideration, the value sunk in machinery compared to the value in structure is as 1 is to 4; if this is compared with another plant in which the machinery and structure values are, for example, equal, it would be found that the maintenance and depreciation charge in the latter case works out nearly 50 per cent. in excess of the former—this is based upon 15 per cent. for maintenance and depreciation of machinery and 5 per cent. for structure in both cases.

General Uses of the Telfer.

Again, the utility of the telfer plant is not confined to the handling of coke or breeze, the purpose for which it was installed; it can deal with any kind of load within its range. For instance, as the telfer line runs through the retort house in this case, it will prove extremely useful for handling all the materials necessary for resetting the retort benches, which, of course, has to be done at fairly frequent intervals.

Grabs can also be used with these machines as well as skips, and therefore any bulk material such as coal, coke, breeze, ashes, oxide, etc., can be picked up or dumped automatically.

When necessary during transit weighing can be readily arranged for by the insertion of a "free length" of track beam in the telfer runway and hanging it from an automatic weighing machine of the Denison or Avery type. This has been done in the case of several coal-handling plants at electricity supply stations.

Flexibility of the Telfer.

The flexibility of this form of conveyor is another very important feature. Fig. 1 illustrates this particular property of the telfer system very clearly; branches can be run off in any desired direction, or any existing lines may be extended as future developments of the works may require, without any inconvenience to the main plant, which can be kept working whilst such additions are being made.

In a large and ever-expanding works, such as the Plymouth Gas Works, the chief requirement to be met by any proposed conveyor is "a larger capacity in a shorter working time" than has had to be



FIG. 5

reckoned with in the past; this means that heavier loads have to be carried at higher speeds, and, let it not be overlooked, with increased efficiency—it does not serve any useful purpose to increase the capacity at the expense of heavy wear and tear and working costs.

The mono-rail telfer system seems to meet these requirements—it is particularly suitable for heavy loads at high

other features, the resistance to travelling and wear and tear are reduced to the minimum.

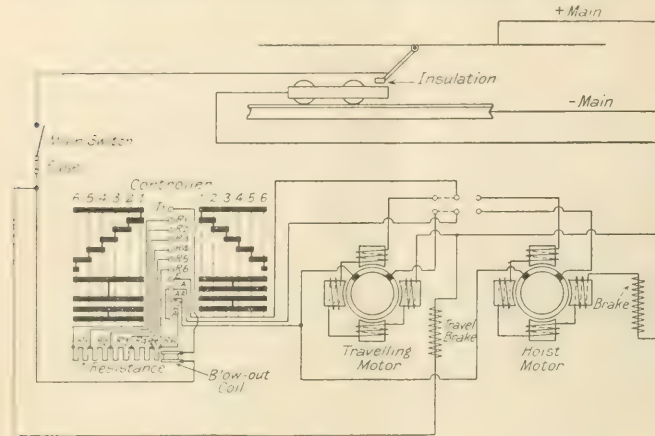


FIG. 6.

working speeds, and by virtue of the "single rail" and special construction of the running wheels, large roller bearings and

Henshaw, Ltd., for the drawings and technical data in this article.

Electricity Important in Gas Works.

From the above description and illustrations it will be recognised that electricity is a most important agent in the development of a modern gas works—without it a telfer plant of this nature would be a practical impossibility.

It will not be out of place to here mention some of the other applications of electricity at these works. They include charging and discharging machines, coal conveyors and elevators, gas compressors, washers, hydro-extractors, blowers, boosters, pumps, long-distance pressure indicators—the use of the latter having originated with the Plymouth Gas Company, and they are the invention of their electrical engineer.

The probability is that the use of electricity will be still further extended in gas works. It only remains for the inventors and manufacturers to come along with their improvements and demonstrate how output can be increased with higher efficiency and reduced cost. The author is indebted to the chief engineer, Mr. P. S. Hoyte, for the photographs of the telfer plant and to the contractors, Strachan and

Ground Nuts Conveyors in West Africa.

By F. P. OVERSTALL.

One of the far-reaching results of the economic disturbance caused by the War is the impetus given to the adoption of mechanical appliances for labour saving in the handling of material. This is a subject which has been receiving ever-increasing attention during the past thirty to forty years, and although the stern necessity restricting capital expenditure at the present time causes many

be found on making even superficial investigation that the cost of movement of material, whether from one part of the world to another, or within the comparatively narrow limits of a manufactory, enters very largely into the total cost of production. It is interesting to note at the outset that the present high cost of labour is not limited to our own and other countries in a similar state of



FIG. 1.—FIRST UNIT DELIVERING GROUND NUTS INTO THE STEAMER.

schemes to be left in abeyance, this is partly counter-balanced by the fact that the high cost of all classes of labour and the return of ordinary competition compels owners and managers to study the possibilities of effecting economies in various directions. One of the most important fields for investigation is the reduction of the cost of labour charges incurred in handling material. It will

civilisation, but extends to lands where hitherto labour has been one of the cheapest commodities.

Botanical Details.

The conveyor installation which forms the subject of the present article and illustrations is for the purpose of discharging ground

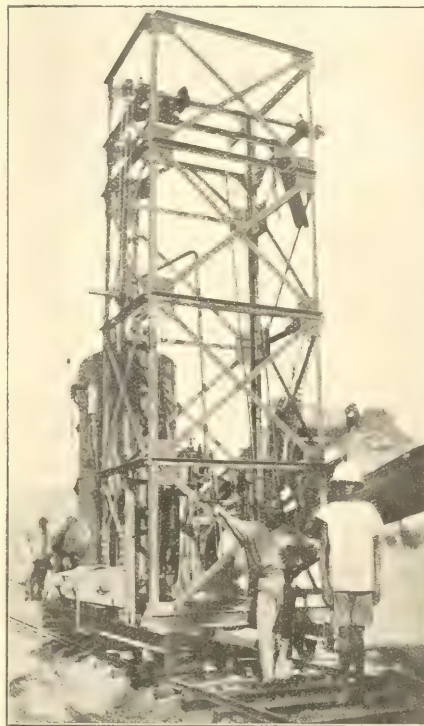
nuts in bulk from cutters and other small craft to the storage ground ashore, and *vice-versa* for loading the same material from shore into ocean-going steamers on the River Gambia, in West Africa. The ground nut will be familiar to the reader under this or other of its appellations, such as earth nut, pea nut, monkey nut, or the French name *arachide*. The plant is an annual, with hanging stem; the pods or legumes are stalked, oblong, and cylindrical, about 1 in. in length, the thin reticulated shell containing one or two irregularly ovoid seeds. After the flower withers the stalk of the ovary has the peculiarity of elongating and, bending down, forcing the young pod underground, and thus the seeds become matured at some distance below the surface, hence the specific and vernacular names of the plant. Originally a native of South America, it is extensively cultivated in many tropical and sub-tropical countries. The plant affects a light sandy soil and is very prolific. It is cultivated by the native farmers in the Gambia, the nuts being usually planted after the first rains in June and maturing in about five months. The plants are dug up in late October or early November, and placed in heaps to dry. Subsequently the nuts are separated from the vines and cleared from the soil which clings to them. The nuts are purchased from the native farmers by the agents of the various European companies which have established collecting stations along the river, and are accumulated during the dry season from November to May, being stored in piles in the open, also in lightly constructed sheds.

When a sufficiently large quantity has accumulated at one or several collecting stations to form a cargo, a steamer is chartered and the nuts are shipped to England or a European port. The annual export varies according to the demand, from 1912 to 1914 the quantity being about 60 000 tons in each year, increasing to 96 000 tons in 1915.

The Cost of Native Labour.

Prior to the adoption of the conveyor installation described herein the discharging from river craft to pile, and subsequently the out-loading to steamers was performed by native labour by means of baskets. For this purpose it was necessary to hire labour at Bathurst to the extent of 200 to 300 natives, and transport them up river to the particular station or stations where the cargo was to be obtained, some of these being situated at 150 to 200 miles from Bathurst. The cost of labour even on the River Gambia has increased very considerably during and subsequent to the War. Early in 1920 the pay for natives for unloading and loading ground nuts up-river was 7s. 6d. per day, but by July of the same year the cost increased to 12s. 6d. per day. Owing to this heavy charge, the proprietors of the group of collecting stations referred to decided to adopt mechanical means of handling the nuts, and an order for the installation was placed with S. S. Stott & Company, of Haslingden, near Manchester, a firm who have specialised in the design and construction of elevators and conveyors for many years. It will be understood that the collecting stations do not possess any facilities in the way of mechanical appliances or motive power; therefore it was essential that the conveyor installation should be provided with its own motive power, and that the whole of the plant should be as simple as possible and of strong construction so as to be

to steamers, whilst the portability of the machinery would afford the additional advantage of enabling the conveyors, &c., to be stored in the sheds when not in use during the wet season. The installation comprises two lines of portable band conveyors placed at right angles with the river frontage, each line consisting of eight



[FIG. 2.—STEAM BOILER, ETC., ON MOVABLE POWER UNIT.

conveyors, in lengths varying from 20 ft. to 44 ft., making a total distance of about 300 ft. from river side to shed for each line. The conveyors are of the standard design as used in conjunction with

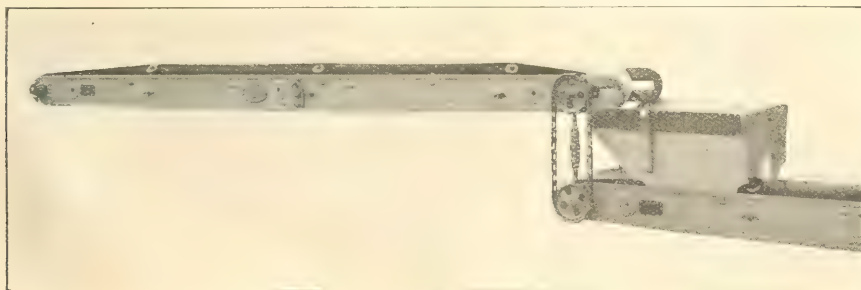


FIG. 3.—VIEW OF CONVEYORS SHOWING DRIVING CONNECTION.

capable of being run by native labour under the supervision of the resident European agent, with occasional visits from the engineering staff at Bathurst.

Portable Power Units Essential.

It was also considered essential that the conveyors and power units be of a portable type, so as to permit of the installation being utilised either for in-loading from river craft or for out-loading

portable ship-discharging grain elevators supplied by Stott & Company for use in many British and Continental ports.

The conveyor sides are of pine, 12 in. deep in middle and tapering towards each end, 1½ in. thick, the edges being protected with angle-iron. The two sides of each conveyor are secured together by means of wrought iron palm-ended straight and diagonal stays. The bands are of solid-woven cotton, 24 in. wide, and run at about 500 ft. per min. Being extremely pliable these bands work

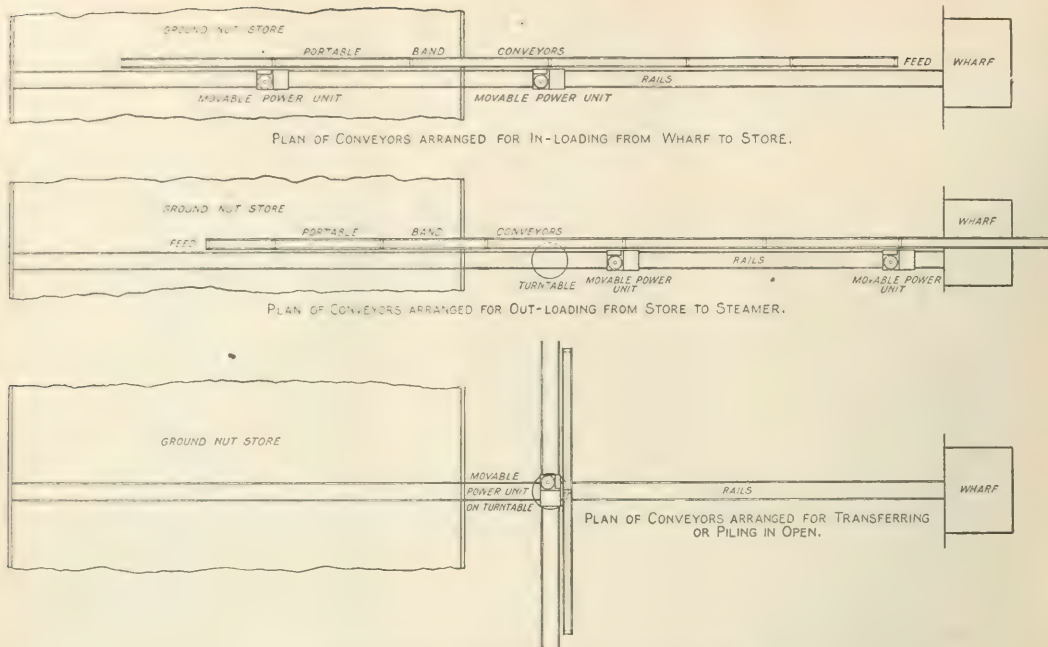


FIG. 4. PLAN OF CONVEYORS FOR DIFFERENT OPERATIONS.

satisfactorily around 9 in. diameter end drums, which are made from lap-welded tubes, rough turned and crowned on the face, and fitted with malleable cast iron ends, keyed on steel shafts. The bearings for the end drums are of phosphor-bronze, in malleable cast iron take-ups or tensions with square-thread adjusting screws for the purpose of tightening the belts as well as for setting the end drums to ensure the belts running truly. The intermediate carrier rollers for the conveyor belts are of sheet steel with stamped ends and turned centres, and work in bronze bearings bolted inside the conveyor timbers. Angle rollers for troughing the belts are fitted near the feed hopper at the receiving end of each conveyor.

Driving Arrangements.

The means for connecting and driving the consecutive conveyors are shown in Fig. 3, and consist of a pair of suspension rods for each joint, with right and left hand threads, and a coupling box, the bored eye-ends of the rods fitting on turned projections on the bronze tension bearings. The projecting ends of the shafts of the 9 in. diameter end drums are turned taper, with keyway cut in, and the connecting drive is effected by a pair of cast steel sprocket wheels, each bored taper and fitted with a fast key, and a short length of malleable link driving chain. All the taper shaft ends and the taper bores of the sprocket wheels are machined to templates and gauges so as to ensure interchangeability.

Motive Power.

The motive power for driving the two lines of conveyors is divided into four units, each comprising a vertical steam boiler, single-cylinder steam engine, and various accessories described below. These are mounted on movable steel structures provided with flanged wheels, capable of being moved by hand along the two sets of rails, the wheels being fitted with roller bearings; this operation can be easily performed by two men. The steam boilers are 3 ft. 6 in. in diameter by 8 ft. 6 in. high on shell, and are designed for a working pressure of 80 lb. per sq. in., and are suitable for coal, briquette, or wood fuel. The steam engines are of the vertical single-cylinder non-condensing

type with a 7 in. bore and 8 in. stroke, running at 180 revs. per min., with high-speed governors and reversing plates. They are totally enclosed in steel-plate housings as a protection

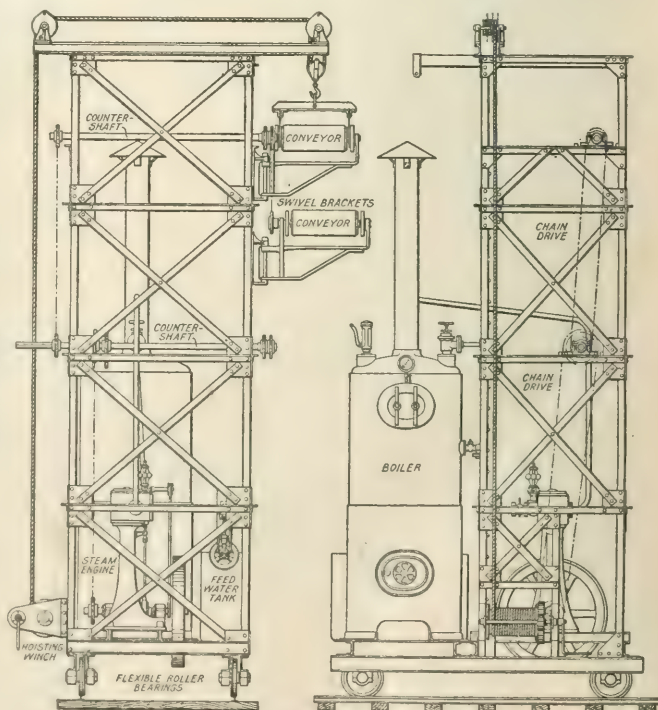


FIG. 5.—DETAILS OF MOVABLE POWER UNIT.

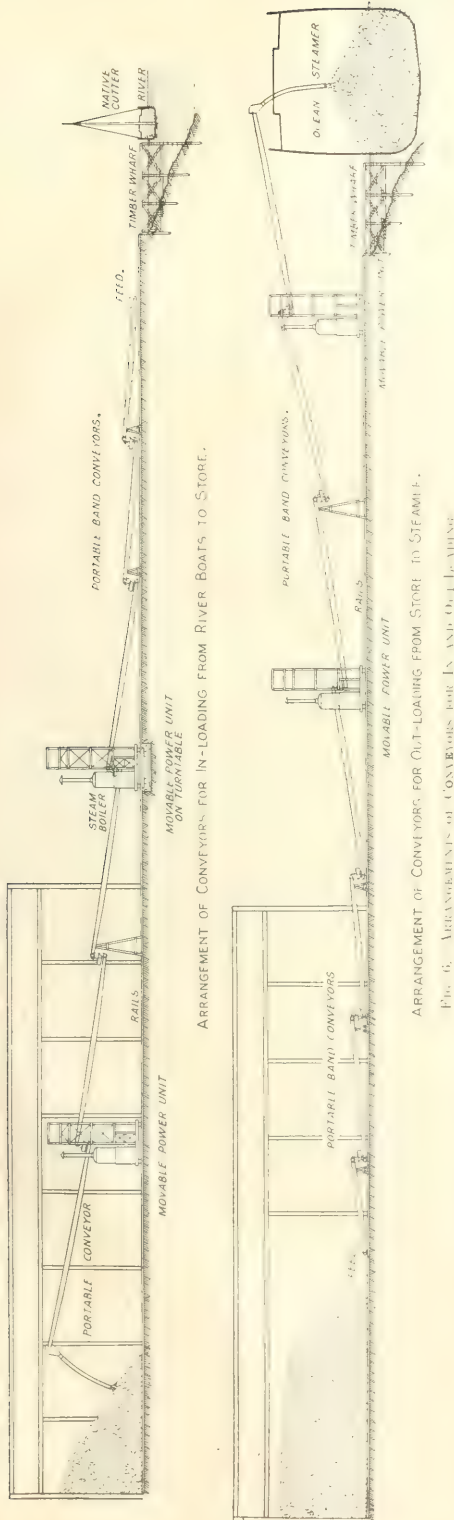


FIG. 6. ARRANGEMENTS OF CONVEYORS FOR IN AND OUT-LOADING.

from the dust which arises in conveying the ground nuts. A steam-driven boiler pump is provided with a steam cylinder 2 in. bore by 2 in. stroke, a water cylinder 1 in. bore by 2 in. stroke, and a rectangular steel feed water tank.

The vertical member at one corner of each of the movable structures is utilised for supporting the swivel brackets which carry the near ends of the two conveyors, the vertical steel channels referred to having bolt holes drilled at 8 in. pitch so as to be suitable for carrying the swivel brackets at various heights as may be necessary. A hand winch with hemp rope and pulley blocks is provided on each of the four structures for raising and lowering the conveyors and the swivel brackets into the required position on the framework. In addition, provision is made for supporting and driving a conveyor at right angles to the main conveyors so as to deliver the nuts into piles on either side of the track, when in-loading.

A Very Flexible System.

It will be seen from the various illustrations that the movable power units, in conjunction with the portable conveyors, afford a very flexible system, readily adaptable to the requirements for in or out-loading. The conveyors are easily handled, the longest, with 44 ft. centres, weighing 15 cwt. The illustrations, Figs. 1, 2, and 3 (from photographs which were taken on the site) only show one fourth of the installation, i.e., one half of one line of conveyors, this portion having been delivered and set to work in advance of the remainder at the latter end of the season.

No figures are at present available as to the actual saving in labour costs, but this will be very considerable, as it will have been observed that manual labour is now only required for the loading of the nuts to the conveyors, thus eliminating the cost hitherto incurred for natives carrying from craft to pile and *vice-versa* from pile to ship. The illustrations, Figs. 4, 5 and 6, from drawings, show the complete lay-out of two lines of conveyors, and the four movable structures which contain the power units.

Witton Kramer Electric Pulley Blocks.

THE WITTON KRAMER ELECTRIC TOOL AND HOIST WORKS have produced an electric pulley block, designed for use in cases where it justifies the installation of an expensive crane. The chief characteristics of the Witton Kramer pulley block are its compactness and lightness. The electrical unit consists of a totally enclosed motor, having a reversing controller forming the other end. The drive from the motor shaft is by a set of spur gear, the spur wheel



THE WITTON KRAMER ELECTRIC PULLEY BLOCK.

being mounted on the worm shaft of a worm gear pulley block of more or less ordinary design, specially strengthened for power drive. The load is lifted by means of an electrically-welded chain and sheave block and hook, special care being taken in the manufacture of this to ensure the chain being a perfect fit in the chain wheel.

This equipment, which is made for direct-current voltages up to 420 V. weight only 2 cwt., and will lift a load of 1 ton at a speed of 10 ft. per minute. The standard equipment shown in the illustration includes a chain for a 10 ft. lifting height.

Recent Developments in Accumulator Electric Trucks.

By RAYMOND J. MITCHELL, M.I.A.E., A.M.I.E.E., A.M.I.Mech.E., &c.

The riddle of the moment is how to bring prices into line with demand. Never in the long history of civilization has there been a larger proportion of the world's people "demanding" (i.e., needing) goods of all kinds, and equally true is it that never previously did high prices so fatally injure the benign flow of goods to users which it is the engineer's job to insure. Now, prices are fixed, as everyone knows, on the basis of gross cost plus additions for

how costly it is to shift pieces about a shop or from department to department as they progress through successive stages to the erecting shop or finished stores. A large percentage of this cost is due to the use of antiquated methods, both in stacking and transporting partially finished pieces and is aggravated by the relatively enormous cost of manual energy, and the fatigue and laziness factors they are apt to entail. Although most technical officials in works of medium and large size are abundantly aware of the economies which are possible by using conveyors, it is a remarkable fact that, in spite of the excellent work already done by electric trucks in this country, their adoption is in many cases too seldom considered, although immediate and large savings can be safely anticipated and even guaranteed. The tendency to consider first cost as an absolute criterion thus prevents some engineers from achieving cost reductions which will more than pay for electric trucks in their first year's working. As the truck makers realise perfectly that unless the electric truck does its job without a shadow of a doubt as to its increased economy then their case is hopeless, it can be confidently stated that the advice tendered by those interested in electric trucks should at all events receive attention. The proof of its correctness is so overwhelming.

Special Trucks and Special Services.

From the foregoing remarks it follows naturally that in order to attain the practically universal application of electric trucks it will

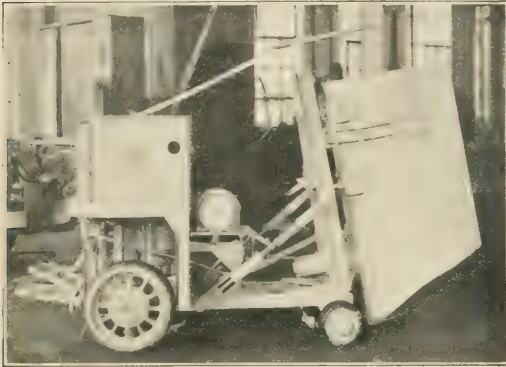


FIG. 1.—ELWELL-PARKER ELECTRIC TRUCK FOR PAPER MILLS.

profit, hence it follows that, *assuming the same volume of purchasing power to remain distributed after the operation of reducing prices*, to reduce cost is the royal road to our economic salvation, and how to do this is a problem in the solution of which engineers must take a primary responsibility for failure, as they will earn the national gratitude if successful. Neglecting further reference to aspects of this problem which are open to extremely technical argument, it remains unquestionably true, that a manufactured article can be disposed of more easily in inverse proportion to the



FIG. 3.—TRUCK CRANE FOR HANDLING CASTINGS AND MACHINE PARTS.



FIG. 2.—AN ELECTRIC TRUCK FOR HANDLING BRICKS.

energy of all kinds required to produce it. Man-power is the most costly form of energy extant, and it is in the devising of means of saving this form of energy that our greatest problem lies.

Solving the Problem.

The feature outstanding in a study of the long and intricate series of stages through which most manufactured articles pass, is the high ratio of cost entailed between the stages compared with the nett costs of applying the processes themselves. In engineering work this is especially observable. Every works manager in fact knows

be necessary to devise special types of such machines to meet the demands of special services. This tendency is happily being realised by designers and, as the following descriptions of modern examples will show, there is abundant evidence of the truck engineer's intention to make his presence felt in preventing this deplorable waste. The special machines illustrated will, in the writer's opinion, be followed by dozens more of a similar character designed specially to accommodate themselves to the peculiarities of the particular industry concerned. This is, in fact, a branch of accumulator traction engineering which is as yet in its infancy. Of course, it is not possible to apply electric trucks in any sort of a ramshackle plant, any more than it is possible to run motor buses across ploughed fields. In many places the works roads are in such a bad condition that even foot-passengers have to go warily to avoid injury. It, therefore, behoves the factory management to study the question of providing clean smooth travel-ways 5 or 6 ft. wide wherever this is at all possible. The modest first expense of such trucks will enable profits of thousands per cent. to be realised wherever electric trucks are substituted for the handbarrow or truck.

The Electric Roll-Handling Truck.

Taking actual examples, the electric roll-handling truck, shown in Fig. 1, was developed in response to a call for some convenient means of handling the heavy rolls of material used in paper mills, printing works, and other similar places. It consists of a standard Elwell-Parker electric truck, on the front end of which is mounted

a special swivelling cradle which can rotate about a trunnion at its lower end. It is mounted on an "A" frame which can swivel against buffer springs in a vertical plane parallel with the axis of the truck. In operation the cradle is allowed to fall until it is in a horizontal position; this permits the "A" frame to tilt upwards, so presenting a wedge-shaped lip from the cradle to the under surface of the roll of paper. The truck is gently pushed up to the roll which is thus "scooped" up into position, the next operation being to pull the "A" frame back and rotate the cradle to a vertical position, in which situation the roll is carried. When the truck has reached the end of its journey the cradle is operated into a vertical position, so that, if the truck be backed away, the roll remains on the floor with its axis vertical. One man can operate the machine, and so do the work which previously required from five to seven men to accomplish. The travelling speed of the machine is from 400 to 500 ft. per minute, that is three times as fast as a man walks, and a load of one ton can be handled at each haul. It should be noted that only one auxiliary motor and cable drum are required in order to operate the lifting and carrying mechanism and that the truck is independent at all times of any further assistance than that supplied by the driver himself. An indication of the speed of operation of this machine is afforded by the fact that in rush hours one man has stacked eighty 36 in. rolls two high in one hour.

Brickmaking.

In Fig. 2 an unusual application of the elevating truck is shown. Most brickworks are remarkable for the extreme crudity of the arrangements employed, for it seems generally to be assumed that brickmaking is a job where serious reductions in cost are not possible. Some trials made recently, however, indicate that providing a works be handling more than a hundred thousand bricks per diem, the elevating platform truck can effect considerable economies. For instance, one well-known brickmaking concern has found that with a gang of five men working as a team, and helped by an elevating platform truck, it is possible to handle ten times the number of bricks they formerly handled in the same length of time with hand trucks and wheel-barrow. The essence of the improvement consists in spending a much larger proportion of the time actually loading instead of waiting for the return of the hand truck. Loading is done by hand on to straddling, castor-legged, tables,

Truck-Cranes.

Another invaluable machine is shown in Fig. 3. In this the crane mechanism is designed to handle a load of 1 000 lb. at a height of 8 ft. Another model picks up 2 000 lb. at a height of 12 ft. The boom may be raised or lowered and locked in any desired position, thus enabling the load to be lowered to any point on the truck's platform. This operation is performed by the same motor which winds the

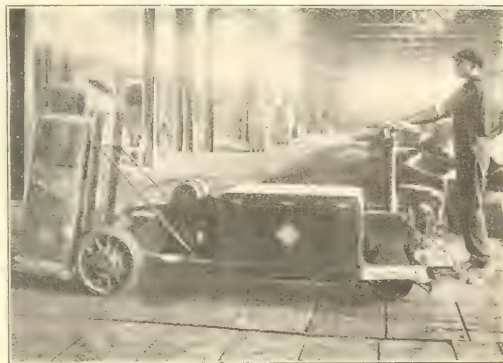


FIG. 4.—ELECTRIC TRUCK FOR FURNACE CHARGING.

cable, a hand-brake being utilised for lowering the load at very slow speed when delicate handling is required, as, for example, when placing a heavy casting on a machine. This type of truck can be used for the delivery of castings from the stock yard to the machine shop, for transferring heavy cases into freight cars, for assisting in the erecting shop, as, for example, by lifting engines into chassis, for piling stock in the yard, and for moving boxes loaded with forgings

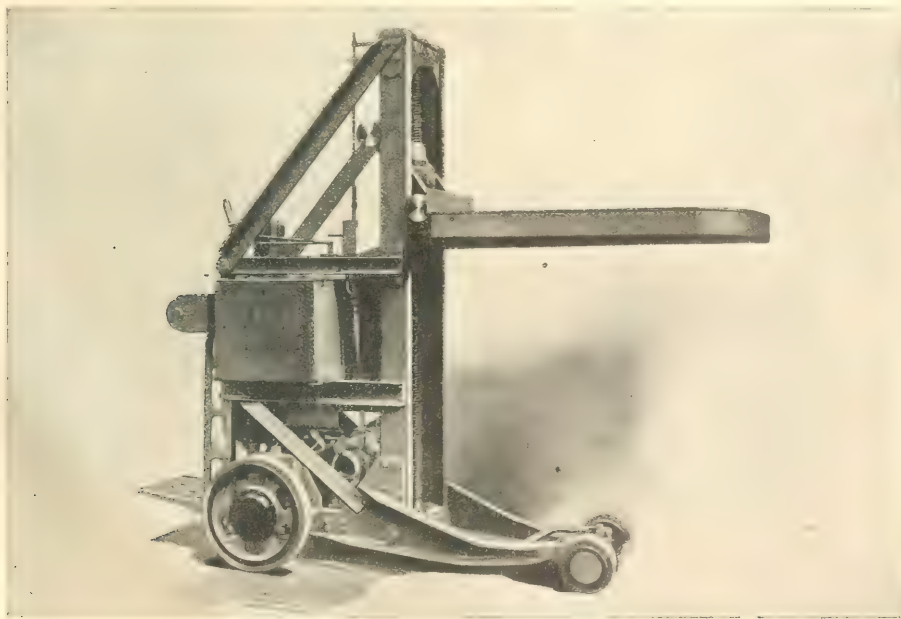


FIG. 5.—VIEW OF THE SLINGSBY ELECTRIC LIFTING TRUCK.

under which the platform of the electric truck is pushed. Five hundred bricks can be carried at one time at a speed of about 500 ft. per min. The cost of operating the truck, exclusive of labour, does not exceed two shillings per working day. This should be interesting to those faced with the problem of high building costs.

from pits in drop stamp plants, while for the stacking of material it is also an invaluable aid. Experiments have been made successfully by equipping this crane with an 18 in. magnet, which takes current from the main battery, thus enabling it to handle stock of awkward shapes which would be uncomfortable to deal with by

manual labour. Due to the provision of four-wheel steering this truck can travel along the narrow alleys in the bays of an average machine shop. In a recent experiment with one of these machines, one truck was used for stacking axle housings in a large motor lorry works. Four men had hitherto been employed on this job, and were able to stack four high, but, by using the electric truck, two men were able to do a given amount of work in less than half the time and to stack the housings eight high, thus practically doubling the yard capacity.

Furnace Charging.

One of the most novel uses of the electric vehicle hitherto recorded is shown in Fig. 4, which illustrates a truck specially designed for charging furnaces, such as are used, for example, in the malleable iron industry. Although mechanical means have been used for this job in some cases, the cost of such equipment in operation is quite considerable, and it was, therefore, sought to apply electrical means to the solution of the problem. It will be seen that the loaded pots are placed on bridges on the floor towards which the truck can be driven, lifting gear foremost, thus enabling two prongs to engage with the support bridges in such a manner as to insure the whole load being lifted clear of the floor by the simple operation of tilting the load slightly backwards, thus making it perfectly safe to carry to its destination at the furnace. Conversely, the same machine may be used for emptying the furnace, thus enabling the work to be greatly expedited and in considerably higher temperature than was possible under previous conditions.

A works employing this type of truck report that a single battery charge will enable one of these furnace trucks to take from one hundred and fifty to one hundred and sixty trips, that is including picking up, backing out, turning, travelling to destination, setting the load down, travelling back, picking up another four thousand pound pot and placing it in the next oven. The reduction in the cost of operation as compared with the previously existing steam furnace charger was more than 50 per cent., whilst further advantages were gained such as less interference with other men, less floor space required for manoeuvring, less interference with the overhead crane operator, and much greater manoeuvrability into relatively awkward situations owing to the extremely small turning radius which the single-wheel steering system insures. Various other designs of this type of equipment are being tried out, but at the time of writing no precise details are available.

Tiering and Lifting Truck.

Fig. 5 shows a new type of elevating truck, called the lifting tiering truck, designed and made by the Automatic Company, whose representative in Europe is Mr. H. C. Slingsby. The truck illustrated is designed to overcome the difficulty that often material has to be transferred from one floor level to another, and no handy means exists for performing the lifting or lowering operations. In order to overcome this difficulty the truck in question is supplied with a horizontal platform supported in a vertical guide frame, and lifted and lowered by a motor driven screw capable of dealing with a load of 2 tons, at a rate of 5 ft. per min. An automatic cut-out is provided when the load reaches the limit of either height or depth, and various heights are available with lifts of 40, 60, or 75 in. As the machine steers on all four wheels it can travel round a right-angled corner in a passage only 5 ft. wide, this representing the minimum. The machine runs at a speed of 6 miles per hour, and is invaluable for operations where stacking is required.

From the foregoing it is hoped that a sufficient further body of evidence in support of the electric truck has been adduced to make many engineers who at present may be sceptical decide to look into the merits of this equipment, and thereafter take action accordingly. No other item of plant in a modern factory will, where correctly applied, more amply justify its installation.

Calendars, Diaries, &c.

THE HAMB ALUMINUM COMPANY has sent us a useful desk calendar, with the calendar for 1922 on each sheet of blotting paper.

As our calendar for 1922 has been received from MAWDSLEY & SONS, Ltd., at Buxley, we have placed small monthly slips at the end of each page. The calendar is a small monthly slip, placed under a coloured picture by Lady Davis entitled "A Refreshing Interval," which depicts a lady artist enjoying a cup of tea.

We have received from C. F. EMMETT, LTD., a handsome pocket diary, with a time scope. This is of the latest best variety, and beside the usual diary features contains tables and other information which should be of great use and interest to those engaged in wireless telegraph work.

We have received the 1922 edition of the SIMPLEX DIARY. There is a note that we should find it useful during the forthcoming twelve months as we have the predecessors in the past. Its general appearance seems a little more solid than it was before, and the useful tables of wire gauges and other electrical information at the back have been thoroughly checked and revised. Too much reliance must not be placed on the prices which are given, as these have in almost every case been altered in the customer's favour.

The Greater London Inquiry.

The Royal Commission on the Local Government of Greater London have taken some evidence on the present position of local government services and administration in the county of London and surrounding districts, and have adjourned for the holidays. Mr. M. L. Gwyer, solicitor to the Ministry of Health, submitted a statement showing the authorities, their powers, duties, &c.

Mr. R. C. NORMAN then gave evidence in support of the London County Council's proposals (set out in these columns on Dec. 2), and urged that the existing local government areas were inappropriate for the present administrative needs of London.

Traffic Conditions.

In regard to the question of traffic, Mr. Norman drew attention to the findings of four different commissions or committees, all of whom had emphasised the importance of having a traffic authority for an area greater than the County of London. There ought to be an authority which could determine traffic routes, and his submission was that a body of a different kind from the County Council would be the proper body for this purpose. There was great divergence of opinion on the Council as to the propriety of the Council itself acting both as an operating and a traffic authority.

Replying to questions by Mr. R. DONALD, witness maintained that the traffic authority should not be the operating authority. Until they knew what would be the organisation in the new area, it was difficult to say what should be done with the municipal tramways outside the County of London. The system of tramways originally carried out in London had not succeeded so well as it should have done. Up to the present there had been a combination of tubes, tramways, electric railways and omnibuses in London, and it had been an immense improvement on the old system. It was, however, commercially unprofitable, and he thought the people who used the transport services ought to pay for them.

In cross-examination Mr. Norman said he considered it inconsistent that one authority should operate a competitive transport system, and at the same time control its rivals. Public ownership of the means of transport in Greater London would mean a vast expenditure of public money. With an efficient traffic authority co-operation could be enforced and routes could be determined. In Canada and the United States the local authority has the power to regulate those matters.

In reply to Mr. Donald, who suggested that if the public authority acquired all transport facilities, it would be in a position to lease them on terms advantageous to the community, witness said he was not afraid of being under the tyranny of a monopoly, but he was anxious for a traffic authority.

Electricity Supply and Education.

It would be convenient if the new administrative area of Greater London were made to coincide with that of the London and Home Counties Electricity District. It would be a great pity to oust the people who had been providing electricity for years, and who knew all about it. He did not think electricity should be produced by the same authority which regulated traffic. There were a number of services which he considered should be administered by committees of the future authority, and not by *ad hoc* authorities or by joint committees.

Mr. Norman also pointed out there were serious difficulties in regard to secondary and technical education which would not arise in the same degree if the urban areas formed a single educational authority. Out of 61 000 students in technical schools in London, 11 000, and out of 69 000 students in the secondary schools, 9 000, came from outside the county. There was great difficulty in getting the out-county authorities to pay for those students.

Obituary.

The death has taken place, at Boulton, of Mr. J. E. RENDELL-BAKER, a former manager of the electricity works at Stratford-on-Avon, in which he was succeeded a short time ago by his brother.

The death occurred at Torquay last week in his sixty-ninth year of Mr. JACOB ATHERTON. Mr. Atherton was associated with his elder brother, Mr. J. B. Atherton, in many important commercial development schemes. When his brother in 1890 returned from the United States with the patent rights in paper insulated cables, Mr. Jacob Atherton joined him in the formation of the British Insulated Cable Company and in the erection in 1890 of the extensive works at Prescott, which now bear the name of the British Insulated and Helsby Cables, Ltd., the business of the Telegraph Manufacturing Company of Helsby, having been taken over more recently. The two brothers established a number of lighting concerns, including the Midland Electric Corporation for Power Distribution, the Blackheath and Greenwich Electric Light Company (now the South Metropolitan Electric Light and Power Company), and the South London Electric Supply Corporation. Mr. Atherton was a director of the last-named company and of the County of London Electric Supply Company at the time of his death. From electric cables and power the brothers turned their attention to tramways, and promoted in Parliament the Bill which authorised the laying down of the South Lancashire tramways system, which ultimately linked up Liverpool by tram track with Manchester. They also secured a Light Railway Order for a tramway between Aigburth and Garston, which paved the way for the extension of the municipal tramway service in the South-end of the city. Mr. Jacob Atherton was also associated with electric supply and tramway construction schemes in Australia.

Electricity Supply.

EDINBURGH Electricity Committee have referred to a sub-committee a proposal by the Electrical Contractors' Association that before the Portobello Power Station is opened an electrical exhibition should be held in the Waverley Market to demonstrate to the public the various uses to which electricity may be put.

Experiments are being carried out by the MARYLEBONE Borough Council to improve the lighting of Oxford-street and Regent-street. The Council have declined the offer of a commercial company to fix illuminating advertising signs to the arc lamps in Oxford-street and pay the Council a rental of £2,000 per annum and 2½ per cent. of the gross receipts obtained from letting the signs to shopkeepers.

At a meeting of COLWYN BAY Council, last week, it was reported that the new transformer station was practically completed, and the plant installed; that the underground main from the North Wales Power Company's sub-station at Brynnyant had been laid to the transformer station; but that the erection of the overhead transmission line from Dolgarrog to the Brynnyant sub-station is being held up through a dispute with landowners as to wayleaves.

The new ELECTRIC PUMPING PLANT at Clara Vale Colliery, erected under the supervision of Mr. L. H. Foster, the electrician at the colliery, was officially started last week. The capacity of the plant is 3,100 gallons per minute, and consists of three patent turbine pumps, and the water will be pumped against a head of 368 ft. The pumps have been supplied by Mackley & Company, electrical engineers, Gateshead; the motors by the Metropolitan-Vickers Company, the switch gear by A. Beyrolle & Company.

In his annual statement to the MERSEY DOCKS AND HARBOUR BOARD, the chairman, Mr. Thomas Rome, stated, with reference to the electrification of the Dock Estate, that the work in connection with the Sandon to Hornby section was now completed, and electricity for power and lighting was available at all the sheds and graving docks in the district. The laying of the main cables in connection with the extension to the Gladstone system of docks had also been finished, and the necessary sub-station machinery was in hand.

New Schemes and Mains Extensions.

Negotiations are in progress between PEMBROKE and RATHMINES Urban Councils regarding proposals which have been made for linking up the electricity supplies of the two townships. If the scheme is decided upon, alterations and additions to the plant at both stations will be necessary, and it is roughly computed that not less than £50,000 will be spent on the work.

The Electricity Commissioners will hold a local inquiry at the Town Hall, Barrow-in-Furness on Tuesday, Jan. 31, at 10.30 a.m. and following days with reference to the area to be included in the proposed NORTH LANCASHIRE AND SOUTH CUMBERLAND ELECTRICITY DISTRICT, and to consider a scheme submitted by a Provisional Joint Committee for the improvement of the organisation for the supply of electricity within the district, and for the establishment of a Joint Electricity Authority.

SEAHAM HARBOUR Urban Council have approved the scheme recommended by Mr. T. Dawson Martin for supplying the district with electricity, and the town is to be canvassed to ascertain the number of prospective users. A public meeting will then be called, and a further report submitted showing the prospective income and expenditure on a commercial basis. The scheme provides for a bulk supply from the Cleveland and Durham Electric Power Company at 6,000 V, and it would be distributed to consumers from the local sub-station.

There is evidence that the revised GRAMIANS HYDRO-ELECTRIC scheme is looked upon with more favour by local authorities, and the Provisional Order is, therefore, likely to encounter less opposition than the 1921 Order. Though the Perth, Inverness, and Argyll County Councils have decided to lodge petitions, this is for the purpose of obtaining a *locus standi*, and for securing protective clauses. In the meantime, the Hydro-Electric Development Company is pushing forward the scheme, and an application has been made to the Government for a guarantee to facilitate the raising of the necessary capital. It is estimated that the complete undertaking will cost £4,000,000.

EDINBURGH Corporation have agreed, subject to the consent of the Commissioners, to supply electricity to the East Lothian County from the Portobello Power Station. It is proposed that Edinburgh should furnish at the county boundary a supply in bulk, leaving the East Lothian County Council and other local authorities concerned to arrange for the distribution of supplies to the county. At a meeting of the East Lothian Council last week it was agreed to engage the services of an electrical engineer to report on the most economical scheme of supply, and to advise the council generally. It was also decided to lodge objections to the application by Musselburgh and District Electric Light and Traction Company for a special Order to authorise the company to provide electricity in the parishes of Tranent and Prestonpans.

At their last meeting, HULL Electricity Committee reported that the work in connection with the supply of electricity to the cement works at Melton and Welton was, with the exception of a few details, now completed, and was working very satisfactorily. The scheme provides for the sale of 9½ million units of electricity per annum, with a maximum demand of 2,000 kW. A 22,000 V trunk feeder has been laid from the power-house in Hull to the cement

company's two sub-stations at Melton and Welton, where the voltage is reduced to 400 V. The necessary "step up" from the 6,600 V generating pressure at Sculcoates is effected by means of three 1,500 kVA transformers installed near the power-house. The cost of the work, for which it would be necessary to apply to the Commissioners for sanction, was £84,951 17s. In addition, permission would also be required for the following proposals adopted at various times by the committee:—Dansom-lane sub-station building £5,250, land for sub-station West and Central Hull, £1,309; sidings, Sculcoates, including haulage gear, £2,953; land for same, £1,983; public lamps, Prospect-street and Beverley-road, £1,199 10s.; a total of £12,699.

Alteration of Charges.

EDINBURGH electricity charges are to be raised from 4½d. to 5d. per unit for lighting, and from 1½d. to 2d. per unit for power.

From April next the price of electricity in LEEDS will be reduced from 80 per cent. on pre-war rates to 50 per cent. for power and 70 per cent. for other purposes. The reduction is the result of the lower price of coal.

WOLVERHAMPTON Electricity Committee recommend a reduction in the charges for electricity for lighting and power, both to private consumers and to the municipal tramways. It is expected that a reduction in tramway fares will now be possible.

Personal and Appointments.

Mr. G. COMPTON has been appointed demonstrator in physics at King's College, London, and Mr. F. A. HONG has been appointed to a similar post at Leeds University.

SIR CHARLES STEWART, of Marconi's Wireless Telegraph Company, will take the chair at a meeting to be held at University College, London, on Jan. 2, at 3 p.m., when Mr. P. A. Best, of Selfridge and Company, will give an address on "Education in Industry and Commerce."

Mr. W. E. PETER, managing director of Vickers-Petters, chairman of the British Engineers' Association, and a member of the Industrial League and Council, was entertained at supper and a concert at Ipswich last week, on the eve of his departure to India in connection with orders for his firm. Over 300 employees were present.

Mr. REGINALD COX, who has been for many years connected with English Electric and Siemens Supplies, Ltd., and their predecessors, has resigned his position in order to undertake the management of the London Office of Tramway Supplies, Ltd., at 93, Cannon-street. In addition to tramway requirements, Mr. Cox will handle the T.S. line of high-class oil switch equipment for all voltages, low tension distribution panels, underground cable boxes, and other manufactures.

Consequent upon the amalgamation of the LONDON and NORTH WESTERN RAILWAY and the LANCASHIRE and YORKSHIRE RAILWAY, Mr. G. HUGHES has been appointed chief mechanical and electrical engineer to the two systems, with Col. H. E. O'Brien, electrical engineer at Horwich, and Col. F. A. Cortez-Leigh, divisional electrical engineer (Division "A") at Euston. Division "A" comprises the whole of the London and North Western Railway prior to amalgamation.

Business Items, &c.

HOLLINGS & GUEST, LTD., have appointed Mr. D. Landale Frew, of 43, Hope-street, Glasgow, their sole agent for Scotland.

The British Pottery Manufacturers' Association propose to revise the PRICES OF ELECTRICAL FITTINGS, but details are not yet available.

THE KARTRET ENGINEERING COMPANY have now moved to their new works at White-street, Southall, to which address all inquiries should be sent.

JOHNSON & PHILLIPS, LTD., ask us to state that the telephone number of their new Liverpool branch, 57, The Albany, Old Hall-street, is Central 5145.

THE SCHOLEY CONSTRUCTION COMPANY announce that they have taken over the agency for the "Lincoln" or "R.W.B." dynamo plant recently held by the Electrical Apparatus Export Corporation. They have also accepted this type of welding plant for contract work in building up dish joints, and especially for the purpose of welding the fishplates to the rails by the "Lincoln" or "R.W.B." process.

TRAMWAY SUPPLIES, LTD., of Grove Mills, Meanwood, Leeds, ask us to state that in order to deal more efficiently with their rapidly growing business in the South, for both home and export requirements, they are opening an office at 93, Cannon-street, E.C. 4—telephone, City 3014; telegrams: "Tramsuplin," Cannon-street—and have appointed Mr. Reginald Cox, late of English Electric and Siemens Supplies, Ltd., as manager. Mr. Cox has had many years' experience in tramway equipment requirements, and is fully qualified to deal with technical points or suggestions, as well as with the business details of prices, &c. In addition to their well-known point controllers, overhead and car equipment lines, Mr. Cox will also handle a range of high-class oil switches manufactured by the company, comprising low, high, and extra high tension gear for all purposes, together with suitable high and low tension cable boxes and sub-station switchgear, fuse panels, &c.

Electric Traction.

Penny fares are to be restored on the BRIGHTON municipal tramways.

Penny fares are also to be reinstated on WALLASEY Tramways, but the 1½ stages will be continued.

PRESTON Tramways Committee have received sanction from the Electricity Commissioner to proceed with the extension of the electric generating station at Deepdale, Preston.

Representative Councils, Councils, are opposing the Bill of the London County Council to use the railless trolley system from West Norwood to Lee Green. They urge the L.C.C. to obtain powers to use buses instead.

THE LIVERPOOL OVERHEAD (ELECTRIC) RAILWAY has just introduced a system of shopping tickets for use between the Dingle and the Pier Head and intermediate stations. The fares represent a reduction of 14 per cent. on first-class and 27 per cent. on third-class fares.

The re-organisation of the LEEDS tramways is to be seriously tackled in the New Year. For many years big surpluses were earned, running up to nearly £80 000 in one year, which were absorbed in relief of rates. Now the undertaking is stated to be losing from £150 to £180 a day. In addition to the loss sustained, there is not a sufficient number of cars to carry the would-be passengers.

Details in connection with the electrification of EDINBURGH tramway system were considered at a meeting of the Tramways Committees last week. It was decided to recommend that the northern routes of the city should be the first or second instalments to be electrified; and, after a long discussion, the question of double deck cars on these hilly routes was dismissed as dangerous. The Ministry of Transport has approved of centre poles in Leith Walk, and of the use of the existing permanent way.

The proposal to obtain powers for the laying of nine new tramway routes in LIVERPOOL, at a cost of £228 578, has ended in fiasco. A special meeting of the City Council was called to enable an application to be made for a Provisional Order. It was fixed for Wednesday, Dec. 21, but the attendance was such that there were fifteen members short of the necessary quorum. After waiting twenty minutes beyond the time for which the meeting was called, the Lord Mayor announced that no meeting could be held. The result was the postponement of the development of the tramway system for a further twelve months. The capital value of the Liverpool tramway undertaking is estimated at £3 000 000.

Municipal Accounts.

According to the annual returns of the BLACKPOOL Corporation, the borough has 4 358 electricity consumers, 1 023 public electric lamps, and 168 miles of electric mains. The electricity output was 8 568 523 units, or 19 per cent. above the previous year's total.

The total income of SOUTHWARK electricity undertaking for the year ended March 31, after deducting £490 for discounts, allowances, and bad debts, was £59 118, an increase of £9 397 over that of the preceding year. The total expenses were £46 654, leaving a gross profit of £12 464 (£1 980). Interest and repayment of loans, however, required £10 864 10s., leaving a net profit of £1 599 10s. The expenditure on capital account was £6 879, leaving at the close of the year a balance expended in excess of loans of £3 495. The total capital outlay at the close of the year was £162 430, the total loan debt £83 977 19s. 4d., and the total amount of debt extinguished (equivalent to depreciation) £73 204 16s. 2d.

The total income of EAST HAM Corporation Electricity Works for the year ending March 31 was £65 035, compared with £54 335 for the previous year; expenditure amounted to £60 559, an increase of £14 832, leaving a gross profit of £4 477 (£8 619). After providing for interest (£4 571), sinking fund and loans repayment (£6 930), and meeting certain items of capital expenditure (£2 986), there was a deficit of £9 989. Units sold totalled 4 477 186 (4 537 758); consumers numbered 2 100 (1 895); maximum load, 2 420 kW (2 534 kW); load factor 23.8 per cent. 23.1 per cent.). The total operating costs were 3.15d. (against 2.28d.) per unit, an increase of 44d. for coal and 27d. for repairs, but rates, capital charges and management were all higher. The total borrowing powers amount to £165 854, but the net outstanding debt is only £47 195.

The total income of HALIFAX CORPORATION ELECTRICITY UNDERTAKING for the year ending March 31, amounted to £182 998, compared with £137 832 in the previous year; total costs, including sinking fund (£15 715) and interest on loans (£13 415), were £162 784 (£113 835), leaving a net profit of £20 124 (£23 997). From this, however, had to be provided £6 058 deficit from last year, when certain items of capital expenditure had to be provided, together with an additional sum of £45 118 for special expenses, including £16 733 in aid of the rates, and £16 853 for new plant, which left a deficit of £31 052. This figure was reduced by the balances on the renewals and reserve funds to £27 534, which amount is carried forward. The capital expenditure at March 31 amounted to £378 041, an increase of £20 108 for the year. The amount now standing to the credit of the reserve and renewals fund is £3 518. The total units sold numbered 18 521 577 (16 161 399), and the maximum demand was 8 790 kW (7 760 kW).

Institution Notes.

A special meeting of the members of the ENGINEERS CLUB of MANCHESTER will be held in the smoke-room of the club at 1.45 p.m. on Tuesday, January 10, when certain alterations of the rules will be proposed.

The Council of the INSTITUTION OF CIVIL ENGINEERS have made the following awards for papers printed without discussion in the "Proceedings" for the sessions 1918-1919 and 1919-1920:—Session 1918-1919.—A Telford medal to Prof. E. G. Coker (London); a Crampton prize to Mr. F. F. P. Bisacre (Glasgow); a Manby premium to Mr. E. H. Lloyd (Cairo); and a Telford premium to Mr. Rollo Appleyard (London). Session 1919-1920.—A Crampton prize to Prof. F. C. Lea (Birmingham); and Telford premiums to Messrs. A. R. Horne (Aberdeen); S. Blencowe (Buenos Aires); and W. J. Walker (Dundee), and R. Koivulehto.

At the last meeting of the CHELMSFORD ENGINEERING SOCIETY, Mr. E. A. Evans (of C. C. Wakefield & Company) gave an illustrated lecture on "Petroleum and Its Lubricating Properties." After dealing briefly with the early history of petroleum, the development of oil wells, and the various refining processes, the lecturer gave a full account of the theory of lubrication and the latest discoveries regarding the molecular construction and properties of oils. Due to small electric charges, a mutual attraction exists between all molecules sufficiently close together, and the friction between two finely polished surfaces is due to the attractive force between their molecules. By the interposition of a film of oil between the two surfaces they are separated beyond their sphere of mutual attraction, and only the outside molecules of oil are caused to cling to the surfaces. Under these conditions the only molecular disturbance due to relative motion between the surfaces occurs in the centre of the oil film, and thus liquid takes the place of solid friction.

THE PHYSICAL SOCIETY AND OPTICAL SOCIETY'S ANNUAL EXHIBITION, which is to be held on Wednesday and Thursday, January 4 and 5, at the Imperial College of Science, South Kensington, will be open in the afternoon (from 3 to 6 p.m.), and in the evening (from 7 to 10 p.m.). Mr. A. A. Campbell Swinton will give a lecture on "The Johnson-Rahbek Electrostatic Telephone and its Predecessors," at 4 p.m. on January 4, and at 8 p.m. on January 5. Mr. F. Harrison Glew will give a lecture on "Radium: its application in Peace and War," at 8 p.m., on January 4. Prof. F. J. Cheshire being in the chair. All the lectures will be illustrated by experiments. Other discourses are being arranged. Over fifty firms are exhibiting scientific apparatus, and a number of experimental demonstrations have been given to the Institution of Electrical Engineers, the Institution of Mechanical Engineers, the Chemical Society, the Faraday Society, the Wireless Society of London, and the Röntgen Society. Admission in all cases will be by ticket only, and therefore members of the societies mentioned desiring to attend the exhibition should apply to the secretary of the society to which they belong. Others interested should apply direct to Mr. F. E. Smith, hon. secretary of the Physical Society, Admiralty Research Laboratory, Teddington, S.W.

Imperial and Foreign Notes.

THE VICTORIAN PARLIAMENT has authorised a loan of £2 006 000 in connection with the Morwell power works of the State Electricity Commission.

BLOEMFONTEIN Council is raising a loan of £10 000 in connection with its trackless tramway service, and will also utilise, it is stated, £8 000 from the tramway renewals fund for the purchase of five new cars, in addition to three other new cars now on order.

City railway extensions estimated to cost £4 500 000 are to be proceeded with in SYDNEY (NEW SOUTH WALES), in order to relieve the existing rail and tram services. In 1905 the tramways on the southern shore of Sydney Harbour carried 120 973 934 persons; in 1920 the number had risen to 269 255 033.

H.M. Senior Trade Commissioner in Australia (Mr. S. W. B. McGregor) reports that an important local departmental store is sending a representative to the United Kingdom, the Continent, and the United States with a view to purchasing all descriptions of domestic, medical, and other electrical fittings and appliances suitable for a retail store.

German exports of electrical supplies during the present year amount to nearly 50 per cent. of the pre-war quantities.

It is stated that various electricity undertakings in the ALPINE DISTRICTS are considering the construction of artificial reservoirs to regulate the flow of the water for their generating stations.

It is estimated that a saving of £4 000 000 was effected this year by the Municipal Council of PARIS, owing to the operation of summer time, and among the economies was a saving of 200 000 tons of coal for the electric lighting and gas services.

Water was turned into the new CHEPPAWA CANAL (ONTARIO) on Wednesday. The canal is 12½ miles long, and represents an excavation of 11 000 000 cubic yards of earth and 4 000 000 cubic yards of rock. Its average depth is 30 ft. in earth and 40 ft. in rock, its width sloping from 162 ft to 70 ft. in earth and being constant at 48 ft. in rock. The power house is near Queenston. Each turbo-generator will be of 55 000 h.p. capacity, and the ultimate capacity of the station from 500 000 to 600 000 h.p.

Tenders Invited and Accepted.

UNITED KINGDOM.

BIRMINGHAM SALVAGE AND STABLES COMMITTEE. Jan. 2, 1922.—Contract No. 1 (a) eight-cell destructor in two units; Contract No. 2, electric garage. Particulars from Mr. J. Jackson, Superintendent, Salvage Department, Council House, Birmingham.

LIVERPOOL OVERHEAD RAILWAY. Jan. 2.—Six months' supply of electrical fittings, insulating taps, &c. Particulars from Mr. E. J. Neacell, General Manager, 31, James-street, Liverpool.

SHEFFIELD ELECTRICITY SUPPLY DEPARTMENT. Jan. 5.—Materials and works required in connection with the erection and completion of a transformer sub-station in London-road, Sheffield. Particulars from Mr. S. E. Fedden, general manager and engineer, Electricity Supply Department, Commercial Street, Sheffield.

SWINDON AND HIGHWORTH BOARD OF GUARDIANS. Jan. 4.—Installation of the electric light at the Children's Home. Particulars from the Clerk, Mr. W. P. Kirby, 17, Bath-road, Swindon.

MALDEN AND COOMBE URBAN COUNCIL. Jan. 10.—Two 10 h.p. horizontal electric motors, starting gear, &c., and electric lighting in the subsidiary pumping station at Blake's-lane; one 24-ton electric lorry with tipping body; and mercury vapour rectifier outfit. Particulars from the Engineer and Surveyor, Municipal Offices, New Malden.

LONDON COUNTY COUNCIL. Jan. 12.—Electric passenger lift to lift a load of 11½ cwt., at Geoffrey House, Tabard Estate, Bermondsey, S.E. 1. Specification from the Chief Engineer, Gloucester House (Room 91), 19, Charing Cross-road, W.C. 2.

PETERBOROUGH CORPORATION. Jan. 12.—One 3000 kW turbo-alternator, with condensing plant, two 750 kW rotary converters, two 100 kW motor converters, e.h.t. and l.t. switchgear; steam, water and drain pipes, &c. Specifications from the City Electrical Engineer.

LEEDS ELECTRICITY DEPARTMENT. Jan. 12.—Single-phase wattmeters, minimum number required 2000. Particulars from Mr. C. Nelson Hefford, Manager, Electricity Department, 1, Whitehall-road, Leeds.

EAST HAM CORPORATION. Jan. 12.—Extension No. 4. Sec. A: 1500 kW rotary or motor converter, for converting 3-phase 50 period 6600 V to d.c. 480-500 V; Extension No. 4 S. Sec. A: e.h.t. and l.t. switchgear and connections. Particulars from Mr. W. C. Ullmann, Nelson-street, East Ham, E.

WORKING CORPORATION. Jan. 23.—One Diesel engine and c.c. dynamo; and vulcanised bitumen-sheathed paper-insulated concentric and triple concentric cable. Specifications, &c., from the Borough Electrical Engineer.

DUNDEE CORPORATION.—Electric lighting of public clocks at Broughty Ferry, Lochee, and St. Peter's. Particulars from the City Architect.

AUSTRALIA.

POSTMASTER-GENERAL'S DEPARTMENT. MELBOURNE.—Jan. 17, 1922.—"Supply and delivery of telegraph instruments, differential galvanometers, keys, relays, sounders, &c., to the stores branch. (Schedule No. 1 718.) Local representation is essential.

VICTORIAN GOVERNMENT RAILWAYS. Jan. 25, 1922.—* Supply and delivery of ten coasting recorders, or, alternatively, ten coasting and service recorders, for electric trains. (Contract No. 34 736.)

CITY ELECTRIC LIGHT COMPANY, LTD., BRISBANE.—Feb. 10, 1922.—*Supply and delivery of six miles of three-core 0.15 by 0.15 by 0.15 paper insulated cable, suitable for 5500 V, with a non-earthed system. Tenders, accompanied by a preliminary deposit of £100, to the Engineer and Manager, Boundary-street, Brisbane.

AUSTRALIAN COMMONWEALTH GOVERNMENT. Feb. 15.—30 tons approximate Wheatstone tape paper white (Schedule 544). Particulars from the Supply Officer, Australia House, Strand, London, W.C. 2.

VICTORIAN GOVERNMENT RAILWAYS.—Feb. 15.—*Supply and delivery of: (1) Fifty track relays, four front and two back contacts, fifty track relays, eight front and two back contacts, fifty line relays, six front and two back contacts (Contract No. 34 739); (2) 100 three-position line relays (Contract No. 34 740); (3) 100 electric signal mechanisms (Contract No. 34 738); (4) electro-mechanical interlocking apparatus (Contract No. 34 822); (5) fifty miles insulated copper wire (Contract No. 34 823). Local representation is essential.

NEW SOUTH WALES GOVERNMENT RAILWAYS AND TRAMWAYS DEPARTMENT (Electrical Engineer's Branch).—Feb. 22, 1922.—*Supply, delivery, erection and maintenance of one 5000 kW 50 cycle turbo-alternator with condenser and accessories, at Zarra-street power house, Newcastle. (Contract No. 556.) Tenders, or proper forms and accompanied by a preliminary cash deposit, to the Secretary for Railways, Phillip-street, Sydney, N.S.W. Local representation is essential.

SOUTH AFRICA.

MUNICIPAL COUNCIL OF JOHANNESBURG. Jan. 4.—*Supply and erection of one two-phase alternating-d.c. 2000 kW converter, switchgear and spares. The h.t. supply is two phase, 3000 to 3500 V per phase, 50 periods, and the converter is to be capable of supplying (a) d.c. three-wire from 460 to 520 V as a shunt-wound machine; and (b) traction supply from 500 to 550 V as a compound-wound machine.

ELECTRIC DEPARTMENT OF DURBAN CORPORATION. Jan. 18, 1922.—*372 consumers' Wh meters, including 37 d.c. meters, 275

—*Particulars from the Department of Overseas Trade.

single-phase, 50 cycle induction type meters, and 60 three-phase, 50 cycle, induction type a.c. meters for unbalanced loads.

MUNICIPAL ELECTRICITY SUPPLY UNDERTAKING OF THE CITY OF PORT ELIZABETH. Jan. 31.—Supply of electrical plant.

PUBLIC WORKS DEPARTMENT OF THE UNION OF SOUTH AFRICA. Feb. 1.—Conduit and conduit fittings. Particulars from the Electrical Engineer, Public Works Department, Pretoria.

SOUTH AMERICA.

ARGENTINE NATIONAL BOARD OF SANITARY WORKS.—January 19, 1922.—*Plant and accessories for new generating station, including three 4-cycle 375 h.p. Diesel engines, to run on crude petroleum, and three 3-phase alternators, each of 250 kW, 2200 V between phases, 50 cycles, power factor 0.8.

ARGENTINE MINISTRY OF PUBLIC WORKS. Feb. 21, 1922.—*Nine electric motors, 36 tip waggons, 1 centrifugal pump with electric motor. Specification expected at the Department of Overseas Trade by Dec. 25.

CHILEAN STATE RAILWAYS. Feb. 4, 1922.—*1 electric compressor; 1 air storage drum and 1 continuous current electric motor (70 h.p.); 1300 electric filament lamps for locomotives; 38 wall telephones.

BULGARIA.

BULGARIAN DIRECTION OF POSTS, TELEGRAPHS AND TELEPHONES. Jan. 10, 1922.—Supply of sixty 50-line and fifteen 100-line telephone exchanges. Particulars and drawings may be obtained from the Bulgarian Legation, 3, Queensberry-place, S.W. 7.

BULGARIAN DEPARTMENT OF POSTS, TELEGRAPHS AND TELEPHONES. Jan. 25.—*100 300 porcelain insulators.

BULGARIAN DEPARTMENT OF POSTS, TELEGRAPHS AND TELEPHONES. January 30.—*Supply of the following parts for telephone exchanges: 2200 subscribers' line indicators, 600 indicators (end of conversion), 2500 jacks, 1500 plugs, 2000 connecting pieces, 20 000 switchboard connecting pieces.

BULGARIAN DEPARTMENT OF POSTS, TELEGRAPHS AND TELEPHONES. Feb. 8.—*Supply of the following telegraphic accessories: Twenty terminal boxes for 40-pair cable, 1 000 combined lightning arresters and 1 A fuses, 500 combined lighting arresters in fuses (different type), 300 transformers, 700 condensers (2 micro-farad), twenty junction-boxes with protective devices for 40 pair cable.

BULGARIAN DEPARTMENT OF POSTS, TELEGRAPHS AND TELEPHONES. February 20.—*2000 telephone instruments for table use, with local battery and magneto. Also for spare parts for these instruments.

Arrangements for the Week.

ROYAL INSTITUTION.

At Albemarle-street, London, W. Christmas Lectures on "Electric Waves and Wireless Telephony," by Prof. J. A. Fleming, F.R.S.

SATURDAY, Dec. 31st.

7 p.m. Lecture II., "Waves in Air."

TUESDAY, Jan. 3rd.

3 p.m. Lecture III., "The Telephone."

THURSDAY, Jan. 5th.

3 p.m. Lecture IV., "Electric Oscillations."

SATURDAY, Jan. 7th.

3 p.m. Lecture V., "Electric Waves."

TUESDAY, Jan. 3rd.

INSTITUTION OF ELECTRICAL ENGINEERS.

EAST MIDLAND SUB-CENTRE.

6.45 p.m. At the College, Loughborough. Paper on "The Electrical Development of Outlying Districts," by Mr. R. A. Chaddock.

WEDNESDAY, Jan. 4th.

INSTITUTION OF ELECTRICAL ENGINEERS.

WIRELESS SECTION.

6 p.m. At Savoy-place, Victoria Embankment, London, W.C. Paper on "High Speed Wireless Telegraphy," by Lieut.-Col. A. G. T. Cousins.

THURSDAY, Jan. 5th.

INSTITUTION OF ELECTRICAL ENGINEERS.

6 p.m. At Savoy-place, Victoria Embankment, London, W.C. Lecture on "Single and Three-Phase Commutator Motors with Shunt and Series Characteristics," by Dr. Stanley Parker Smith.

LIVERPOOL ENGINEERING SOCIETY.

STUDENT SECTION.

7.30 p.m. At the Royal Institution, Colquitt-street, Liverpool. Paper on "Towns, Gas and the Gas Engine," by Mr. E. Crowther.

FRIDAY, Jan. 6th.

INSTITUTION OF MECHANICAL ENGINEERS.

6 p.m. At Storey's Gate, London, S.W. Joint meeting with the Society of Chemical Industry. Paper on "The Co-operation of the Engineer and Chemist in the Control of Plants and Processes," by Mr. G. M. Gill.

COMMERCIAL INTELLIGENCE.

The following information is taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette.

Bankruptcy Information.

BARNETT, B. (male), 104, Whitechapel-road, London, E. 1, electrical engineer. Receiving order, Dec. 20 (creditor's petition). First meeting, Jan. 6, 1 p.m., and public examination, Mar. 8, 11 a.m., Bankruptcy Buildings, Carey-street, London, W.C. 2.

Bills of Sale.

[The undermentioned information is from the Official Registry. It includes Bills of Sale registered under the Act of 1882 and under the Act of 1878. Both kinds require registration every five years. Up to the date the information was obtained it was registered as given below; but payment may have been made in some of the cases, although no notice had been entered on the Register.]

DRIVER CYRIL, 10, Willmer-road, Anfield, Liverpool, electrical instrument maker. Dec. 21. £30.

Mortgages and Charges on Limited Companies.

[NOTE.—The Companies Act of 1908 provides that every Mortgage or Charge, as described therein, created by a Company after the commencement of the Act, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its annual Summary under the Companies Act, specify the total amount of debt due from the Company in respect of all Mortgages or Charges which would, if created after the commencement of the Act, require registration. The following Mortgages and Charges have been so registered. In each case the total debt prior to the present creation, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.]

NOTTING HILL ELECTRICAL LIGHTING COMPANY, LTD. Registered Dec. 14, £25,000 7½ per cent. seven-year notes; general charge. *£64,000. Guaranteed by this company and the Kensington and Knightsbridge Electric Lighting Company, Ltd., and issued under the powers of the Kensington and Notting Hill Electric Lighting Companies Act, 1899, £221,550. Mar. 29, 1921.

Receivership.

ALLIES ELECTRIC LAMP REPAIRING COMPANY, LTD. A. Elliott, of 2, Langdale-avenue, Mitcham, was appointed receiver and manager on Dec. 13, 1921, under powers contained in debenture dated Jan. 7, 1919.

Bankruptcy Proceedings.

WILLIAMS, J. G., 4, Blaenmant-street, Duffryn, Cymmer, Port Talbot, Glamorganshire, electrical engineer. The first meeting of creditors was held recently at Swansea. According to the statement of affairs the gross liabilities amounted to £4,433, of which £393 was expected to rank for dividend, against assets estimated to realise £11, or a deficiency of £382. Meeting adjourned.

Company Winding-up Voluntarily.

ILFORD DRY BATTERY COMPANY, LTD. (in voluntary liquidation), Wool Exchange, London, E.C. 2. The statutory meeting of creditors was held recently at the offices of the liquidator, 2, Guildhall-chambers, E.C. 2. The statement of affairs showed liabilities £1,976, and net assets £682, a deficiency of £1,294. It was stated that the company was originally interested in the manufacture of batteries under French patents, and in 1919 one of the patents was sold for about £2,000, and that money was utilised in discharging liabilities and wiping out a debenture. Since that date the company had traded in various goods, but had not succeeded in making a profit. It was pointed out that the assets shown in the statement of affairs were not sufficient to fully discharge the claims of the debenture holder, and there was nothing left for the unsecured creditors. After discussing the position, a resolution was passed confirming the voluntary liquidation of the company, with Mr. E. W. Roberts as the liquidator.

Books Received.

"Costing for Manufacturers." By W. Howard Hazell. (London: Nisbett & Co., Ltd.). 12s. 6d.
"Converting a Business into a Private Company." By H. W. Jordan. (London: Jordan & Sons.) Pp. 48. 1s.
"Die Transformatoren." By Prof. Dr. Gustav Benischke. (Brunswick: F. Vieweg & Sohn.) Pp. xviii. + 277. M. 70.
"The Electro-Metallurgy of Steel." By Colin C. Gow, A.R.S.M., B.Sc. (London: Constable & Co.) Pp. xvi. + 351. 27s. 6d.

New Companies.

The following list is compiled from information supplied by Messrs. Jordan & Sons, Ltd., company registration agents, 116-118, Chancery-lane, London, W.C. 2.

AMESBURY ELECTRIC LIGHT AND GENERAL SUPPLY COMPANY, LTD. (178 421), South Mill, Amesbury, Wilts. Registered Dec. 16, 1921. To generate and supply electric current for light and power in or near Amesbury, Wilts. Nominal capital, £5,000, in 5,000 shares of £1 each. Minimum subscription, 3,500 shares. Directors: H. C. James (chairman), J. O. March, Sir C. G. Antrobus, Bart., A. Swan, and L. Binns.

BRITISH ENGINEERING UNITS, LTD. (178 516). Registered Dec. 20. Mechanical and electrical engineers. Nominal capital, £1,000, in 1,000 shares of £1 each. Directors: A. Green and S. A. Bailey. Qualification of directors, one share. Subscribers: H. Megainey, 17, Shaftesbury-road, Earlsdon, Coventry, and H. N. Gillitt.

PATENT ELECTRIC BOILER SCALING COMPANY, LTD. (178 502). Registered Dec. 19. Boiler cleaners. Nominal capital, £500, in 500 shares of £1 each. Directors: J. Townson, 28, Samson-street, Oldham, and R. Townson. Qualification of directors, £100.

PROJECTOR PUBLICITY COMPANY, LTD. (178 533). Registered Dec. 20. Merchants and dealers in electrical fittings and devices, and electric novelties for advertising. Nominal capital, £500, in 500 ordinary shares of £1 each. Directors: H. Gerson, 80, New Cavendish-street, W. 1., and H. Fletcher. Qualification of directors, £1.

SUPRA ELECTRICAL COMPANY, LTD. (178 452). Registered Dec. 16. Mechanical, electrical engineers, &c. Nominal capital, £2,000, in 2,000 shares of £1 each. Directors to be appointed by subscribers. Qualification of directors: one share. Subscribers: L. H. Rochford, 63, Loveday-road, Ealing, W. 13, and Miss Lucy Rochford.

Catalogues, Price Lists, &c.

R. A. EVANS, LTD., have just published a new loose-leaf illustrated catalogue and price list (No. 928) of their electric lift accessories and parts.

The RUNBAKEN MAGNETO COMPANY have issued a series of leaflets describing the Runbaken headlight dimmer switch steering wheel controls, dashboard petrol gauges, sparking plugs, and pistons, &c.

British Insulated and Helsby Cables, Ltd., have issued a pamphlet (No. P.171) containing details of their PRESCOT ALUMINIUM MATTING AND SECTIONS, and aluminium and copper sheets.

Electrical accessories, fittings, switch gear, switch boards, etc., are described in a loose-leaf catalogue just issued by the PRIORY ELECTRICAL ENGINEERING COMPANY. Each article is fully described and illustrated.

The AUTOMATIC ELECTRICAL DEVICES COMPANY OF CINCINNATI have issued Bulletin No. 628, describing a small and compact apparatus known as the Homecharger, and comprising a transformer and vibrator rectifier for charging small batteries from alternating current circuits.

Prices of Metals, Chemicals, &c.

		TUESDAY, DEC. 27.			
		Price.	Inc.	Dec.	
Copper—					
Best selected	per ton	£68 5 0	10s.	—	
Electro Wirebars	.. ..	£75 10 0	—	—	
H.C. wire, basis	per lb.	0s. 11½d.	—	—	
Sheet	.. ..	0s. 10½d.	—	—	
Phosphor Bronze Wire (Telephone)—					
Phosphor-bronze wire, basis	.. ..	1s. 3½d.	—	—	
Brass 60/40—					
Rod, basis	.. ..	0s. 7½d.	—	—	
Sheet, basis	.. ..	0s. 10½d.	—	—	
Wire, basis	.. ..	0s. 11½d.	—	—	
Pig Iron—					
Cleveland Warrants	per ton	£5 5 0	—	—	
Galvanised steel wire, basis S SWG	.. ..	£22 0 0	—	—	
Lead Pig—					
English	.. ..	£26 10 0	—	10s.	
Foreign or Colonial	.. ..	£25 0 0	—	10s.	
Tin—					
Ingot	.. ..	£171 5 0	—	£1 10 0	
Wire, basis	per lb.	2s. 3½d.	—	—	
Antimony Ingot	.. ..	£120 0 0	—	£5 0 0	
Salmoniac.—Per cwt. 65s.-60s.					
Sulphur (Flowers).—Ton £12 10s.					
" (Roll-Brimstone).—Per ton £12 10s.					
Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.					
Copper Sulphate.—Per ton £28 10s.					
Boric Acid (Crystals).—Per ton £65.					
Sodium Bichromate.—Per lb. 6d.					
Sodium Chlorate.—Per lb. 3½d.					

Rubber.—Para fine, 1s. 2½d.; plantation 1st latex, 1½d. to 1½½d. The metal prices are supplied by British Insulated & Helsby Cables, Ltd.

Companies' Meetings, Reports, &c.

HUGHES JOHNSON STAMPEERS, LTD., recommended a dividend of 7½ per cent, tax free.

THE CHILL TELEPHONE COMPANY announced an interim dividend of 5s. per share, tax free.

SEVERN-TAMER WATER AND POWER COMPANY, Ltd., declared a dividend of 1½ per cent, on the common stock for the quarter ended Dec. 31 at 1½ pence of record on Dec. 27.

CROMPTON & COMPANY have declared an interim dividend at the rate of 7 per cent. per annum on the preference shares for the six months ended September 30.

The accounts of FERANTINI, LTD., show a net profit for the year to June 30 of £36,268; £39,462 was brought in, making a total of £125,750, of which £100,000 has been placed to general reserve. Out of the general reserve it has been decided to write down the value of goodwill and patent rights (£59,371) to nominal value of £1, leaving a balance in the general reserve of £102,630. The directors recommend out of the profits for past year a dividend of 18 per cent., less tax, being three years' arrears, on account of arrears of preference share dividend. They have decided to postpone submitting a definite scheme for reorganisation of capital until conditions are more stable.

The annual meeting of C. A. VANDERVELL & COMPANY was held in London last week, Mr. C. A. Vandervell (chairman and joint managing director) presiding. Dealing with the report and accounts, the chairman referred to the item of £74,000 in the freehold land and building account. This, he stated, was in connection with the new works, which were now nearly completed, at Larden-road, Acton, which had been constructed to enable the weekly output of complete electrical equipments to be brought up to 2,000. During the year Mr. Vandervell, at his own expense, bought the valuable patent rights of the Willard Patent Rubber Separators for batteries, as the company was not in a position to purchase them, and was in danger of losing the opportunity of securing them. Mr. F. R. Wade and Sir Charles C. Hobhouse were elected directors.

Mr. Douglas Vickers, M.P. (chairman) presided at the annual meeting of VICKERS, LTD., at Sheffield, last week. In moving the adoption of the report and accounts, the chairman dealt at length with the subsidiary and connected companies. This item, he said, showed an increase over the last balance-sheet of about £340,000. This was partly due to a transfer from "marketable securities" of about £250,000, the price in their books of certain shares in Sir William Arrol & Company, and the South Metropolitan Electric Light and Power Company. The first-named shares were mainly acquired in exchange for some crane works in Glasgow. The interest in the latter was taken for reasons of policy at the time when Vickers, Ltd., and the Metropolitan Carriage Company were jointly acquiring interests in and around the British Westinghouse Company. The shares of both these companies are quoted, but, as the interests are held for reasons of policy, it was thought logical that they should be transferred to the item of "interests in subsidiary and connected companies." The balance of the increase was also mainly due to the acquisition of certain electrical interests. The outstanding interest in the account was, of course, the Metropolitan Carriage, Wagon, and Finance Company, which stands at about £12,954,000. As its name implied, it was a holding as well as a manufacturing company, and its assets included a portion of the capital of Electric Holdings, Ltd., and of the Metropolitan-Vickers Electrical Company. The other part of the capital of Electric Holdings was held directly by Vickers, and stands at £1,082,500. Electric Holdings, Ltd., was formed by the Metropolitan Carriage Company before the amalgamation in order to hold, among other interests, the controlling interest that was being acquired in the British Westinghouse Company. Of the issued preference capital of the Metropolitan-Vickers Electrical Company, Vickers, Ltd., held about £800,000 nominal out of £1,235,000, about £691,000 out of £1,136,000 ordinary capital, all the deferred shares, and £675,000 out of the £1,241,000 4 per cent. mortgage debenture stock. Electric Holdings, Ltd., also held a large interest in Brown, Boveri & Co. Another electrical manufacturing interest directly held by Vickers was that of W. T. Glover & Co., in which Vickers, Ltd., own about 99 per cent. of the capital of about £227,000.

An abstract of the accounts appeared in our issue of Dec. 15.

Forty Years Ago.

(THE ELECTRICIAN, DECEMBER 31, 1881.)

THE ELECTRIC LIGHT FOR EMERGENCIES.—The large tool shop belonging to Messrs. Fowler's engine works at Leeds was burnt down a few days ago. Messrs. Fowler at once telegraphed to Messrs. Hammond & Co. to erect some of the Brush lights to enable the debris to be cleared away by night as well as day. Within forty-eight hours the ruins were illuminated, and we believe the light is to be used until the buildings have been re-erected.

THE TELEPHONE AND FIRES IN BIRMINGHAM.—In consequence of the terrible disaster at Vienna, a special inspection has been made of the theatres and concert halls in Birmingham by Superintendent Tozer, the head of the fire brigade, with a view of ascertaining the danger to be apprehended under circumstances of an alarm of fire. In his report on the subject to the Watch Committee, amongst other things, he strongly recommends that there should be telephonic communication with the central fire stations.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by MESSRS. NEWBOLD, LEECH & CO., Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.

COMPLETE SPECIFICATIONS.

- 110,075 TAIT FRANK, MANUFACTURING CO. Magneto engine. (7/11/19.)
- 162,505 THOMAS ART. GES. R. Electric light apparatus. (16/1/20.)
- 169,465 HANNA-LAMON, W. R. And GOS. Electric light apparatus, model made in U.S.A. (1/8/20.)
- 150,257 BOSCH ART. GES. R. Heating in the atmosphere, total, no direct current dynamo electric machines. (16/8/19.)
- 150,281 JACOBSON, A. J. Electric whistles or mechanical acoustic function. (21/8/19.)
- 152,012 COLERBROOK, W. Electric water heater. (7/10/19.)
- 152,025 ARTHUR THOMSON, GEORGE. Propagation of electric discharges. (14/10/19.)
- 153,458 BROWN, G. AND SON, LTD. Electric light apparatus, model made in U.S.A. (1/10/19.)
- 153,602 ASH, G. AND SONS, LTD. Electric light apparatus, model made in U.S.A. (10/11/19.)
- 153,605 BOSCH ART. GES. R. Battery ignition timing devices for internal combustion engine. (13/11/19.)
- 156,581 SHARPENBERG, E. Electrical cable sockets or lugs. (2/1/20.)
- 156,581 (Contd.) SHARPENBERG, E. Electric cable sockets and lugs. (2/1/20.)
- 156,582 TAIT FRANK, MANUFACTURING CO. Magneto engine. (7/11/19.)
- 156,582 (Divided Application on 140,075.)
- 156,587 BRAUN, A. AND SONS, LTD. Electric light apparatus, model made in U.S.A. (9/11/19.)
- 167,520 BULTEMAN, A. F. E. Electric insulators of the built up or compound type. (2/3/20.)
- 167,522 HARRISON, J. M. Electric light apparatus, model made in U.S.A. (4/4/20.)
- 167,528 SODEY, J. K. Electric table heaters. (9/4/20.)
- 167,537 LAMBERT, A. Electric resistance furnaces. (30/4/20.)
- 167,539 NOLAN, J. Electric immersion heaters. (30/4/20.)
- 167,542 STAYER, M. THOMAS, H. AND PETER, M. J. Improved electric motors. (4/5/20.)
- 167,543 HALL, J. Electric control circuit breakers and the like. (4/5/20.)
- 167,545 BRITISH THOMSON-HOUSTON CO., LTD., & RALPH, G. J. Electric furnaces. (5/5/20.)
- 167,549 CUNNINGHAM, E. Electric switches. (7/2/20.)
- 167,550 DUNSTALL, W. R. Sparking plug. (6/5/20.)
- 167,555 CO. DELER, F. H. Means for connecting the ends of the receivers of telephonic or like instruments. (7/5/20.) (Cognate Application 13,557/20.)
- 167,560 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). Systems of electric ship propulsion. (7/5/20.)
- 167,561 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). Electric discharge devices. (5/5/20.)
- 167,567 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). High frequency electric signalling systems. (8/5/20.)
- 167,568 POUCHAIN, A. Positive electrodes for electric accumulators. (8/5/20.)
- 167,577 POUCHAIN, A. Positive electrodes for electric accumulators. (10/5/20.)
- 167,584 MACROBIE, A. K., & SHEARING, G. Thermionic valve transmitting circuits for telegraph and telephony. (11/5/20.)
- 167,593 SCHOLFIELD, H. Means for connecting the ends of electric or other cables or the like. (14/5/20.)
- 167,606 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). Electric lighting installations. (18/5/20.)
- 167,608 DEAN, W. Means for applying electricity to the soil for agricultural purposes. (19/5/20.)
- 167,615 LEITCH, H., WOOD, G. E., & GREENWOOD & BATLEY, LTD. Electric accumulators or secondary batteries. (20/5/20.)
- 167,627 NICHOLSON, E. G. Fuses for protecting electrically heated utensils from overheating. (27/5/20.)
- 167,631 LARKIN, R. Electric means suitable for railway signalling systems. (1/6/20.)
- 167,702 ASHWOOD, H. Variable hot and cool radio direction electric air diffuser. (5/10/20.)
- 167,719 TURNOCK, G. Fuses for electric circuits. (1/12/20.)
- 168,213 ROMAGNOLI, C. Means for fixing conducting wires to their insulators. (30/6/20.)
- 168,238 BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co.). Electric resistance devices. (11/8/20.)
- 168,249 BURNHAM, W. W. System of winding multi-layer electric coils for use as inductances for wireless radio-telegraphy, radio-telephony, and the like. (1/9/20.)
- 168,253 ELECTRIC CONTROL LTD., & FISHER, J. J. Electric controllers and operating mechanism therefor. (10/9/20.)
- 168,263 STROUD, E. Electric light fittings. (12/10/20.) (Cognate Application 30,505/20.)
- 168,336 ELLIS, K. F. Dynamo-electric machines and magnets. (27/2/20.)
- 168,337 HASTINGS, R. C. M. Party-line telephone systems. (1/3/20.)
- 168,338 HASTINGS, R. C. M. Party-line telephone systems. (1/3/20.)
- 168,339 SHOTTER, G. F., & HILL, E. W. Alternating current electrical systems. (1/3/20.)
- 169,063 BRITISH L. L. ERICSSON MFG. CO., LTD., HAYES, H. H., & GODFREY, A. A. Electric lamp holders. (18/3/20.)

APPLICATIONS FOR PATENTS

August 5, 1921.

- 20,791 C. L. I. MEYER, Co. Sweden. Wireless signalling, &c.
- 20,800 WALL, Wireless signalling, &c.
- 20,813 BOSCH (R.) ART. GES. Magneto. (23/8/20, Germany.)
- 20,825 TOLSON, Screw grip tongues for lampholders.
- 20,836 TOLSON, Electric shade breakage preventer.
- 20,841 ROBINSON, Directional wireless apparatus.
- 20,855 REDMOND, Electric light device.
- 20,861 ART. GES. BROWN, BOVERI ET CIE. Oil-cooled transformer boxes. (5/8/20.)
- 20,868 B. T.-H. Co. (G. E. Co.). Wireless systems.
- 20,878 BAYNHAM, Electro-magnetic gearing.

August 6, 1921

- 20,922 FANGHAENEL, Current limiting devices.
- 20,925 HARRISON, Electric heating.
- 20,927 THURPE, Electric resistance furnaces.
- 20,928 BEAVER & CLAREMONT, Glands for joint boxes.
- 20,930 RELAY AUTOMATIC TELEPHONE CO. Electric switching devices for telephone, &c., plants. (8/9/20, Sweden.)
- 20,935 G. E. CO. AND CASTLE, Electric testing and measuring instruments.
- 20,942 B. T.-H. Co. (G. E. Co.). Wireless systems.
- 20,943 DE GOS. ANDERSON, Telegraph systems.

Aug. 8.

August 18.

- 21 017 METROPOLITAN-VICKERS ELECTRIC CO. Circuit breakers. (18/10/20, U.S.)
- 21 023 B. T. H. Co. (G. E. Co.). Friction rolls.
- 21 026 B. T. H. Co. (G. E. Co.). Recording apparatus for current impulses.
- 21 030 S. H. H. Co. Apparatus for recording the position of machines having commutator secondary machine. (7/8/20, U.S.)
- 21 052 MAXCILL. Application of natural ambient or artificial magnetisms in combination with ambient or artificial electric energy.
- Aug. 9.
- 21 112 H. H. Co. Apparatus for recording the position of machines having commutator secondary machine. (7/8/20, U.S.)
- 21 114 CORWAL & THURFIELD. Link boxes for electric mains.
- 21 120 IONIANIC ELECTRIC CO. (Cutler-Hammer Manufacturing Co.). Thermostatic controlling devices.
- 21 138 B. T. H. Co. & CLINKE. Variable inductances.
- 21 140 B. T. H. Co., FARMER & HASTINGS. Control of motors.
- 21 153 CHAMBERLAIN. Electric colour changing discs.
- 21 167 LANGDON-DAVIES & SOAMES. Cores for transformers, motors, &c.
- 21 169 BINARD. High frequency self-induction coils. (10/8/20, Belgium).
- Aug. 10.
- 21 251 WESTERN ELECTRIC CO. Telephone exchange systems.
- 21 280 AGATE & HILL. Means for regulating strength of electric currents.
- 21 283 EVER-READY CO. (GT. BRITAIN) & JOHNSON. Electric torches, &c.
- Aug. 11.
- 21 305 MACKELLOW. Starting crank for engines fitted with fly-wheel magneto systems.
- 21 312 WINGROVE & ROGERS. Switches for electric vehicles.
- 21 332 WIGHT. Transmitting and recording picture impressions by cable.
- 21 333 TINGEY. Induction coils for currents at radio frequency.
- 21 335 WELER & YOUNG. Incandescent lamps.
- 21 338 KRUPP (F.) AKT. GES. Metallic articles having electrically insulating and mechanically adhesive coating. (19/9/20, Germany).
- 21 342 STACEY. Electric machines for producing oxides of nitrogen.
- 21 346 TELEPHONE MANUFACTURING CO. (1920) & MURRAY. Mine rescue, &c., telephone apparatus.
- 21 347 IONIANIC ELECTRIC CO. (Cutler-Hammer Manufacturing Co.). Motor controllers.
- 21 355 PLYMOUTH. Hydro-electric generating plant.
- 21 357 HASTINGS. Party-line telephone systems.
- 21 359 MURPHY. Electric machines for producing oxides of nitrogen.
- 21 365 SIEMENS-SCHUCKERTWERKE. Apparatus for condensing mercury vapour in mercury vapour rectifiers. (19/8/20, Germany).
- 21 371 G. E. Co. & GOUCHER. Drawn wire filaments.
- Aug. 12.
- 21 400 BIBBY & HOUGHTON. Electrical gear for operating theatre curtains, &c.
- 21 419 GILL. Winding, &c., cuts for electric machinery.
- 21 438 DAS. Electric emergency lighting installation. (28/10/20, Holland).
- 21 473 B. T. H. Co. (G. E. Co.). Wireless signalling systems.
- 21 474 & 21 475 B. T. H. Co., FARMER & HASTINGS. Control of motors.
- 21 478 MIDGLEY. Electric engine starter.
- 21 495 ELECTRO-MECHANICAL BRAKE CO. & PATTISON. Electric controllers.
- Aug. 13.
- 21 499 HECRTLEY. Telegraphy.
- 21 504 DAVIS. Quick make and break switches.
- 21 549 NOBBS. Electrically operated polishing, grinding, &c., apparatus.
- 21 561 HENLEY'S TELEGRAPH WORKS CO. & NICHOLS. Casing for cut-outs, &c.
- 21 562 HENLEY'S TELEGRAPH WORKS CO. & ROSLING. Means for connecting meters with supply mains.
- 21 574 GRANET. White electrical insulating plastic mass.
- Aug. 15.
- 21 582 HALL. Electric light fitting.
- 21 595 COXON & SOULSLEY. Shade-carriers for electric lamp-holders.
- 21 600 HOLLAND. Clips or brackets for holding accumulator boxes, &c.
- 21 612 ROBINSON & STENZEL. Electric floor polishing and waxing machine. (27/11, U.S.)
- 21 624 METROPOLITAN-VICKERS ELECTRICAL CO. & KUYSER & TOWNEND. Electric machines.
- Aug. 16.
- 21 690 CABLE ACCESSORIES CO. Electric lamp brackets or supports.
- 21 691 CHASTREE. Plug and socket connections, &c.
- 21 692 CHASTREE. Switches.
- 21 725 MARRIOTT. Electric radiators.
- 21 742 BRITISH POWER RAILWAY SIGNAL CO. & COX. Connection of conductors.
- 21 749 B. T. H. Co. (G. E. Co.). Fluorescent screens.
- 21 755 EVERSHED & VIGORLES & NEEDHAM. Electric revolution counters.
- 21 757 HENSON. Electric moving figure.
- 21 761 HIGGS. Means for increasing sound transmitted by telephones, &c.
- 21 770 S. H. H. Co. Apparatus for recording the position of machines having commutator secondary machine. (7/8/20, U.S.)
- 21 785 CREED & CO. Electric transmitters for automatic telegraphy.
- Aug. 17.
- 21 798 EFANDAM CO. & EATON & WILLIAMS. Electric lanterns for signalling, &c.
- 21 814 DAVIS. Apparatus for testing magnetos, insulated plugs, &c.
- 21 819 B. S. T. ELECTRIC FITTINGS CO. & THOMPSON, BARNETT, & SAUNDERS. Electric lamp-holders.
- 21 846 EASTERN TELEGRAPH CO. & GATE. Amplification and/or shaping of impulses in telegraphy.
- 21 857 HASTINGS. Selective telephone systems.
- 21 858 HASTINGS. Telephone systems.
- 21 859 D. H. H. Co. Apparatus for recording the position of machines having commutator secondary machine. (7/8/20, U.S.)
- 21 867 EASTERN TELEGRAPH CO. & GATE. Electric telegraphy.
- 21 868 COHEN & FIRTH. Electric connections between conductors.
- 21 871 HET. Electric clutch coupling for dental technics. (20/11/20, U.S.)
- 21 872 LODGE, FUME CO. (International Precipitation Co.). Electrical precipitation.

- 21 893 MORREY. Electro-magnetic motors.
- 21 897 BARSTOWE. Small motors.
- 21 933 KAWARADA & YAMAMOTO. Motors. (7/12/20, Japan.)
- 21 935 KINGSMILL ELECTRICAL CO. & DAMEY. Cut-outs.
- 21 974 BOWLEY. Telephones, phonographs, &c.
- 21 954 AYRES. Windings for electric machines.
- August 19.
- 21 986 WEBB. Dimming electric lamps of automobiles.
- 22 000 WESTWOOD. Mounting electrical apparatus on cycles.
- 22 001 WESTWOOD. Switches.
- 22 005 HERWITT. Apparatus for converting acetylene and other lamps for use as electric lamps.
- 22 021 HOLOPHANE, LTD., & STROUD. Electric light fittings.
- 22 026 WADE (Concordia Elektrizatsat Akt. Ges.). Miners' electric lamps.
- 22 032 B. de V. MOTOR CO. & COLEMAN. Magnetos.
- 22 035 CLARKE. Connections for cable conduits.
- 22 040 BOOLEY. Instruments for producing interrupted electric current of controlled frequency.
- 22 070 B. T. H. Co. (G. E. Co.). Measuring high voltages.
- 22 071 (HILAN ELECTRIC TRAMWAY & LIGHT CO. BOWEN). Automatic trolley retrievers for trams.
- 22 076 GOLDFARB, BARRINGTON, & BOLTON. Electric fittings.
- August 20.
- 22 084 IRWIN & RUSHTON. Automatic citation regulators.
- 22 147 G. E. Co. & TRIPPE. Supports for electrodes in ionic tubes.
- 22 148 METROPOLITAN-VICKERS ELECTRICAL CO. & CRETCHAM. Electric meters.
- 22 149 METROPOLITAN-VICKERS ELECTRICAL CO. Electric protective relay apparatus.
- 22 151 NEALE. Suspension of electric lamps, &c.
- August 22.
- 22 195 MAIDEN. Electric heaters.
- 22 201 HOFFMAN. Discharge of cycles.
- 22 217 R. ROEBER, BANTOW & MULDER. Mounting telephone instruments. (16/12/20, Holland.)
- 22 218 DE ROEBER, BANTOW & MULDER. Mounting telephone instruments. (16/12/20, Holland.)
- 22 222 GELLMAN. Submarine cables.
- 22 244 B. T. H. Co. & FITZGERALD. Protective devices for electric distribution systems.
- 22 245 B. T. H. Co. & FITZGERALD. Differential electric apparatus.
- 22 273 PETERSON. Systems for wireless transmission of pictures, &c. (9/9/20, Norway).
- 22 286 VERNER. Covering aluminium with electrolytic deposit of nickel, &c.
- August 23.
- 22 299 WELCH. Heater for electric kettles.
- 22 317 JUDGE. Commutator rotating disc and terminal for ignition sets.
- 22 324 MARKHAM. Electric rubbing, cleaning, and flattening machines.
- 22 329 BEAUFORT. Electric converters for use with drum alarm clocks.
- 22 335 DIEHL & FAIRWEATHER. Electric cord holder.
- 22 345 METROPOLITAN-VICKERS ELECTRICAL CO. Speed-regulator systems. (11/9/20, U.S.)
- 22 355 TOGAMI. Electric distributing systems.
- 22 361 ELECTRIC OUTLET CO. Electrical connecting and supporting devices. (9/4/20, U.S.)
- 22 378 SIEMENS-SCHUCKERTWERKE. Burners for electrical yarn-gassing machines. (18/12/20, Germany).
- 22 380 G. E. Co. & GOSSLING. Electron discharge devices.
- 22 381 G. E. Co. & GOSSLING. Manufacture of lungsten.
- 22 389 RUTHERFORD. Telephone receiver rest or holder.
- August 24.
- 22 421 WILKINSON. Electric circuit breakers.
- 22 423 MOSER. Means of supporting shade holders of electric lamps.
- 22 424 GATH. Electric machines.
- 22 447 DE & PAINTER. Electric switches.
- 22 470 HARPER, BROWN, BOWEN & CO. Akt. Ges. Transformers for high voltages. (4/3/21, Switzerland.)
- 22 482 ROBINET DE LA PICHARDAS. Simultaneous assembling and insulating of parts of electric outfits. (25/8/20, France.)
- 22 499 AKT. GES. BROWN, BOWEN & CO. High voltage switch plant. (15/4/21, Switzerland.)
- 22 500 KINGSMILL ART METAL ELECTRIC CO. & DAMEY. Switches.
- 22 521 B. T. H. Co. (G. E. Co.). Thermostatic controlling devices.
- August 25.
- 22 539 GARRATT. Electric heaters of stoves.
- 22 546 WHITLOCK. Shade supporting device for electric lamps.
- 22 559 EISLER. Electric burglar alarm circuits.
- 22 584 AUTOMATIC TELEPHONE MFG. CO. Telephone systems. (3/9/20, U.S.)
- 22 585 B. T. H. Co. (G. E. Co.). Electrodes.
- 22 591 RAILING & SAUNDERS. Electric light fitting for ships' berths, &c.
- 22 602 DAMEY. Switches, &c.
- 22 606 FELTES & GUTENBERG CARLSWARK A. G. Self-induction coil pair for loading telephone lines. (17/1/21, Germany.)
- 22 611 STANDARD TIME CO. & WEBBER. Switches for charging batteries, &c.
- 22 614 G. E. Co. Apparatus for transforming crystal structures of wires, filaments, &c.
- August 26.
- 22 640 NOBBS. Electric motor attachment for bath chairs, &c.
- 22 644 VERITIS & PIPKIN. Electric regulators, resistance switches, &c.
- 22 657 THOMPSON (Spiltoft Electrical Co.). Magnetoelectric generators.
- 22 684 STEINER & CO. & LE MANSCHAL. Thermionic valves.
- 22 704 JENKINS. Portable electric lamp.
- 22 716 B. T. H. Co. & TAYLOR. Cooling and ventilating systems for electric machines.
- 22 717 B. T. H. Co. (G. E. Co.). Motors.
- 22 722 BERRY. Electric and gas fires.
- 22 724 DAVIS. Calling devices operated by wireless signals.
- 22 726 COLLINS. Dynamos, &c.
- August 27.
- 22 735 CONSTANTINESCO. Driving of electric generators by internal combustion engines.
- 22 736 NORWEST ELECTRICAL MFG. CO. & MACDOWALL. Switch fuses.
- 22 740 SANDERSON. Electric telephone.
- 22 798 NAMAALOOZE VERNOSCHAP PHILIPS' GLOELAMPEN FABRIKEN. Incandescent lamps. (2/9/20, Holland.)
- 22 800 BLUR. Electric machines. (8/11/19, U.S.)

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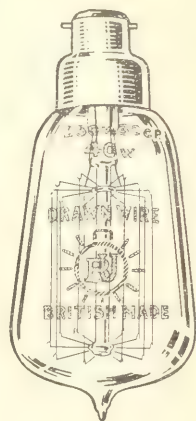
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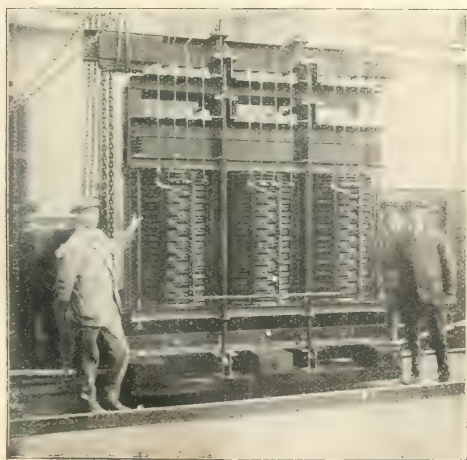


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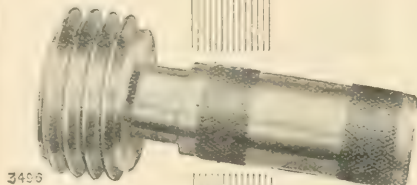
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IMPORTANT ANNOUNCEMENT.

The decision of the House of Lords in the important action by the British Thomson-Houston Company, Limited, the manufacturers of the MAZDA Lamp, against the Corona Lamp Works, Limited, for infringement of the British Thomson-Houston Company's Letters Patent No. 10918 13 which covers the well-known gas-filled electric incandescent lamp (more popularly known as the half-watt type lamp) was given on Monday last in favour of the Patent.

Mr. Justice Sargant, who tried the case in the first instance, decided against the Patent, and the Court of Appeal supported his decision.

The effect of the present final decision is to reverse the decisions of the lower Courts and to establish the Patent in favour of the Patentees. The Patent was held to cover an invention in incandescent electric lamp manufacture of a high order of merit and of the greatest practical utility.

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NOTICE.—Legal action will be taken against any person or persons representing themselves to be directly or indirectly importing CONDOR LAMPS.

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See also Advertisement in the "Electrical Review."

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